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Knowledge Work Productivity Measurement for Software Development Process in SMEs

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ABSTRACT

Small and medium-sized enterprises play an important role in the growth of the economy, but most enterprises have failed to develop knowledge work productivity (KWP). The purpose of this study is to discover and propose KWP measurement factors in software development process in small and medium-sized enterprises (SMEs). First, we are making theoretical and prior research progress before the key features of KW and KWP were defined. Secondly, the conceptual model, which explores the relationship between the KW and KWP dimensions, has been built. This research will use the data collected from 150 Malaysian SMEs. Structural equation modelling or SEM was used to validate the model. Based on the results, we propose KWP measurement factors that can help knowledge-based companies, such as SMEs, measure employee productivity.

Keywords: Knowledge work, Knowledge Work Productivity, SMEs.

I INTRODUCTION

Knowledge work (KW) and knowledge work productivity (KWP) are vital for business success. KW is viewed as capability needed of knowledge worker (Eikebrokk & Olsen, 2007) to become more productive and to achieved that is through to measure KWP and it will become the greatest competitive weapon of today’s organizations (Jazzolino & Laise, 2018). Most of the researchers indicated KW is essential to develop the nations (Drucker, 1999; Davenport, Jarvenpaa, & Beers, 1996).

Davenport, Jarvenpaa, & Beers (1996) state that SMEs also must be able to understand and leverage KW of the knowledge workers as the key for the KWP measurement. Several studies have shown that SMEs, not given much attention to the KW and KWP issues as well as quality measurement for the software development process (Drucker, 2006; Min & Changjun, 2011). A pilot survey of 100 SMEs company found several issues regarding KW for example in strategic planning problems information system and lack of innovation strategies (Levy & Powell, 2000). Moreover, most of the failed project are related to SMEs Company attributed to wrong specification requirement in software development process.

Software is becoming pervasive in every business. Many SMEs companies have seen their products and services evolving to become interconnected. (Ponsard & Deprez, 2018). For example, it must offer a digital presence through an e-commerce shop or even develop new digital assets (apps or connected hardware) to support their business. However, developing software is challenging for SMEs, especially to ensure the quality, time, and budget constraints. SMEs differ from larger organizations because of their limited, often less specialized, resources (Mishra & Mishra, 2009). The software development process involves all the stages and activities that are followed by SMEs to develop a software product. Software development is an intensive knowledge process that should be updated, improved and maintained to meet current business and customer requirements (Ponsard & Deprez, 2018). Therefore, it is vital for SMEs to manage knowledge work resources or KW and KWP (Drucker, 2006). The study of KW become a theoretical basis for SMEs to identify the knowledge work dimension and which factors realize as KWP measurement in software development process.

II LITERATURE REVIEW

A. Conceptual Model

In order to examine KW factors and the effect to the KWP the authors used the previous KWP model (Figure 1) to conceptualize a new model for this study. KWP model is widely accepted model that provides a critical review based on the KW strategies to improved KWP. Based on the model, effectiveness and efficiency strategies was established as KW factors to improve KWP.
B. Knowledge Work

KW involves any activities which need specialized skills and new knowledge (Ware & Grantham, 2007). Software development process involve many activities of KW comprise of planning, analysing, monitoring, and evaluating in order to transform the information form one form to another form. First, it’s important to discuss briefly the measurement factors of KW.

Davis & Naumman (1999) stated that effectiveness and efficiency are two main factors used to measure KW. Effectiveness can be measure by performing KW with more creativity which can extend the scope, depth and completeness and introduces some new applications with a new method. To archive that technology, communication, and decision-making plays major role for the knowledge worker to enhance their KW. By using latest technology will determine the individual ability and skill for KW and KWP (Spinuzzi et al., 2004). Furthermore, technology becomes vital for understanding the function of KW (Dan, 2011). The effective communication of the team of knowledge workers can reduced the time needed and improved KW (Harris, 1995). However, efficiency is how to improve the process or procedure engage using technology. It’s important for knowledge workers to manage the resources in the efficient way (Liao & Yi, 2010). Dan (2011) pointed out the relationship of efficiency as measurement factors for KW under dynamic work environment.

Knowledge worker as individual who involved in the whole process of software development need to be consider based on their performance (programmer performance) (Han & Williams, 2008; Pyöriä, 2005). According to the Erne (2011) programmer performance has to be consider as specific parameter for the KW measurement based on the quality day work results and interaction, innovation behaviour, compliance with organizational standard.

SMEs also focus on collaboration aspect to improve the KW (Han & Williams, 2008; Pyöriä, 2005). In addition, improving the performance in the team work involves effectiveness, KWP and performance of organizational (Erne, 2011). The organization depends on the knowledge workers based on innovation which essential part of KW (Krishnan & Prabhu, 2003). Krishnan & Prabhu (2003) stressed that the innovation created by knowledge workers is referred to the power of intellectual capital. The impact of KW based on the innovation process through creativity and new idea revolution is an effective way to improve organization performance (Xin-miao et al., 2007).

C. Knowledge Work Productivity

KWP is known as quality of KW and describe the performance of SMEs. According to Cappola, (1991) quality are those that meet customer needs, do not fail during use, and pose no threat to human well-being. KWP is merely concern on crucial performance of knowledge worker rather than traditional meaning of the term. This is supported by Orna (2006); Fitzpatrick (1996); Denning (1992) and DeWitt, Nguyen, & Marshall (2008) state that the KWP is reflect to the how to evaluate KW results.

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A conceptual model is established based on the theoretical analysis and structural equation modelling method, figure 2 depicted of the overall proposed model (Drucker, 2006). The studies have found that KW measurement factors are contribute to the KWP and organizational performance. Understanding the relation between KW and KWP will provide a certain direction from a quality perspective of view. It states that KW factors can be listed as effectiveness, efficiency, collaboration, programmer performance and innovation.
III DESIGN CONCEPTUAL MODEL AND HYPOTHESIS

KW has significant effect to the KWP. To explore the effect, the conceptual model is proposed as shown in figure 2. KW factors consists of effectiveness, efficiency, collaboration, programmer performance and innovation. For the research purpose 6 hypothesis are constructed to test the correlation KW domain and KWP (Iazzolino & Laise, 2018).

- H1 KW is highly corelated with effectiveness strategies
- H2 KW is highly corelated with efficiency strategies
- H3 KW is highly corelated with programmer performance
- H4 KW is highly corelated with collaboration
- H5 KW is highly corelated with innovation strategies
- H6 KWP is highly corelated with KW

IV METHODOLOGY

A. Data Collection

The research instrument of this study was adopted from previous work in the literature (Zhang & Chen, 2010; Ramirez & Nemphard, 2004). In the questionnaire we used 89 questions, grouped into 4 categories. Knowledge workers with over 1–3-year work experience in software development process in SMEs, are invited for this research. Altogether 150 questionnaires were collected and valid for further analysis. The questionnaire used 7 points interval scale ranging from “strongly disagree” (1) to “strongly agree and (7). The research instrument for this research was based on content validity (the degree that measure covers the domain of interest), by discussing group of experts in the related field. The modification for item was made based on their comment. The reliability test was focusing on internal consistency of the instrument was conducted based on pilot study. The data collection procedures were done by collecting data from 30 software developers in SMEs Company. In order to analyze measurement and structural model we used SmartPLS 3. The results can be used to predict theoretical part of the model. The research instrument demonstrated satisfactory reliability and validity. Data’s reliability for internal consistency is measured by composite reliability. Data’s validity assessment is measured by convergent validity.

B. Data Analysis

Measurement Model. Composite reliability (CR) value shows the reliability index is more than 0.7 for 68 items used have ranged from 0 to 1. It means the value represents better internal consistency. The convergent validity test has been provided by using Fornell and Lacker two criteria: (1) The significant level for all indicators must not lower than 0.05 and their loading value is more than 0.7 or 0.6. (2) Average Variance Extracted (AVE) for each construct (AVE should exceed 0.5. All indicators loading exceeds 0.6 for the constructs at significant level p<0.005. In addition, AVE value for each construct exceeds more 0.5, in between ranges. For this research we find that all criteria for validity condition were satisfied.

Structural Model. The convergent validity test has been provided by using Fornell and Lacker two criteria: (1) All indicators must significant (at least at 0.05 values) and loading value must exceed 0.7 or 0.6. (2) Average Variance Extracted (AVE) construct value must exceed 0.5. For this research we have obtained results for all indicators loading exceeds 0.6 on the constructs and significant at p<0.005. AVE value for each construct was greater than 0.50. Based on the total effect results, we found that the effectiveness (0.193) which the highest total effect on KW, followed by programmer performance (0.179), efficiency strategies (0.026) and innovation strategies (0.047). However, collaboration (-0.082) has a negative effect on the KW and KWP.
V DISCUSSION AND CONCLUSION

This study predicted that KW has the strongest effect on KWP. We found that effectiveness strategies, efficiency strategies, and programmer performance, and collaboration and innovation strategies are highly correlated with the KW.

Having collected and analysed data we found that KWP is strongly correlated with the effectiveness strategies and programmer performance. This is line with the previous conceptual model (Davis & Naumann, 1999) and previous studies (Erne, 2011). Effectiveness is concern how we archive the target and how we solve the problems and the strategies used to improve KWP. Effectiveness has a significant relation to KW and give strongest total effect positive effect on the KWP. In addition, programmer performance also has strong positive effect to the KWP.

Programmer performance is related to the accomplishment of a given task. This is measured against present known standards of accuracy, completeness, cost, and speed. In the KW context performance measurement totally different from using performance measurement in a more traditional setting. Success factors in knowledge work are more resource orientated. The measures considering the results, external key stakeholders or processes are somewhat similar.

Efficiency was another KW factors found not significantly influence on KW. Efficiency mainly concerns to the efficient ways to manage the resources, eliminate waste, and reduce cost. Efficiency is still having the positive effect KW and KWP. One plausible explanation for the non-significant explanation result in efficiency is the context of the study. This study emphasizes the individual’s role as software developers.

Innovation strategies is the creation of better or more effective products, processes, services, technologies, or ideas that are accepted by markets, governments, and society. It related to the creative and novel fashion on a process engage to the improvement effectiveness and efficiency or marketability. Innovation Strategies has less significant results to the KWP, but still important for software developers become more innovative towards quality improvement in KW.

REFERENCES


Knowledge Map for kXpert: Humanising the Quest of Finding Experts

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ABSTRACT
The global pandemic of Covid-19 in 2020 has brought upon an impact to the economy, with high unemployment rate in all countries including Malaysia. Organisations experienced high employee turnover and knowledge loss along with the employees who left them. This impact has beckoned the ever-needed quest of finding experts, with expertise verified from reliable knowledge sources. This paper looks into the design of knowledge map for kXpert framework that humanises the online search for experts, based on the common practice in a knowledge-intensive organisation. The knowledge map is expected to reduce the time and effort of engaging in conversation to get to know a person to verify whether he or she is the right expert in demand. Nevertheless, this knowledge map is only part of the overall framework of knowledge-based information retrieval for expert profiling (kXpert), which provides the guide for the system development at later stage.

Keywords: knowledgebase, information retrieval, expert profiling, knowledge expertise mapping.

1 INTRODUCTION
The year 2020 has brought upon an experience of global pandemic that affects everything in a normal human life, including economic, social, technology, politics, and especially humanity. The impact of this pandemic has affected many workers especially in service providing companies. The unemployment rate in Malaysia alone has increased quite drastically since the commencement of Movement Control Order (MCO) in March 2020. A total 67,068 cases of unemployed citizens were reported as of July 31st, 2020, with Selangor recording the highest among the states with about 30 percent of the unemployment figure of 19,914 cases (Zainuddin & Kaur, 2020). In the overall view of the nation’s unemployment rate shown in Figure 1, there is a sharp increase from 3.9 percent in March 2020 to 5 percent in April 2020, and this rate remains high between 4.7 percent to 5.3 percent from May 2020 to August 2020 (DOSM, 2020).

The impact of this unemployment rate hits the organisations as well, as people are retrenched amid the ongoing COVID-19 pandemic. In a Malaysian institute of higher institution, five academicians with PhD qualification resigned, two professors retired and more than three contract-based employees did not get their contract renewed during the pandemic, and these are only for one of the thirteen faculties it governs. As the number of employees dwindles, so do the knowledge experts that the organisation possesses. The demand for knowledge experts is so significant during this time unlike never before.

Figure 1. Malaysia unemployment rate 2019-2020.

The quest of finding experts does not rely on personally knowing the people anymore, since the pandemic has confined the knowledge seekers from personally meet new people and learn from them. There is less opportunity to embark in face-to-face conversation to verify that they are truly the experts these seekers are looking for. Everything has to be done online, over the Internet, provided that the experts are keen to be contacted and communicated online. Due to the difficulty and stress that the pandemic and MCO affect, experts, who are also humans, may not indulge in communication with potential seekers whom they have never met.

However, most of the expertise information is already made available online by the experts, which in turn represents their personal portfolio. Hence, there is an opportunity to “knock on the door” of these locations and access the information that tells “who knows what” regarding an expertise domain. It is also part of the tasks common to a university when they need to verify a researcher’s expertise domain in finding the right people to do certain jobs, like mentoring a new project, supervising new postgraduate students, and participate in new collaboration with industry. In a medium-to-large organisation with high employee turnover, especially during pandemic, the quest of finding the right experts among the existing employees could be significant as well, since people still work in silos for many personal reasons and beliefs.
In fulfilling the purpose of solving the issues mentioned above, the main objective of this paper is to design a knowledge map of experts to knowledge domain, to be managed in the knowledgebase of kXpert. The knowledge source for this mapping is mainly from external sources made available in the trusted sites, even though the experts are from the same organisation as the knowledge seekers. This paper is an extension of work originally presented in the Applied Informatics International Conference 2020 (Ismail & Ahmad Suhaime, 2020).

II RELATED WORKS

This section covers two domains of related works, namely knowledge-based expert profiling and knowledge map design.

A. Knowledge-based Expert Profiling

Expert profiling often relates to human point affiliation, but it is not limited to the business or organisation that the expert is working for. The yield of profiling an expert is a positioned rundown of points that are related to particular individual (Becerra-Fernandez, 2000). Knowledge seekers, or people who are in search of knowledge experts, can utilise the expert profiles in framing exact recognitions, clarify misconceptions, and create inspiration when seeking after an expert in a knowledge area (Ismail & Ahmad Suhaime, 2020). They can benefit from the master profiles that convey the mixture of explicit information, knowledge and intelligence, as well as innovativeness, characterising the expert performance in the expertise (Sternberg, 2003).

In adopting the knowledge management concept, frameworks were proposed based on community question answering, in which knowledge experts are identified based on their activities of answering questions in online platforms. A framework by Riahi et al (2012), for example, automatically route a newly posted question to an expert user, as that expert was earlier identified in a community platform, using statistical topic models. This work was then extended to a bigger picture by Pal (2015) to solve the issue of routing a right question to the right community, and finding relevant communities for a question. These two frameworks efficiently find experts by improving time, but time was not the only issue in finding the right knowledge expert. An improvement was made by Neshati et al (2017) who identifies future experts by ranking them on expertise evidence observed in the current time.

Unlike the works mentioned above, this study focuses on certain criteria in finding and profiling knowledge experts. Among the existing frameworks relevant to this study are knowledge-based framework (Rodrigues et al, 2015), expert finding (Balog et al, 2012), and expert profiling (Silva & Ma, 2017). In general, these frameworks provide reliable and secured processes that link people in a system, facilitating knowledge seekers in search for the right experts. Table 1 presents the brief summary of these frameworks.

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Process</td>
<td>Identify, capture, evaluate, retrieve and share organisational information asset</td>
<td>Map tacit knowledge for better awareness on which individual knows what</td>
<td>Link humans to expertise areas; Identify the best match between an expertise need and the expert’s document content; Improve expertise search with more visibility; High potential of accessibility, reliability, physical proximity and freshness</td>
</tr>
</tbody>
</table>

The main aim of expert finding framework by Balog et al (2012) is to connect the person who are searching for knowledge expert to the sources. As shown in Figure 2, it is performed by a source-selection process based on selection criteria determined by the context and the needed task and information. Comparing this with the expert profiling framework by Silva and Ma (2017), the latter starts with a research problem that is broken down into “expertise topics” during problem analysis process, which are then mapped to the available potential experts. As shown in Figure 3, the other side of this framework has the potential experts (who want to be found) going through a profiling process that generates individual profiles for the expertise mapping.

From the related works covered in this section, it is summarised that the gist of an expert profiling system is the knowledge map, or the mapping of experts to the expertise. Knowledge mapping opens the door to organising knowledge in many ways including learning design, path and problem solving, as well as online learning and distance education (Okada & Shum, 2006). There is a technique to develop a knowledge map for industrial organisation through capturing and demonstrating organisational knowledge.
knowledge, as suggested by Kim et al (2003). From the experience in research, Kim et al (2003) stated that knowledge map is the best tool to represent knowledge in an organisation. On top of that, knowledge map development can assist administrator or developer to build and enhance training support system as it will encourage effective teamwork and knowledge relations within and across knowledge areas in an organisation (Balaid, 2013).

Balaid et al (2015) summarized different methodologies of building knowledge maps, as they found many different methodologies of constructing knowledge maps, proposed in the last few decades, each with different set of principles, design criteria and phases. For example, Vail (1999) introduced a nine-step methodology, starting with sponsor identification up to the final step of knowledge map development. It focused on the growth process instead of paying ample attention to the core competencies within an organisation. The drawback of this methodology by Vail (1999) is the difficulty in knowing who has unique expertise to solve a particular problem and how to identify information within the company in a better way. In another example, Bargent (2002) suggested a typical lifecycle method of building a knowledge map, which has 11 steps like identifying requirement, reviewing and evaluating the information until it generates the link between the people and the affinities, conducting information audit, and such.

In the essence of knowledge map, Kim et al (2003) explored a techniques used for the representation of information maps and suggested a guideline for the development of a general map of information. The guideline consists of six steps: understanding the knowledge within the organisation; analysing the knowledge process map; extracting knowledge; profiling knowledge; linking knowledge map; and validating the proposed knowledge map (Kim et al, 2003). In a more recent work, Pei and Wang (2009) focused on the knowledge management network for matrix organisation in their methodology. From their research, it was found that the experts were not readily available in the matrix organisation, as they may not stay around at the same place in the organisation at any time. Without proper access for the exchange of knowledge among the members of the organisation, the general organisational performance would be in serious danger, hence the suggestion to develop the knowledge map.

Table 2 presents the comparison summary among the four methodologies discussed in this section, showing some similarities in processes, in terms of identifying and evaluating knowledge. Some methodologies take more steps than others, and some take an effort to validate first before defining the mapping instead of the other way around. The similar processes are shown with the same symbol next to the words. For example, “produce initial knowledge map” by Vail (1999) and “produce extracted knowledge” by Kim et al. (2003) are similar and indicated with asterisks (*). Another similarity is found on “testing of knowledge map” by Bargent.
(2002) and “evaluate the knowledge map” by Pei and Wang (2009). This paper refers to the processes presented in Table 2, to design the knowledge map for kXpert framework. The steps selected as suitable to be adopted in this study are as shown in bold and italic fonts in Table 2. Detailed explanation on this will be covered in the next section.

Looking at the important issue from the perspective of an expert who constantly needs to update his/her knowledge in the field to avoid being saturated in the field of expertise, a new method was proposed for expert finding. This recent method of T-shaped expert finding is based on Convolutional Neural Networks, in the domain of artificial intelligence.

### III METHODOLOGY

This research is based on a case setting of a Malaysian private university, in which the need to improve the expert database is important for the work employees’ efficiency. With the recent pandemic, the requirement for the knowledge map is more significant as the employees are mostly working from home during the MCO. The improvement required is in the context of information retrieval mechanism and knowledge repository efficiency, which can be achieved with a structured knowledge map design to support the framework.

This study adopts the main principles from the related works, i.e. literature review, presented in Table 2, taking into account processes deemed suitable, based on the needs and focus on how the knowledge map needs to be designed. From Table 2, eight steps are chosen after going through a process of content analysis, and presented in Figure 4. The aim in mind during the content analysis is to make the kXpert process as close as possible to the human behaviour of searching for experts. It is understood that the common practice is to have an objective beforehand, locate the source of knowledge that is reliable and has credentials, understand the gist of information from the source, and access to extract that knowledge from the source once the review is satisfied. The process may end at knowledge extraction, but for the purpose of making the knowledge constantly updated and stored in the knowledgebase in a structured way for efficient access, there is a need to set up the boundaries for the retrieved knowledge. This is the part where the knowledge map is purposely designed.

Figure 4 shows the knowledge map design process, derived after going through the content analysis. As shown in Figure 4, this study started off with requirement analysis phase, with the representatives from the case organisation took part for three steps. The first step is to identify the objective, in which the goal of the knowledge map is decided and set. In this step, all stakeholders (i.e. users, namely knowledge seekers and knowledge experts) are identified, and scope of the knowledge map is identified as well. The second step is to locate knowledge resources, in which the requirement of the stakeholders is clarified

<table>
<thead>
<tr>
<th>Step</th>
<th>9-step methodology (Vail, 1999)</th>
<th>11-step methodology (Bargent, 2002)</th>
<th>6-step methodology (Kim et al., 2003)</th>
<th>7-step methodology (Pei &amp; Wang, 2009)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Identify the objective</td>
<td>Identify requirement</td>
<td>Define knowledge map</td>
<td>Set up project team</td>
</tr>
<tr>
<td>2</td>
<td>Determine the objective</td>
<td>Information evaluation</td>
<td>Analyse process map</td>
<td>Analyse source</td>
</tr>
<tr>
<td>3</td>
<td>Education plan</td>
<td>Review information</td>
<td>Knowledge extraction</td>
<td>Set up knowledge boundaries</td>
</tr>
<tr>
<td>4</td>
<td>Identify stakeholder</td>
<td>Modify stop word</td>
<td>Produce extracted knowledge</td>
<td>Structuring the knowledge extracted</td>
</tr>
<tr>
<td>5</td>
<td>Involving key people</td>
<td>Assigning of different sets of rules</td>
<td>Identify knowledge link</td>
<td><strong>Evaluate the knowledge map</strong></td>
</tr>
<tr>
<td>6</td>
<td>Construct technical committee</td>
<td>Generate profiles</td>
<td>Validate knowledge map</td>
<td>Locate knowledge resources</td>
</tr>
<tr>
<td>7</td>
<td>Construct evaluation strategy</td>
<td>Set up of data source</td>
<td>Update the knowledge content</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Identify maintenance process</td>
<td>Creation of knowledge map</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Produce initial knowledge map</td>
<td>Training of knowledge map</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td>Generate affinates</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td></td>
<td>Testing of knowledge map</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Similar processes are noted with same symbols, i.e. * and **. Bold and italic fonts indicate the processes adopted in this paper.
and analysed, in terms of the form of knowledge (source), and where it is located. Once the location is defined, the third step is to review information, in which the generated list of information is reviewed and refined, and a new list with all necessary sources is generated. The new list contains all the sources necessary for knowledge map development by putting the most relevant document and their sources as the top priority to be included in the process.

Figure 4. Methodology for knowledge map design.

The next phase of the methodology is the design work itself, i.e. knowledge map design. It consists of three steps, namely knowledge extraction, set up knowledge boundaries and structuring the knowledge extracted. Knowledge extraction, i.e. step 4, involves planning the process map for knowledge extraction from the source. This is basically done as closely as possible to the way stakeholders (human) perform the task of extracting knowledge online. This is followed by step five, where knowledge boundaries need to be set up to avoid information overload and unnecessary linkage between the experts and expertise that will affect the performance of the kXpert. The boundaries were defined according to the scope given by the case organisation. The final step (i.e. sixth step) in this design phase is to determine the structure and elements that define the relationship between the expert and expertise, and identify the similarities, logics and ranks for the mapping results.

The last phase is the part where the final outcome of the knowledge map is produced, and revised to meet the requirement of the kXpert framework. Step seven requires knowledge link to be identified, by creating knowledge profile from the structure created in the sixth step, and identifying the link between the elements in the knowledge map, using arrows. Finally, the eighth step is to update the knowledge content accordingly, in which the knowledge content in the repository would be updated and evaluated according to the process defined in the knowledge map, and the expert-resource relationship would be updated as well.

IV KNOWLEDGE MAP FOR KXPERT

From the scenario given by the case organisation during the requirement analysis phase, a knowledge seeker in the company will seek for experts using a keyword, which will be referred to in the expertise knowledgebase. In the background, knowledgebase would update the request to the kXpert system, and the system will access the knowledge source based on the given keyword and affiliation, i.e. the case organisation. Knowledge source would be the external source that is often identified through its credential and quality of knowledge provided, and generally in the form of works published and recognised worldwide. When the knowledge source is accessed, the system will generate the program based on the knowledge map, to translate the knowledge expertise of the experts into expert profiling. The system will return the result to the knowledge seeker with the expert’s details based on the keyword on the front end, and update the mapping and store the mapped result in the expertise knowledgebase on the back end. In a glimpse, the knowledge seeker will see the result as the name of the expert suggested by kXpert system, which is based on the given keyword. This covers the overall scenario on how the kXpert framework looks like.

Analysing the existing frameworks is part of the requirement analysis process too. The result from the analysis is then tabulated in Table 3. The summary of the findings is analysed to compare between the components and to identify the differences. Table 3 shows the comparison between these two frameworks by Balog et al (2012) and Silva and Ma (2017), because they are the closest similarity to the proposed kXpert, and the considerations to be considered in this study.

The proposed knowledge map is based on the process performed by kXpert framework, which are: the retrieval of expertise in the form of keywords; search of keywords based on affiliation name in credential site(s); retrieval of search results to be imported to the knowledgebase; knowledge expertise mapping in the knowledgebase; and displaying of results to the knowledge seeker. The results will be customised based on the needs of information details, such as name of experts, affiliated faculty/campus, expertise topics, and number of publications based on the expertise topics (keywords).
Table 3. Comparison of Expert Profiling Frameworks for kXpert.

<table>
<thead>
<tr>
<th>Expert Finding (Balog et al., 2012)</th>
<th>Expert Profiling (Silva &amp; Ma, 2017)</th>
<th>Considerations for kXpert</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Input</strong></td>
<td><strong>Problem, topic, expert profile</strong></td>
<td><strong>Keywords (topics), affiliation of experts, name (if required for updates)</strong></td>
</tr>
<tr>
<td>Context, criteria (from Seeker), task, information</td>
<td>Problem, topic, expert profile</td>
<td><strong>Search, retrieval, knowledge expertise mapping</strong></td>
</tr>
<tr>
<td><strong>Process</strong></td>
<td><strong>Problem analysis, expertise mapping, profiling of experts</strong></td>
<td><strong>Experts identification with number of publications on keywords (topics)</strong></td>
</tr>
<tr>
<td>Source-selection process</td>
<td><strong>Search, retrieval, knowledge expertise mapping</strong></td>
<td><strong>Experts identification with number of publications on keywords (topics)</strong></td>
</tr>
<tr>
<td><strong>Output</strong></td>
<td><strong>Experts identification</strong></td>
<td><strong>Experts identification with number of publications on keywords (topics)</strong></td>
</tr>
<tr>
<td>Selected source (link to the identified sources)</td>
<td><strong>Experts identification</strong></td>
<td><strong>Experts identification with number of publications on keywords (topics)</strong></td>
</tr>
</tbody>
</table>

Figure 5 shows text-based knowledge map design, that acts as a blueprint. Figure 6 shows the result of knowledge map design translated from Figure 5, which acts as the rules for the kXpert framework to run. The rules start with entering the keyword by the users, in which the keyword will belong to the research paper that is published on the designated website. The paper is written by researcher who belongs to a domain or research area. From there on, two possibilities to be expected where once the researcher is found in the domain, they are proficient; however, should the researcher’s name is found in multiple papers or to be the main author, the researcher is an expert in the specified field of study.

**Keyword**

\[
\text{Keyword} \quad \text{belongs to Paper} \quad \text{belongs to Domain} \quad \text{written by Researcher}
\]

\[
\text{belongs to Domain} \quad \text{means Proficient} \quad \text{but if Many Papers means Expert}
\]

\[
\text{but if First Author means Expert}
\]

Figure 5. Text-based knowledge map design.

Figure 6. Knowledge map for kXpert framework.

V DISCUSSION

The knowledge map that is designed is a result of the objective in this paper. The whole framework relies on this knowledge map, which is set to be the rules stored in kXpert. The knowledgebase will store the mapping once linked and the rule will be looped for every search and rely on the following factors: the language used and the competency of the software and hardware. The knowledge map provides the base for the full prototype development of the kXpert, in which it can be used as part of the pseudocode and algorithm. From the look of it, the knowledge map can be further enhanced with ontology if the situation calls for it, like foreseeing that the system could be more complex and scalable in the near future once implemented.

The proposed knowledge map in this paper has followed the considerations derived from the comparison of existing frameworks that is presented in Table 3 and the proposed kXpert framework. As a recap, the keyword that is the starting point of the knowledge map and the input by the knowledge seeker is comparable to the topic or problem proposed in expert profiling (Silva & Ma, 2017), and context and criteria proposed in expert finding (Balog et al., 2012).

In terms of process, Silva and Ma (2017) proposed expertise mapping and profiling of experts, in which kXpert adopts in the sense of knowledge expertise mapping, hence the mapping from paper to researcher in the knowledge map as shown in Figure 5 and Figure 6. In fact, the whole knowledge map proposed for kXpert is the process of how the mapping is done to produce the expert profiles. This does not mean that this paper disregards the significance of source-selection process by Balog et al. (2012), but merely translating the process in more detail and straight-to-the-point that the kXpert will process the tasks of search, retrieval and mapping.

In terms of output, kXpert knowledge map adopts the output of experts’ identification from Silva and Ma (2017) but with number of publications on the requested keywords tagged to the expertise details. This number of publications can be produced by kXpert every time it runs the code to decide on expert candidates’ level of expertise, i.e. whether the candidate is “expert” of “proficient” based on number of papers and candidate being identified as main author or co-author (as shown in Figures 5 and 6). This contradicts with Balog et al. (2012) that merely links the seeker to the identified sources, i.e. research papers or other types of files available and found. Nevertheless, it complements the methods of T-shaped expert finding and temporal expert profiling by Dehghan, Biabani and Abin (2019).
The challenges faced in this study revolves around meeting the requirements of the kXpert framework. This paper presents the work that is mostly on research part, in which the results would prepare the developer for the next phase of kXpert system development. There are no specific development tools or programming language that are covered in this study; however, this paper covers the design for the knowledge map, useful as blueprint for the system development phase. It is more flexible and less constraint, allowing the use of any language that can retrieve information from external source or sources to be added into the knowledgebase.

In previous literature, it is stated that knowledge (and process) maps are both used to analyse business problems in terms of transferring some aspects of knowledge into a clear form, mostly in graphical form (Eppler, 2004). Referring to this, Tawana (2008) has suggested an approach using Petri Nets to develop and validate a knowledge-based system, in which Petri Nets are found “well-suited for the design, specification and formal verification of complex information systems” (Sakthivel & Tanninu, 1989). This proves that there are a number of ways to validate a knowledge map and its framework. However, in most cases, a solid validation can only be satisfied with prototype development and data collection and analysis that support the system functions and features, which then supports the validity of the framework.

VI CONCLUSION

In this paper, the knowledge map for kXpert is proposed and designed to elevate the current standard of knowledge-based information retrieval and help the organisation to organise, convey, and encourage learning results. The idea is to humanise the way the employees search for experts in a system, or in other words, making the system works as closely as possible to the way humans do and expect when searching for expertise. The outcome of this work is to show that we can improve the performance of information retrieval with expert profiling, which is not currently available. The achievement of the objective of this study will contribute to a useful and effective knowledge-based framework and knowledge map, catered to the needs of mitigating knowledge expertise loss in an organisation, especially due to the pandemic crisis.

In terms of limitations, this study is based on the current knowledge map methodologies, which do not have the same degree of maturity and thus no latest standard methodology is available. This research covers the design part from literature review and requirement analysis by the case organisation, yet it does not cover the (prototype) development that could further validate the completeness and fitness of the kXpert framework.

As this study shed a light on the research and design of kXpert knowledge map, it is recommended for future researchers to further consult experts on their views and validation towards kXpert. To further extend this study, observation can be done on the development of the system using pseudocode, algorithms and suitable language.

REFERENCES


Personalized Microlearning Resources Generation and Delivery: A Framework Design

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ABSTRACT
The evolution of digital technologies is leading the world towards the direction of the information explosion. It gradually increases the difficulty for the people to find appropriate content to learn. It has becoming a norm whereby people often use their fragmented spare time for learning. It leads to the motivation to look for a solution to boost up the learning effectiveness. Microlearning serves as a service to generate and deliver microlearning resources to the learners. However, it is also challenging to convey the microlearning resources to each learner based on different learning needs. In this paper, a personalized microlearning framework named “Unique-Learn” is proposed. It possesses the intelligence to identify the real learning needs of a learner based on the contextual information, then conveys the appropriate microlearning videos to the learner from time to time. The proposed implementation plan details how the “Unique-Learn” will be used in a workplace environment for the employee’s training and development purpose.

Keywords: personalization, microlearning resources, adult’s learning

I INTRODUCTION
Along with technology advancement, people could easily use mobile devices to browse online learning resources for different purposes. Especially for adult learners, they could always look for learning materials that aid in their workplace or self-development during their spare time. The norm that people using their fragmented time to undergo learning leads to the research gap on how the learning effectiveness could be enhanced when the learner’s learning duration is fragmented and flexible (Lin et al., 2019). Thus, microlearning comes into plays to adapt to this lifestyle. Sun et al. (2016) also pointed out that short-term learning processes cover the period from a few seconds up to 15 minutes to ensure no information overloaded and retain the learning engagement.

However, the explosive online learning resources gradually lead to the issue whereby a learner may not find appropriate microlearning materials from the Internet since the online learning resources could be represented in various formats. Besides, it is also challenging to personalize the delivery of learning content to each learner due to different learning needs. Lin et al. (2019) conducted a survey on the overall workflow of microlearning services which comprises three main aspects: 1) Segmentation Process; 2) Annotation Process; and 3) Recommendation Process. However, there is lack of a complete personalized microlearning framework that depicts the overall architecture for practical implementation.

Based on the issues mentioned as above, a personalized microlearning framework named “Unique-Learn” is proposed. It aims to generate microlearning resources and deliver them to the learners based on unique learning needs. “Unique-Learn” is designed from the perspective of the microlearning resources providers. The paper’s contributions as follows: Firstly, the microlearning resources are generated by identifying “micro-friendly” learning objects from various online resources. Then, the delivery of microlearning resources will be personalized based on learner’s data. The overall architecture of “Unique-Learn” is presented for future practical implementation. The activities involved in microlearning resources generation and personalized delivery are described in detail.

To summarize, learning is a life-long process. Especially as adults, they should continue to learn new knowledge or skills to ensure always compatible in this rapidly evolving world. In the past decades, learning activity is usually conducted physically. However, the advancement in technology nowadays has bridged the knowledge and the learners regardless of time-space restrictions. In the year 2020, online learning seems like an inevitable solution to ensure everyone can continue to learn in the Covid-19 pandemic wave. With "Unique-Learn", the learning experience for adult learners is expected to be leveraged. The rest of the paper has been organized as follows: Section II discusses the related works about adult's learning theory, microlearning service, and personalization in the learning domain. The methodology and proposed solution are presented in Section III and IV. Conclusion and next research plan are described in Section V.

II RELATED WORKS
In this section, the learning theory is discussed as the building block of a personalized microlearning framework for adult learners and the general
microlearning service workflow is described. A personalized microlearning framework will be proposed to resolve the research challenges in the existing microlearning workflow.

A. Adult’s Learning Theory

Before a comprehensive learning ecosystem can be constructed, learning theory is vital to be the building block to support the learning needs. Knowles’ Theory of Andragogy is the art and science of adult learning (Pappas, 2013). Based on Knowles’ Theory, the characteristics of an adult learner are described as the following points, as stated in (Pappas, 2013):

- **Self-concept:** Adults are self-direct in learning.
- **Experience:** Adults gain experience as they grow.
- **Readiness to learn:** Adults are ready to learn new knowledges.
- **Orientation to learning:** Adults can change their perspectives from procrastination to new learning interest.
- **Motivation to learn:** Adults are motivated to gain new knowledge as they grow.

Based on the adult learners’ characteristics, the learners are motivated to learn by internal incentives, such as the self-esteem or the desire to grow. In the current online learning trend, it is a common practice for people to obtain open online resources from the platform like YouTube when they are ready to gain new knowledge.

To summarize, adult learners can be interpreted as individuals which having a clear understanding of their learning objectives, driven by their internal incentives to grow. They will continue to learn based on personal interests and needs. Zhu (2020) has pointed out several use cases about how adults are self-directed in learning. In conjunction with the adult learning theory, microlearning could be the catalyst to boost the overall learning effectiveness in a learning ecosystem.

B. Microlearning

Microlearning refers to the learning mode with small chunks of learning objects within a short-term period (Kovachev et al., 2011). The learning process should cover the period from a few seconds up to 15 minutes to retain the learner’s attention and ensure no information overloaded. Generally, the microlearning concept could be imposed to adapt to the norm whereby the learning time of the learners is irregular and fragmented. To support microlearning activities throughout the learning path, Lin et al. (2019) has outlined the microlearning service workflow into three essential phases: 1) Segmentation; 2) Annotation; and 3) Recommendation.

**Segmentation process.** It is the first step to classify microlearning content from the massive online resources. Short video is the most common among learners (Guo et al., 2014; Anderson et al., 2014). In (Lin et al., 2019), the authors describe two segmentation strategies for videos: the content-based and the user’s interaction-based segmentation strategy.

- **Content-based:** It focuses on the segmentation of the learning object itself, machine learning algorithm such as Optical Character Recognition (OCR) or Automatic Speech Recognition (ASR) is applied to extract the textual metadata. To be specific, study in (Baidya & Goel, 2014) has explained the methodology used to capture the key frames of a learning video and extract the textual information in the scenes using OCR. However, the study also pointed out that sometimes content-based segmentation could be error-prone as some of the texts with artistic fonts are difficult to be recognized.
- **User-interaction-based:** It focuses on the learner’s interaction such as watching behavior to reflect the point of interest and the fitness of learning content. However, the cold start issue is always a challenge to a new learning ecosystem because the involvement of the users is low at the beginning.

**Recommendation process.** It describes how microlearning materials can be conveyed to the learners quickly and precisely. The effectiveness and efficiency of the recommendation process can be verified based on the ability of a recommender system to memorize a learning behavior of a learner and
generalize similar finished learning paths for a certain group of learners with similar learning requirements. For examples, the recommendation strategies as follow:

- **Ant Colony Optimization (ACO):** A finished learning path by certain groups of learners who have similar learning goals and requirements can be reused (Zhao et al., 2016). However, ACO might suffer from the cold start if it is implemented in a new learning ecosystem.
- **Transferred Learning:** It makes use of the knowledge gained from the other domains to resolve a similar problem in the relevant domain. The missing user-rating values in the target domain can be filled with a similar recommendation decision. Yet, knowledge from other domains might not be appropriate transferred to the learning domain due to the pedagogy issue like prerequisite knowledge (Wu et al., 2015).
- **Context-Aware:** It utilizes the similarity of contextual information such as location between a learner and his/her friends to define the recommending result. Yet, the generic contexts such as geo-location is not sufficient to personalize the delivery of learning resources precisely because a group of learners with different learning ability may share similar geo-location.

Based on the review done in the three essential parts of the microlearning service, the drawbacks of each strategy have been summarized. First, there is a shortcoming in the segmentation process whereby the approach to segment the learning resources using machine learning techniques may be error-prone, and dependency on the user’s interaction to classify the learning resources could suffer from the cold start. Second, the approach to use pre-defined rules to annotate semantic information of learning resources could be labor-intensive. Third, the generic contextual data of the learners is not sufficient to determine a learner’s needs. Hence, these shortcomings mentioned above will be resolved in the proposed framework.

### C. Personalization in Learning

Personalization in learning advocates that a learner’s characteristics influence the way that they engage in learning environments and the outcomes that are obtained (Walkington & Bernacki, 2020). The learning pace, ability, surrounding environment, and behaviors can act as vital contextual information to determine a learner’s learning path or goals. The context value can be retrieved from either the user’s input or the user’s interaction from time to time.

Especially for adult learners, they are self-directed to learn and have a clear understanding of the learning objectives. Thus, adult learners’ characteristics and behaviors are sufficient to reflect on how they want to personalize their learning process. Table 1 describes the data sources that can be used to personalize learning process, as stated in (Lin et al., 2019).

**Table 1. Data Sources for Personalized Learning**

<table>
<thead>
<tr>
<th>Data Source</th>
<th>Utility/Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>User-item rating matrix</td>
<td>Use of user’s historical rating.</td>
</tr>
<tr>
<td>Content Information</td>
<td>Use of content format and semantic information.</td>
</tr>
<tr>
<td>User’s interaction</td>
<td>Use of user’s behavior to design learning path.</td>
</tr>
<tr>
<td>User’s profile</td>
<td>Use of user’s characteristics such as age and learning interests.</td>
</tr>
<tr>
<td>Contextual Information</td>
<td>Use of prerequisite knowledge, time, location, or anything in learning activity for decision making.</td>
</tr>
</tbody>
</table>

From the perspective of the content provider, the work to impose personalized learning is challenging, especially in the aspect of learning resources delivery due to unique learning needs. In the learning domain, contextual information like prerequisite knowledge is more important to determine the personalized recommending result (Wu et al., 2015).

In a nutshell, the learning theory, concepts, and existing challenges have been discussed in this section. Hence, a microlearning framework named “Unique-Learn” is proposed to personalize the microlearning resources generation and delivery. With “Unique-Learn”, a hybrid approach will be introduced to classify and annotate the learning resources based on data mining techniques and the user’s interaction. Besides, the difficulty to personalize the delivery of learning resources is aimed to be resolved by using specific contextual information such as the learner’s prior knowledge instead of generic contexts like age or geo-location. “Unique-Learn” is expected to be implemented in the workplace environment for evaluation.

### III METHODOLOGY

In this section, the activities involved in “Unique-Learn” to personalize the microlearning resources generation and delivery will be discussed. The activities can be categorized into three main phases: 1) Segmentation; 2) Annotation; and 3) Recommendation. Meanwhile, the employee training and development related learning content will be used as an example of data input to provide a better understanding of how to implement the “Unique-
Learn” framework. Figure 1 illustrates the activities in sequence for the “Unique-Learn” framework.

![Diagram](attachment:image.png)

Figure 1. Activities In “Unique-Learn”

1. Phase 1 - Segmentation Process.

For the first activity (Activity 1), the video-based learning resources will be used as the input of the “Unique-Learn” framework since the video is the most common learning object format (Guo et al., 2014; Anderson et al., 2014). YouTube learning videos are used as the source of learning materials as it is a video-centered platform that is able to provide free-to-use learning materials continuously for non-commercial use (Airolida et al., 2016). The YouTube Data API will be used to obtain a generic list of employee training and development learning videos by querying the results with employee training and development related keywords.

In Activity 2, two strategies are implemented to classify the learning videos from the generic list of videos. First, the content-based strategy is applied. The glossary items defined in (Training Industry, 2020) have been referenced as the representative of different learning content categories. Then, the video’s title, tag, and metadata are used to classify the videos into different learning categories. The identification of microlearning videos is depending on the video length. Specifically, learning videos that cover a period from a few seconds up to 15 minutes will be categorized as microlearning resources. Then, the user’s interaction strategy is applied. The re-watch rate is used to determine the fitness of the microlearning video. If a video has a low watching rate, it will be eliminated from the list of qualified microlearning videos even though the video length fulfills the micro-learning concept. A hybrid approach is applied to segment the learning videos and improve the overall segmentation process accuracy.

2. Phase 2 – Annotation Process

The annotation of microlearning videos is performed in Activity 3. Besides defining the video’s based on its title or metadata, Natural Language Processing (NLP) is used to extract the semantic information from the video’s keyframes and audio. So, a model that comprises the algorithms to implement NLP is constructed. Idea from (Dessì et al., 2018) is adopted, which is to use the Speech-to-Text and NLP Tools such as IBM Watson’s suite to translate the spoken language in a microlearning video from an audio signal to textual information since the study has demonstrated a mature solution to annotate a learning resource based on keywords and concepts (Lin et al., 2019). Then, the extracted video keywords are mapped to the glossary terms such as Agile, Compliance Training, and Leadership Development, which had been defined in Phase 1. As a result, all microlearning videos are organized based on its topic and ready to be delivered.

3. Phase 3 – Recommendation Process

Activities 1 to 3 are executed for microlearning resources generation. The next two steps are executed for content delivery. The learner’s needs, ability, and prior knowledge are determined in Activity 4. A learner is required to fill up a questionnaire to define some static user’s data, such as the topic of interest and profession before they learn. This approach will help to tackle the cold start issue in a new learning ecosystem for the first-time recommending result. The recommending result will be fine-tuned from time to time when the user’s interaction increased.

The microlearning videos are delivered to the learners based on the user’s contextual information in Activity 5. The Context-Aware Recommendation strategy will be applied. A context-aware predictive model will be constructed based on Random Forest machine learning algorithm. This is because the algorithm provides a high accuracy recommendation result (Dessì et al., 2018). In the model, the default context has been defined as follows: content topic, content publisher, and prior knowledge. The different types of contextual value will be transformed into a numeric value and fed into the machine learning classification technique. From the contextual value, the model predicts the next potential microlearning videos for the learner. The content delivery can be personalized by using the specific contextual information like prior knowledge instead of the generic context, such as similar learning requirements from the other learners.

Activities 1 to 5 are executed sequentially to realize the personalize microlearning resources generation and delivery. The ability of “Unique-Learn” to personalize the generation and delivery of microlearning resources is evaluated in Activity 6. The completeness of the framework is evaluated based on the research motivation and reflected by the learner’s satisfaction and learning outcome effectiveness. The proposed framework is designed to provide the learning videos to the learners in micro-formed. Then, the framework should suggest appropriate microlearning videos to the respective learners based on the user’s contextual information. Moreover, the complete framework must be able to be applied in a use case.
IV PROPOSED SOLUTION

In this section, the overall architecture and implementation plan of “Unique-Learn” are elaborated. Figure 2 illustrates the overall architecture of “Unique-Learn”.

The architecture of “Unique-Learn” is combined from two parts: Part I is focusing on the classification and interpretation of the learning videos obtained from YouTube to generate the microlearning materials. The output from Part I is the micro-formed YouTube learning videos which serves as the data source for Part II. Part II describes the action to convey different microlearning videos to the learners based on their contextual information such as the topic interest, the learner’s favorite content publisher, and the prior knowledge on the certain learning topic. Since the overall “Unique-Learn” framework is built on top of the Self-Directed adult learning theory, the target learners will be mainly adults and we assume that the learners take responsibility for what they want to learn. Specifically, the learner’s contextual information clearly defines the learner’s needs.

The implementation plan of the “Unique-Learn” framework is presented as follow: First, learning videos will be extracted from YouTube by querying the employee training and development related keywords. The initial set is 500 videos as it is the maximum number of items returned based on YouTube API (Airoldia et al., 2016). Then, the initial set of videos will be segmented and classified into microlearning videos. To annotate the topic represented in the microlearning video, the semantic information from the video will be extracted by using the NLP technique and mapped with the video’s tag, metadata, or title. When the user’s involvement is sufficient in the learning ecosystem, the user’s re-watch rate on microlearning video will be identified to determine the fitness of the content. The criterion to classify and annotate the microlearning video is based on the video length to represent micro-content, the metadata to annotate educational topics, the semantic information from the video content, and the learner’s rating to evaluate content fitness.

When the generation of microlearning videos are completed, the appropriate content will be delivered to the learners by using the Context-Aware Recommendation strategy. Since different learners may have different learning needs, the learner’s contextual information is essential to predict the next required microlearning video for the learners. In the “Unique-Learn” framework, the default contexts have been defined as follow: content topic, content publisher, and prior knowledge. Given the contextual information, the microlearning videos that are closely matched to the contextual value are identified.

In a nutshell, the overall architecture of “Unique-Learn” is presented and the vital contextual information that describes a learner is identified. Next, we evaluate “Unique-Learn” based on the Kirkpatrick’s Learning Evaluation Model (Kirkpatrick & Kirkpatrick, 2006). We perform the Level 1 Evaluation: Reaction to reflect the learner’s satisfaction towards the “Unique-Learn”. Survey questionnaire is used to evaluate how the learners feel about the learning process through “Unique-Learn”. For example, we gather the learners’ feedback to assess the ability of “Unique-Learn” to provide appropriate microlearning materials to different learners throughout the learning journey. Then, the Level 2 Evaluation: Learning will be evaluated using the post-learning quizzes to understand the knowledge gained by the learners.

V CONCLUSION

“Unique-Learn” facilitates the adult’s learning process in this digitalized era by capturing and managing knowledge with microlearning and personalization concepts. In this paper, the related works on microlearning services and the shortcomings in each process have been discussed. “Unique-Learn” has been proposed as a comprehensive microlearning framework. It possesses the intelligence to identify the real learning needs of a learner, then conveys the appropriate microlearning videos to the learner from time to time. Meanwhile, the overall architecture and essential activities in “Unique-Learn” have been described in detail for future practical implementation. “Unique-Learn” aims to achieve the objectives whereby the learner can obtain microlearning videos and receive learning resources that matched the learning needs. As there is a lack of practical implementation of the personalized microlearning framework, “Unique-Learn” will be implemented in a workplace environment to evaluate the learning outcome effectiveness and the learner’s satisfaction to receive appropriate learning resources based on the contextual information. Based on the practical work, the shortcomings, and possible future extensions of “Unique-Learn” can be identified.
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Knowledge Creation in Malaysia: a SWOT analysis

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ABSTRACT
Malaysia aims to be a developed nation by 2025. In congruence with this, the National Industry 4.0 Strategy (NI4.0) was launched in 2018 to accelerate high-technology adoption, improve efficiency and competitiveness across industries. NI4.0 utilizes data across the dynamics enactment process to maximize businesses’ intelligence capacity as a smart factory in the ASEAN region. The effect of high-technology adoption in NI4.0 is expected to accelerate knowledge creation (KC). However, research on this impact is still scant. As such, KC should be promptly analyzed as it has become a global source for competition-surpassing individuals, organizations, and nations. IT professionals are heavily reliant on the value of KC to sustain competitive advantage. Evidence shows that KC in Malaysia is growing at a slower rate. Therefore, this paper aims to provide a SWOT analysis of KC in Malaysia, discussion of the evidence and insights for a slower KC growth and discussion of the findings to accelerate KC in Malaysia.

Keywords: knowledge creation, national industry 4.0, SWOT analysis

INTRODUCTION
In recent years, the remarkable development of Information and Communications Technology (ICT) systems has encouraged the movement of talent, resources, and knowledge beyond the limits of ICT ventures. The ICT industry has increased employment opportunities in Malaysia which consequently, increased the country’s GDP. To enumerate, statistics indicate that the ICT industry contributes RM 267.7 billion to the national economy, which is equivalent to 18.5 percent of the GDP in 2018 (DOSM, 2019). Under NI4.0, the Malaysian government has defined main digital areas for the ICT industry which inevitably facilitates a digital transition in the ongoing industrial revolution. (Reinhard et al., 2016). Key digital fields include Artificial Intelligence (AI), Internet of Things (IoT), Cloud, Data Mining, Cyber Protection, Data Centres, and e-commerce. Meanwhile, the increased use of new technology with broader scope and complexity within the ICT industry has created a wealth of new knowledge. While the usage of such emerging technology by organizations has been an increasing cause of worry, the implications for the practice of KC and the potential to improve for enterprises remain mostly unknown (Pauleen and Wang, 2017). As a consequence, the future of a business relies on its knowledge maximization in the shortest period to gain a sustainable competitive advantage. KC fosters organizational human resources development (Mehralian et al., 2018), resulting in an organization to become more innovative and achieve better competitive advantage.

KC has been a catalyst for global competitiveness for NI4.0. Competitive advantage is attained through KC and contributed to the firm’s potential progress. Moreover, KC is a constant commitment to broaden knowledge in Malaysian organizations and to create greater insights for the firms.

The current KC landscape in Malaysia encompasses a research focus on the KC process, factors and, influence on various contexts covering medical, cultural, tourism, government, wakf, education, technology, and agriculture. This paper will expound on KC’s strengths and opportunities, avoiding the threats and weaknesses within this paradigm. Therefore, the aim of this paper is:

1. To review KC in Malaysia.
2. To perform a SWOT analysis for KC in Malaysia.
3. To suggest the way forward for the KC agenda in Malaysia.

This paper proceeds as follows: Section I provides an introduction to the study. Section II provides a literature review on KC and the background of the study, revealing the current KC trend in Malaysia. Section III describes the SWOT analysis. Section IV discusses the way forward. Finally, Section V concludes the study.

LITERATURE REVIEW
A. Knowledge in Organizations
In the modern world of the digital age, it is challenging for an organization to locate correct information in the right form to support its daily activities. Hence, the organization might lose its competitive advantage. Ikujiro Nonaka and Hirotaka Takeuchi, pioneers in knowledge creation research, have performed extensive studies on how the nation of the rising sun had developed its economy in 1995 by using this knowledge.
Plato, a philosopher in ancient Greece, defines knowledge as a “justified true belief” (Fowler, 1966). He stresses that belief in the truth of something does not constitute our true knowledge of it, so long as there is a chance or a possibility that we may have made mistakes in our belief (Cambridge, 1995). Nevertheless, knowledge needs to be nurtured, supported, enhanced, and protected by humans (Nonaka and Konno, 1998). In the modern world, the Cambridge dictionary defines a knowledge worker as an individual who knows how to apply and create knowledge in the job field (Cambridge, 1995). Later, scholars clarified that knowledge is not utter reality; hence it can modified according to perspectives through synthesized contradictions allowing one to overcome the current state and build a new truth (Nonaka, Toyama and Konno, 2000). Multiple scholars (Quinn, 1992; Toffler, 1990; Nonaka et al., 2000) speak of knowledge as the new resource for the new economy, and consequently an essential asset.

**B. Knowledge Creation**

The Theory of Organizational Knowledge Creation (TOKC) by Nonaka and Takeuchi (1995) is the kernel theory. TOKC explains the organizational knowledge creation process through four modes of conversion- through individual or group experiences (Socialization), expressing awareness into concepts (Externalization), linking and systemizing the concepts (Combination), and embodying knowledge to create product value (Internalization) (Nonaka and Takeuchi, 1995). Nonaka, Toyama, and Konno (2000) further explained that KC is a subsidiary process under Knowledge Management (KM). That is, to acquire a new context, view, or knowledge, one transcends the limit of the old self to a new self. From past research, TOKC indicated that innovation through the integration of both explicit and tacit knowledge amongst different sources in the value chain broadens the organization’s knowledge (Nonaka et al., 2014). KC covers multidimensional studies that broach numerous areas of research dealing with human interactions, organizational behavior, organizational learning, and leadership (Kao and Wu, 2016). As a result, the phronesis dimension covering an individual’s beliefs, obligations, passions, and judgments were incorporated in KC to solve the practical issues in organizations (Nonaka and Nishihara, 2018).

KC has become increasingly necessary as businesses adapt to continual rapid shifts in the market and advances in emerging technology (Kiklhorn et al., 2020). In the new competitive market climate, KC is highly associated with innovation to modernize goods and services (Andersson et al., 2008; Anthony and Tripas, 2016; Goyal et al., 2020). Innovation is the fruition of knowledge (Faccin and Balestrin, 2018), as a result of the KC process (Landoni, 2020). In the modern business world, co-creation is a sustainable method for leveraging expertise and creating new forms of knowledge (Goyal et al., 2020).

**C. KC in Malaysia**

The current KC activities in Malaysia are described in Table 1.

<table>
<thead>
<tr>
<th>Initiative (Year)</th>
<th>Agency</th>
<th>Details</th>
<th>Contribution on KC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malaysia Social Innovation (MySI)</td>
<td>Ministry of Science, Technology, and Innovation (MOSTI)</td>
<td>Program to improve services and welfare of rural community</td>
<td>New innovation generate new knowledge</td>
</tr>
<tr>
<td>High Impact Program 6 (HIP6)</td>
<td>Yayaan Innovasi Malaysia (YIM)</td>
<td>Program to source and develop new innovation</td>
<td>Platform to perform science and technology research and create new knowledge</td>
</tr>
<tr>
<td>Mainstreaming Grassroots Innovation (MaGRIx)</td>
<td>Malaysia Global Innovation &amp; Creativity Centre (MaGIC)</td>
<td>Platform to develop advanced technologies</td>
<td>New knowledge creation through experiment and development process</td>
</tr>
<tr>
<td>National Technology and Innovation Sandbox (NTIS)</td>
<td>Malaysia Industry-Government Group of High Technology (MIGHT)</td>
<td>Knowledge hub to dissemination and sharing knowledge in sustainable cities initiative</td>
<td>Accelerate innovation and develop new knowledge</td>
</tr>
</tbody>
</table>

**Malaysian Industry-Government Group of High Technology (MIGHT)** introduced Malaysia International Centre for Sustainable Cities (MyICSC) to serve as a knowledge hub to disseminate and share knowledge in the sustainable cities initiative (MIGHT, n.d.). The project accelerates innovation and develops new knowledge. Malaysia Digital Economy Corporation (MDEC) organized My Digital Maker Fair to embrace youth innovation in Science, Technology, Engineering, and Mathematics (STEM) (MDEC, n.d.). New knowledge creation was achieved through STEM innovation. Ministry of Science, Technology, and Innovation (MOSTI) implemented the Malaysia Social Innovation (MySI) program to improve services and welfare within the rural community (MOSTI, n.d.). Hence, innovation generated new knowledge.

Yayaan Innovasi Malaysia (YIM), which is a government agency that promotes creativity and innovation amongst Malaysians offered programs such as High Impact Program 6 (HIP6) and...
Mainstreaming Grassroots Innovations (MaGRIs) to serve as platforms to create new knowledge through research in the area of Science and Technology (YIM, 2020). Meanwhile, Malaysia Global Innovation & Creativity Centre (MaGIC) provides National Technology and Innovation Sandbox to develop advanced technologies and new knowledge creation through the experimentation and development process (NTS, 2020).

An exploration of research papers on KC in Malaysia within the last five years from major international databases such as Scopus and Emerald revealed minimal research on KC in Malaysia, particularly concerning NI4.0. However, the 14 papers found on the MyCite database are further discussed in groups (KC process, KC factors, KC influence). The summary is provided in Table 2.

**Table 2. Past Studies on KC in Malaysia**

<table>
<thead>
<tr>
<th>Author</th>
<th>KC Focus</th>
<th>Focus</th>
<th>Context</th>
<th>Key Factor to KC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yee et al. (2020)</td>
<td>Organizational factors (Reward, training, and collaboration)</td>
<td>KC Process &amp; KC Factors</td>
<td>Association of Malaysian Medical Industries (AAMI)</td>
<td>Reward and Collaboration</td>
</tr>
<tr>
<td>Wahono and Hara (2019)</td>
<td>Corporate Knowledge and Innovation</td>
<td>KC Process</td>
<td>Batik industry</td>
<td>Environment conditions</td>
</tr>
<tr>
<td>Liow et al. (2019)</td>
<td>Brand Orientation &amp; Organizational Performance</td>
<td>KC Process</td>
<td>Tourism</td>
<td>Top-down management approach</td>
</tr>
<tr>
<td>Yusof and Masrek (2016)</td>
<td>Job Design and Knowledge Productivity</td>
<td>KC Factors</td>
<td>Administrative and Diplomatic Officers (PTD)</td>
<td>Task, knowledge, social and work context characteristics</td>
</tr>
<tr>
<td>Yusof et al. (2016)</td>
<td>Job design’s task characteristics</td>
<td>KC Process &amp; KC Factors</td>
<td>Administrative and Diplomatic Officers in Malaysian federal ministries</td>
<td>Work, Scheduling, Autonomy, Decision Making, Autonomy, Work, Methods, Autonomy, Task Variability, Task Significance, Task Identity and Feedback form, Job</td>
</tr>
<tr>
<td>Sidswanto &amp; Rosliana (2016)</td>
<td>Sustainable development of cash waqf</td>
<td>KC Influence</td>
<td>Wakf</td>
<td>Innovation</td>
</tr>
<tr>
<td>Jali, Abas, &amp; Ariffin (2016)</td>
<td>Social innovation</td>
<td>KC Factors</td>
<td>Malaysian university-industry-community</td>
<td>Social innovation</td>
</tr>
<tr>
<td>Wahil et al. (2015)</td>
<td>Entrepreneurship Intentions</td>
<td>KC Factors</td>
<td>Entrepreneurship</td>
<td>Innovation</td>
</tr>
</tbody>
</table>

**KC Process:** KC process has 7 papers. These papers discussed the organizational and environmental conditions to perform KC in batik, tourism, technology, education, agriculture, and armed forces.

**KC Factor:** This dimension has 4 papers. The key factors of KC include work context characteristics, social innovation, and innovation capability.

**KC Process & KC Factor:** 2 papers discussed both the KC process and factors. The papers discovered that reward, collaboration, job design, and task characteristics play significant roles in KC.

**KC Influence:** Only 1 paper was found in this dimension. The study explained that innovation is crucial to develop cash waqf sustainably.

A review was done on the papers published in relation to the Malaysian NI4.0. The challenges of NI4.0 that would influence KC in Malaysia are presented in Table 3.

**Table 3. Past Studies on Malaysia NI4.0**

<table>
<thead>
<tr>
<th>Author</th>
<th>Journal</th>
<th>Issues</th>
<th>Impact to KC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mokhtar and Noordin (2019)</td>
<td>Indonesian Journal of Electrical Engineering and Computer Science</td>
<td>Lack of awareness, skills and competencies</td>
<td>Difficulty to create knowledge</td>
</tr>
<tr>
<td>Ghabakhloo and Fathi (2019)</td>
<td>Journal of Manufacturing Technology Management</td>
<td>Lack of collaboration between academics and industries</td>
<td>-</td>
</tr>
<tr>
<td>Lin et al. (2018)</td>
<td>Industrial Management</td>
<td>Lack of foreign direct</td>
<td>-</td>
</tr>
</tbody>
</table>
Abdul-Hamid et al. (2020) found there is a lack of knowledge management system which impacts KC. Furthermore, lack of awareness, skills, and competencies causes difficulties to create knowledge (Mokhtar and Noordin, 2019, Kannan and Garad, 2020). Moreover, a lack of collaboration between academic institutions and industries to build knowledge together impacts the KC ecosystem (Ghobakhloo and Fathi, 2019). Lin et al., (2018) and Mohamad et al., (2018) revealed that a lack of foreign direct investments and trade prospects causes a void in financial support for KC.

In a nutshell, literature on KC in Malaysia revealed that it requires a detailed study to accelerate KC proliferation in Malaysia. Therefore, a SWOT analysis is required. The primary objective of the SWOT analysis is to help Malaysian organizations to develop awareness of the fundamental change involved in enhancing KC in Malaysia.

### III METHODOLOGY

This paper is constructed based on an extensive review of KC literature in the context of Malaysia and develops a Strengths, Weaknesses, Opportunities, and Threats (SWOT) analysis. Secondary data were analyzed to identify SWOT. It includes newspaper and annual reports from PwC, HRDF, EPU, MCMC, MOHE, MOSTI, and MyIPO. These reports were selected based on their coverage of various national perspectives including education, ICT, intellectual property, technology, human resources and, Research and development (R&D).

The contribution of this paper is the SWOT analysis that will serve as an insight for any agencies working on KC agendas in Malaysia.

#### A. SWOT Analysis

Figure 1 shows an analysis result of the Strengths, Weaknesses, Opportunities, and Threats for KC in the context of Malaysia.

**Strength:** Recent statistics have shown that Malaysia had remarkable growth in educational institutions from the public and private sectors. In Malaysia, there are five research universities, fourteen public universities, four hundred private institutions covering university, university college, and international branch campus (MOHE, 2019). Besides that, educational institutions linked local and foreign communities to expand their knowledge and expertise (Aziz and Abdullah, 2012). Additionally, the growth of educational institutions had significantly contributed to new knowledge in the nation through journal publications, conferences, and proceedings.

<table>
<thead>
<tr>
<th>Strengths</th>
<th>Weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The growth of the education institutions (SJ, 2020)</td>
<td>1. Lack of innovation capability (MyIPO, 2018)</td>
</tr>
</tbody>
</table>

**Opportunities**

1. High-technology on Blockchain, Artificial Intelligent (AI), Internet of Things (IoT), Big Data Analytics (EPU, 2019)
2. Rapid growth of online communities (DOSM, 2020)

**Threats**

1. Political and economic instability (Wong, 2020)
2. Information overload (MCMC, 2018)

According to the Scientific Journal Rankings, a total of seventy-three Malaysian publishers had generated 6,044 journals and 1,001 conferences and proceedings in 2019 (SJ, 2020). Moreover, a total of 18,875 journals and 2,379 conferences and proceedings have been published in the past three years (SJ, 2020). In the past three years, two percent of the published journals are first quartiles and twenty-five percent of the published journals are second quartiles (SJ, 2020). This statistics indicates that Malaysian journals are competitive with other publishers from the rest of the world. Nevertheless, Malaysia is a key player in knowledge creation in the region. Statistics have shown Malaysia ranked thirty-three out of 240 countries and territories, surpassing Singapore, and Thailand, placed thirty-four and forty-four respectively (SJ, 2020). The development in research produced an abundance of seminars and workshops locally to support knowledge exchange and also to create new knowledge (WASET, 2020). Consequently, local researchers are able to interact with other researchers and expand their knowledge. Multiple event organizing platforms such as conferencemalaysia.com, conferenceindex.org, Eventbrite, and so on are used to promote conferences and seminars.

R&D refers to activities that create and apply the knowledge that is performed by scientific experts (Asmawi and Chew, 2017). As such, the Malaysian government continues to promote innovation by improving R&D structure. For instance, the government provided funds to ministries and public agencies with an allocation of RM 524 million to enhance R&D in the public sector (PwC, 2019). Another approach was providing tax exemption up to 10 years from the income generated via intellectual property (PwC, 2019).

From the human capital development perspective, education and training can create new knowledge and
skills (Schultz, 1963). Malaysian government’s continued support for education and training is another strength of knowledge creation. In line with Malaysia’s Budget 2020, the Malaysian government has allocated RM 50 million to Human Resource Development Fund (HRDF) to provide training and upskilling workshops to the employees (PwC, 2019). Together with the Ministry of Human Resource Malaysia, HRDF continues to catalyze employee growth to create a knowledge-based economy.

**Weakness:** A weakness of knowledge creation in Malaysia is shown in the area of innovation capability. Innovation capability is defined as an organization’s ability to accumulate, improve, and develop new products or services (Amit and Schoemaker, 1993; Raddats and Burton, 2014; Mohamad et al., 2017). Innovation capability can be identified through new patents or copyright (MOSTI, 2018). In Malaysia, between 2008 and 2018, local patent and copyright applications remained sluggish. This is unlike vigorous foreign patent applications; which averages 5,719 applications per year (MyIPO, 2018). In contrast, the average number of patents for local applications per year is only 22% of the average number of foreign applications annually (MyIPO, 2018). Moreover, Malaysia’s lack of abundant innovation capability is also reflected in the Global Innovation Index, a measurement for countries’ innovation capacity. The report indicated that Malaysia only ranked 33th out of 131 countries, placing eighth in Asia behind Singapore, the Republic of Korea Hong Kong, and China (WIPO, 2020). However, the abovementioned index might not be an exact indicator of the level of knowledge creation in Malaysia because KC emphasizes innovation through research and development (R&D).

Critics expostulate that Malaysia’s R&D remains at infancy level (The Star, 2020, Asmawi and Chew, 2017). This is echoed by Aman (2008) who further suggests that Malaysia’s R&D only focuses on specific areas such as infrastructure and construction which are conducted by large corporations. In contrast, 98.5 percent of the Malaysian firms consist of Small Medium Enterprises (SME) (SME Corp, 2018) which have scarce resources, are highly vulnerable to economic turbulence, and lacking-formal R&D pursuits (Adams et al., 2006; Bourgrain and Haudeville, 2002).

Contending that R&D was related to knowledge creation, a serious impediment to R&D progress in Malaysia is the lack of capital, human resources, technology, skills, and intellectual property protection (Partanen et al., 2008; The Star, 2020). According to recent press, the ratio of R&D spending based on Gross Domestic Product (GDP) in Malaysia is only 30 percent of South Korea’s R&D spending in 2019 (Hamid, 2019). This finding indicates that Malaysia needs an improvement in national R&D prospects and innovation. In Malaysia, only a handful of grants or incentives from the government or private institutions are made available. Without adequate monetary support, it is hard to incorporate R&D in firms. In sum, a lack of R&D is detrimental to knowledge creation development in the nation.

According to scholars, it is undeniable that knowledge creation requires extensive reading or listening to sense the realism and ‘know-how’ to create new knowledge (Nonaka and Takeuchi, 1995; Nonaka et al., 2000). Therefore, it is proven that reading and knowledge creation are intertwined. Ironically, studies from the National Library shows that Malaysians only read fifteen books on an average per annum (The Star, 2019). Comparatively, citizens from developed countries read an average of forty books annually. Previous studies in Malaysia have found that newspapers are the most popular reading material, followed by magazines and books (Baba et al., 2020). A fundamental question that arises is the effectiveness of only newspapers, which is primarily a leisure read, in generating knowledge. Regardless, it is pivotal to cultivate a better reading culture in Malaysia.

**Opportunities:** Shared Prosperity Vision 2030 is the next initiative to reprioritize Malaysia’s development goals. The nation is slowly adopting high technology from the Fourth Industrial Revolution (IR4.0). Therefore, there exist vast opportunities for creating specialized knowledge associated with high-technologies such as Blockchain, Artificial Intelligent (AI), Internet of Things (IoT), Big Data, and so on. However, the usage of high technology in the industrial and service sectors remains limited at 37% and 20% respectively (EPU, 2019). The nation is targeting an increased adoption rate in the manufacturing and service sectors up to 50% for the former and 30% for the latter by 2030 (PwC, 2019).

According to a survey performed by Malaysia Communication and Multimedia Commission (MCMC), the nation has a total of 28.7 million Internet users in 2018, which is equivalent to 87.4 percent of the Malaysian population (DOSM, 2020). Furthermore, most of the active Internet users are youngsters, who contributed to about 62 percent of the total online content. The online content falls under the categories of education and entertainment through social networking and messaging applications. Malaysian online communities have a huge potential to create new knowledge; owing to diverse ethnic groups with different religious practices and cultures. Therefore, online communities are a useful source of personal tacit knowledge for the market for co-creation and innovation.
Treats: According to Socio-Economic Research Centre (SCRC), political and economic stability in Malaysia is crucial for national growth policy continuity (The Edge Markets, 2020). Recent instability in political powers and the outbreak of the Covid-19 pandemic are predicted to affect the nation adversely in the long run. Moreover, multiple credit rating agencies are apprehensive that the political instability in the nation might cause a negative outlook on long-term foreign direct investment (The Edge Markets, 2020). On the other hand, while resources are channelled to rebuild a nation’s economy and combat political uncertainty, knowledge creation outlook will be affected by the lack of funding and support from the government.

In the modern world, the Internet has become one of the largest sources of knowledge (Majid, 2017). People are used to creating content or obtaining information through the Internet. Statistics indicate that Malaysians spend nearly 7 hours a day online (MCMC, 2018). The ease of information flow within the online media in turn amplifies the possibility of spreading misinformation and those who receive such misinformation may not be able to evaluate it critically (Soto-Acosta and Cegarra-Navarro, 2016). Evidently, most Malaysian Internet users do not check the content before sharing it online (MCMC, 2018). Recent research acknowledged that misinformation is harmful because it may foster unlearning and stops the creation of new knowledge (Norri-Sederholm et al., 2020). Therefore, it is necessary to be aware of the impact of misinformation on knowledge creation in the nation.

IV THE WAY FORWARD

The SWOT analysis revealed that there is greater potential for KC in Malaysia. Despite the financial supports provided by the government for R&D, KC growth depends on individual efforts through socialization to facilitate new knowledge. One of the strategies is to create more online communities in various segments such as education, entertainment, and government.

High-technology such as blockchain, artificial intelligence (AI), Internet of Things (IoT), and big data analytics can be made more extensive by increasing expertise and skills through specialization programs. The strategy to materialize this is to improve the current education ecosystem. Furthermore, new knowledge can be captured through the implementation of high-technology in organizations.

Strategies to tackle the lack of innovation include encouraging firms to participate in innovation activities, providing platforms for knowledge sharing between collaborators, holding more innovation competitions amongst experts, creating expert systems, and conducting hack day.

Moving forward, KC will play an important role in supporting the Shared Prosperity Vision of 2030. Any strategies outlined to address the issues regarding the lack of innovation, R&D, and reading culture will enhance KC under NI4.0. These improvements should be pioneered by the government as the primary driver to develop R&D friendly policies, introduce subsidy, tax reduction, and encourage more intellectual property.

V CONCLUSION

This study presents a review and insights on KC in Malaysia. Besides identifying the strengths, weaknesses, opportunities, and threats, this paper represents the contributions to link knowledge creation theory in Malaysia. Secondly, this study provides useful insights for the public and private sectors in Malaysia. The findings from this study are expected to ignite interest in KC research by filling the existing gaps in literature and theory. Ideally, it is also expected to further extend the opportunity for interdisciplinary discussions. This study acknowledges the important role of knowledge creation in developing competitive advantage for a firm. Finally, KC will contribute to the achievement of NI4 through the collaboration between the government, industries, and universities.

REFERENCES


Survey on Vulnerability of 4G/LTE Network Security and Improvements

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ABSTRACT
Network security is considered a significant issue in our daily life due to its entering into many people’s activities such as social activity, marketing and business. However, the need for a secure and powerful network has increased. The needs for a secure network have increased due to the increasing threats and hackers in our daily life. In fact, based on the current statistics, each second the number of subscribers is increasing by 10 times worldwide which refers to the fast growth of 4G/LTE networks. It is noticed that 80 percent of people globally have owned 4G mobile phones and the number is increasing during the recent several years. Furthermore, 4G/LTE is the foundation of the 5G network, so advanced security is needed. From this point, this paper presents a survey of the improvements that have been done recently on 4G/LTE security and reveals the weaknesses that still exist and that will allow researchers to focus and work on these weaknesses.

Keywords: Attacks, 4G/LTE, vulnerability and security.

I INTRODUCTION
The evolvements of fourth generation cellular network is up to date news nowadays. The trend toward developing and getting more reliable and authentic devices is increasing year by year. Hence, the researchers dedicate their time investigating and finding the solution for any backhaul or problem which still exists until now in the fourth generation of mobile communication. Based on (Ahlwat, 2018), the evolution from single authentication in the first generation to the mutual authentication in the 4G/LTE networks has made the network prone to new kinds of threats and vulnerabilities. The design of LTE is suitable for the demands of customer for getting fast access to data, less delay, high throughputs and high data rates. All these features motivate researchers to investigates more and works to improve and protect LTE security from any intruder. Therefore, this research surveys the recent improvements and developments on LTE security as well as figuring out the vulnerabilities that still exist in the LTE network and need to recover.

II LTE AND LTE-A SECURITY DESIGN
The design of LTE and LTE-A network consists of two main components, The first is Evolved Universal Terrestrial Radio Access network (E-UTRAN) and the second is Evolved Packet Core (EPC). Only a few surveys have been done to support LTE security and show the possible threats and recent improvements in LTE security. However, LTE security system architecture consists of five layers which are defined by the Third Generation Partnership Project (3GPP):

1. Network Access Security: Responsible for securing the access of the mobile users to the network and guaranteeing the radio access link is secured from any attack.
2. Network Domain Security: guarantees that portable backhaul hubs to safely trade signaling information and client information at the versatile backhaul systems and secures against assaults on wireline connection.
4. Application domain security: This permit applications from the user and network considerations to securely interchanging data.
5. Visibility and Configuration of security: Permits clients to use data around empowered security highlights and arrangement of administrations.

The layers are shown in Figure 1 (Liyanage et al., 2015).

Figure 1. LTE security layers
III VULNERABILITIES ON LTE AND LTE-A SECURITY

Based on (HE et al., 2018) studies, they presented a comprehensive research study on the LTE and LTE-A network security attacks and they classified the attacks as groups and they illustrated their effects on LTE and LTE-A networks. This part reviews the attacks and their threats on LTE as presented in Figure 2.

![Figure 2. Attacks Classifications on LTE and LTE-A network.](image)

A. Attacks on Access Network

(HE et al., 2018) discusses some issues that threaten 4G network security such as revealing or discovering the IMSI which is referred to International Mobile Subscriber Identity which is a very important part in LTE and LTE-A networks. Discovering the IMSI leads to leaking of the user’s data which means breaking the privacy of the user. Furthermore, there is a threat in the ability to track user’s location by getting the location ID and cell phone ID which has put the user at a very high risk. Moreover, there are more attacks in access networks such as RF jamming, Spoofing and Sniffing, which are common in physical layer attacks lead to DOS/DDOS attacks (Mohapatra et al., 2015). Both attacks are serious and critical on LTE and LTE-A networks because they make the CPU exhausted and to not respond to the services. DDOS assaulter can master a botnet which can get and use the victim’s information. There are also other intruders on accessing networks for example replay attacks and Eavesdropping attacks where until now LTE and LTE-A have not been completely stopped them.

B. Attacks on EPC (Evolved Packet Core)

There are many risks that still threat LTE and LTE-A core networks such as DOS and DDOS attacks which influence the HSS (Home Subscriber Server) that is the heart of EPC networks because it contains the subscriber’s data such as IMSI and the attacker will make overloads on HSS and cause it to consume more resources and consequently effect on the user equipment's behaviour and SGW (Serving GateWay). There is also insider attacks that affect the base station and shutdown it. (HE et al., 2018)

C. Attacks on IMS

The SIP-related attack is the most serious threat in IMS, for example, SIP-flooding attacks. This attack can make resource exhaustion and result in DOS attacks and also can launch further attacks on IMS like VOLTE (Voice over LTE) and SMS. The attacks on VOLTE can infect the LTE network and link it back to the previous circuit switch system. Examples of VOLTE attacks, SIP flooding DOS attack, silent call attacks, VOLTE spamming, spoofing and phishing. Also, there are other serious attacks on SMS which is considered fundamental in any mobile service and it is based on the IMS system. Figure 3 shows the structure of the attacks on Another kind of attack is Abnormal charging in VOLTE. The attacker can get to the data in free of charge through VOLTE services and this can lead to a DOS attack. Peng and others mentioned three kinds of attacks of data charging on VOLTE. The first is free charging which can get to the data by using IP spoofing, the second is a fraud charging attack where attacks establish a link with a spamming server and send wrong information to the victim so the charging will highly increase. The last attack on VOLTE is overcharging, this attack can change the IP packet time to live therefore the packets are rejected when they are accounted. There are more attacks on IMS such as TCP/SYN flooding attacks and SQL injection attacks. Based on (Mohapatra et al., 2015) many different users can interact with LTE network which enables malicious attacks, worm attacks, spam email, changing data and stealing the number of credit cards in banking.

![Figure 3. Structure of attacks on IMS.](image)
D. Attacks on End User Equipment

This type of attack infects the devices of the users which forms a high impact of threats on user’s privacy such as botnet and malware. The former has the ability to steal any kind of data from the victim such as SMS, email and many more while the latter can be used by attackers to abuse mobile user through launching attacks to the network such as DOS attack, SMS attack and abnormal charging attack. As mentioned by Ahlawat et al. (2018), there are various probable vulnerabilities in LTE network which is divided into three aspects; the first is the internal network included in the access and the core networks; the second is the external network which means the coming attacks from a third party. The third aspect is the attacks coming from the user’s equipment. In addition, the author designed a framework that includes six categories of LTE vulnerability as described in Figure 4. The author also categorizes the attacks based on the LTE layers networks which consist of five layers as mentioned in the LTE security architecture section (Ahlawat et al., 2018).

![Figure 4. Vulnerabilities in LTE security framework.](image-url)

<table>
<thead>
<tr>
<th>Table 1. Survey on improvement on LTE/LTE-A network Security.</th>
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<tr>
<td><strong>Author</strong></td>
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<tr>
<td>Alyaa Ghanim</td>
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<tr>
<td>Soran Sabah Hussein</td>
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<tr>
<td>Madhusanka Liyanage</td>
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<tr>
<td>Sumant Ku Mohapatra</td>
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<td>Nicholas DeMarinis</td>
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IV IMPROVEMENTS ON SECURITY ASPECT OF 4G/LTE NETWORK

This section showed the improvements that have been done with the security of the LTE and LTE-A network from different perspectives and summarized them according to the year from 2014 until now in an ascending order in the Table (1) below, thus anyone can take an overview on them and understand how the developments on LTE security have been done.
<table>
<thead>
<tr>
<th>Author(s)</th>
<th>Year</th>
<th>Contribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brian Cusack</td>
<td>2016</td>
<td>Used an innovative detection method of the DDoS attack with detail and he discussed the benefits of using his method of revealing the slow DDoS attack. (Cusack et al., 2016)</td>
</tr>
<tr>
<td>Okoye Emmanuel Ekene</td>
<td>2016</td>
<td>Made or proposed a modification in EPS-AKA which is referred to evolved packet system authentication and key agreement in LTE network by using PKI which is a reference to public key infrastructure and this change will protect IMSI which has the main role in LTE network security. (Ekene et al., 2016)</td>
</tr>
<tr>
<td>Yun Ye</td>
<td>2016</td>
<td>Discussed and proposed methodologies to improving the throughput of the LTE system and also overviewed on LTE spectrum sharing technology in three types of spectrum (Ye et al., 2016)</td>
</tr>
<tr>
<td>Mohamed Amine Ferrag</td>
<td>2017</td>
<td>Did a comprehensive survey on four and five generations of mobile network especially from the authentication and privacy aspects and he suggested open issues for future research on authentication and privacy to keep 4G and 5G en safe from any intruders (Ferrag, 2017)</td>
</tr>
<tr>
<td>Eman Ashraf Mohammed</td>
<td>2017</td>
<td>Proposed a new novel algorithm which is based on the RC6 algorithm by combining of the two RC6 in one algorithm to get 256 bit instead of 128 bit to boost the speed and increase the security level comparing with EEA2 which is the second set of the LTE cryptographic algorithm. (Mohammed, 2017)</td>
</tr>
<tr>
<td>Mourad Abdeljebbar and Rachid El Kouch</td>
<td>2018</td>
<td>Proposed a solution for improving EP Authentication by combining the simplicity of deployments and the full mutual authentication which secured all the communications entities.</td>
</tr>
<tr>
<td>Alyaa Ghanim Sulaiman</td>
<td>2018</td>
<td>Modified the AES cryptographic algorithm which is the core of the EEA2 algorithm of the LTE network security by HISEC algorithm which is a lightweight block cipher algorithm in order to increase the security and decrease the cost (Sulaiman &amp; ALDa bbagh, 2018)</td>
</tr>
<tr>
<td>Raja Ettiane</td>
<td>2018</td>
<td>Proposed an approach to detect DDoS attack signalling on LTE network with 91% of accuracy and with fast time which is around only 380 seconds (Ettiane et al., 2018)</td>
</tr>
<tr>
<td>Carol Davids</td>
<td>2018</td>
<td>Did a research on the trend of the real-time communication toward 5G network and he mentioned that the SDN and the virtualization are the key parts of developing the 4G toward 5G network also he encourages the researchers to work effectively to overcome the backhauls that exist in the 4G network (Davids, 2018)</td>
</tr>
<tr>
<td>Fuwen Liu</td>
<td>2018</td>
<td>Presented a novel scheme used for 5G to reduce the weaknesses and vulnerability in 4G/LTE network without any effect on AKA protocol and identity management process (Liu et al., 2018).</td>
</tr>
<tr>
<td>Xu Zhang</td>
<td>2019</td>
<td>Presented a novel design for improving the emergency communication in LTE network including UAV, data a question and video return devices (Zhang et al., 2019).</td>
</tr>
<tr>
<td>Abubakar Muhammad Miyim</td>
<td>2019</td>
<td>Evaluated the performance of LTE network using OMNeT++ simulator and noticed that LTE network is provide high quality of voice call (Miyim &amp; Wakili, 2019).</td>
</tr>
<tr>
<td>Chi-Yu Li</td>
<td>2020</td>
<td>Presented a new security design named as MECsec to decrease the latency in the</td>
</tr>
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</table>
V DISCUSSIONS

This paper discusses two opposite issues of the 4G/LTE network security which are the vulnerabilities and improvements and shows the current studies that have been done on this network from different perspectives. So, this will add a sufficient knowledge for researchers who want to search and investigate on this field.

VI CONCLUSION

In a nutshell, this article intends to gather some issues in the vulnerabilities in LTE network security that recently have been done to identify the gaps or the challenges which need to overcome to achieve a high level of security and avoid the attackers from stealing or spying on any personal information or shutting down the LTE/LTE-A network. Furthermore, it survived the improvements that have been done until now to boost the fourth-generation networks security.

REFERENCES


Updated DeLone and McLean IS Success Model and Commercial Open Source Software (COSS) Company Success

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ABSTRACT
Commercial Open Source Software (COSS) is a promising business model as it represents the middle ground between expensive proprietary software and free software. The unique nature of COSS companies has captured researchers’ attention; hence several studies have been conducted to assess the success of a few prominent COSS companies. However, comprehensive empirical study consisting of various COSS companies of different size, type, and prominence is lacking. Hence, the aim of this study is to evaluate the success of diverse COSS companies by adapting the DeLone and McLean Updated Information Systems (IS) Success Model. The result indicates that COSS companies’ success is significantly influenced by user satisfaction while the impact of software use on COSS company success is insignificant. Moreover, both software quality and product property positively impact user satisfaction as well as software use.

Keywords: Commercial Open Source Software, company success, DeLone & McLean Model.

I INTRODUCTION
Software can generally be classified as proprietary software, open source software (OSS), and free software (Anand, Tiwari, Krishna, & Sharma, 2018). OSS in turn is divided into two categories of software: community open source software and commercial open source software (COSS) (Shahrivar, Elahi, Hassanzadeh, & Montazer, 2018; Riehle, 2009). Community OSS is a cost-free software offered by foundations or individuals within the OSS-community. In contrast, COSS companies use two distinct strategies. The first strategy is a dual-licensing strategy where the same product is licensed under open source license and commercial license. The second strategy is the open core model which entails open sourcing the core, but closing off the extensions or additional features (Riehle, 2020).

The COSS industry consists of several big and small companies. The top tier alone consists of 42 companies with an estimated market value of 150 billion USD in 2019 (Riehle, 2019). This has attracted multibillion-dollar proprietary software companies such as Facebook, Microsoft and IBM, whose heavy investment in OSS is highly threatening the survival of COSS companies (Daniel, Midha, Bhattacherhjee, & Singh, 2018).

An in-depth review of literature revealed that a COSS companies’ success model is absent (Kamal, Mahoto, & Memon, 2018; Amrollahi, Khansari, & Manian, 2014) indicating the existing knowledge gap. A lack of standard measurements to assess the success of COSS companies is also evident (Mäntylä, Jørgensen, Ralph, & Erdogmus, 2017). Finally, a simple search on google scholar showed that there are around 4 million publications on and around Red Hat, MySQL, and Linux. However, there appear to be no comprehensive studies involving groups of companies. Hence, these research gaps motivated this study to investigate the critical factors that contribute to the success of COSS companies.

The current study adapts the widely applied and validated DeLone and McLean Updated Information Systems (IS) Success Model to the context of COSS companies. An expert-validated tool for assessment of COSS companies’ success is also used. Finally, data is collected from 49 COSS companies of varying sizes, services and products. Thus, the purpose of the study is to evaluate the success of COSS companies.

The rest of the paper is organized as follows: related literature, research design, discussion, implication, and conclusion.

II RELATED LITERATURE
A. COSS Companies
Commercial open source software (COSS) is controlled by a single company, who is responsible for the development of some or all of the source code for the software which it licenses under an open source and commercial version. Additionally, COSS companies generate revenue through complementary products or services (Riehle, 2020).

The societal benefits of OSS development methodology are widely popular among commercial companies, developers, sponsors, and OSS communities. Some of the advantages of OSS development methodology include the ability to utilize the support of the OSS community in providing technical support, test products before release, promotion, and distribution (Riehle, 2009; Deodhar, Saxena, Gupta, & Ruohon, 2012). These advantages, in turn, translate into low development cost, lower distribution cost, higher quality, lower
price offer for the customer, and social welfare (August, Shin, & Tunca, 2017). Thus, COSS companies can offer software products at an affordable price to individuals, SMEs, civic societies, and educational institutions. In recognition of these benefits, several COSS companies have been able to hybridize closed source alongside open source development strategies. They have been able to successfully develop complex systems. On the other hand, many others seem to suffer from lack of clarity and pay the ultimate price (Lokhman, Mikkonen, Hammouda, Kazman, & Chen, 2013). The enormous success enjoyed by pioneers such as Linux, Mozilla, and MySQL have attracted researchers’ attention (Lokhman, Mikkonen, Hammouda, Kazman, & Chen, 2013). Between 2002 and 2017 alone there have been more than 474 published articles in relation to success of OSS and COSS (Gezici et al., 2019), yet the majority of COSS companies face a variety challenges to succeed (Ehls, 2017; Silic & Back, 2015; Ghapanchi and Aurum, 2012; Singh, Tan, and Mookerjee, 2011; Stewart & Maruping, 2006).

COSS company challenges can be broadly categorized into technical and non-technical (project and business management decisions related) (Verner, Sampson, & Cerpa, 2008). Among the major causes of technical problems affecting the COSS companies is vulnerability. The increased adoption of OSS by commercial companies has raised reported cases of vulnerability from 14,000 in 2017 to 16,000 in 2018 (De Villiers, 2019). Closely related to vulnerability is the issue of bugs that forces software programs to deviate from the expected operation (Chen, Shi, Shoga, Wang, & Boehm, 2018).

Bugs claim the lion share accounting for an alarming 81.1-86.7% of all software related problems (Tong, Ying, Hongyan, & Zhonghai, 2016). This is notwithstanding developers committing 45-80% of their valuable development time to bug evaluation and fixing. Often, bug inflicted failures take the form of system failure, malfunction or vulnerability (Akbarinasaji, Caglayan, and Bener, 2018; Zineddine, Alaoui, and Saidou, 2017; Tong, Ying, Hongyan, and Zhonghai, 2016).

Another important technical issue faced by COSS companies is software testing. Insufficient planning and testing of software both during the development and acceptance test phases may have dire consequences (Kaur & Sengupta, 2011). Additionally, maintainability and obsolescence are other issues rendering a software product useless. Maintainability problems may arise from an architectural design decision during initial development, while obsolescence is a result of features, applications or technologies no longer desired by the customer or client. Besides technical problems, COSS companies are affected by non-technical matters such as project abandonment, lack of sustainable participation, documentation problems, and failure to meet the demands of the OSS community (Daniel, Maruping, Cataldo, and Herbsleb, 2018; The Linux Foundation, 2017; Stol & Babar, 2010; Fang & Neufeld, 2009). Another non-technical issue affecting COSS companies is licensing. In some cases, the combination of different licenses is illegal. For instance, the use of GPL v2 in combination with Apache v2 is impossible as the condition of GPL v2 prohibit the mixing of licenses that exhibit stronger conditions (Lokhman, Mikkonen, Hammouda, Kazman, & Chen, 2013).

In addition, COSS companies are affected by quality uncertainty. Due to the availability of a wide variety of similar software products in the market customers are often unable to determine the quality of the product they intend to buy (Stol K. and Babar M.A., 2010; Zaidan et al., 2015). Moreover, software development efforts by COSS company can be influenced by predicaments such as inability to accurately budget, schedule, meet expectations of clients, lack of skills, goal ambiguity and communication problems (Peter as cited in Zahid, Haider, Farooq, Abid, and Ali, 2018). Hence, these problems are worrisome as they may have a detrimental effect on COSS company’s success.

Consequently, technical and non-technical challenges can sometimes be financially devastating. For instance, software development failure has cost US business 30 billion USD in 2010 alone (Kaur & Sengupta, 2011). In 2014 an estimated 77.75 billion dollars were lost to software development failures (The Standish Group Report, 2014). Hence, in order to overcome these challenges associated with COSS company success, evaluating and understanding the critical factors behind successful COSS companies is important.

B. Updated DeLone and McLean IS Success Model

The first DeLone and McLean IS success model was developed in 1992 which was updated a decade later (DeLone & McLean, 2003). Since its development, the DeLone and McLean model (D & M model) has been applied in diverse disciplines and contexts for the past 18 years. For instance, it has been deployed to evaluate the success of expert systems, knowledge management systems, enterprise systems, online shopping, e-commerce, mandated use and vulnerable use of technology, etc. (Jeyaraj, 2020).

However, these are not the only settings D & M model has been used in. Romi (2013), has extended and validated D & M among financial institutions in
Palestine. Similarly, Sharma and Sharma (2019) have applied D & M to evaluate the growing use of mobile banking in Oman. The purpose of their study was to find out customers’ intention to use mobile banking and the associated customer satisfaction (Sharma & Sharma, 2019). Likewise, Rahi and Abd.Ghani (2019) assessed the continuance intention of internet banking users.

Another area of study that D & M has found wide application is the education sector. For instance, Alzahrani, Mahmud, Ramayah, Alfarraj, and Alalwan (2017) have adopted the D & M model for the study of digital library systems among four universities in Malaysia. The goal of their study was to identify the causes or determinants of lower usage of digital libraries in Malaysia. Similarly, Kurt (2019) studied the Italian e-learning system using D & M model. More specifically, his investigation was aimed at evaluating students’ perception of e-learning systems. An earlier study by Freeze, Alshare, Lane, and Wen (2010) has investigated the same theme.

In the telecom sector, Adroni and Sitorus (2017) have studied the success in implementation of Bardix information system in Indonesia by a telecom company called “Telkomsel”. Closely related to the telecom sector, Wang, Tseng, Wang, Shih, and Chan (2019) have examined the success of mobile applications via observing customer loyalty and intention to reuse.

Although not specifically in COSS company settings, D & M model has been used in studies that have evaluated the success of OSS (Lee, Kim, & Gupta, 2009; Lee and Lee, 2012; Gezici, Tarhan, & Chouseinoglou, 2019). Noticeably these studies have adopted the dimensions of the D & M model to OSS context. The dimensions of the updated DeLone and McLean IS success model includes six dimensions: information quality, system quality, service quality, use, user satisfaction, and net benefits developed to assess information systems success (DeLone & McLean, 2003).

Since the D & M model was developed for information systems success, operationalizing the six dimensions to software production and marketing is essential. Consequently, information quality has been adjusted to product property. This is because information quality in the D & M model assumes processing or production of information (Gezici, Tarhan, & Chouseinoglou, 2019). In contrast product property is concerned with launching new software products, developing a complex piece of software, and the ability to add more lines of code (Gezici et al., 2019).

The second dimension, system quality, is also operationalized as software quality, since COSS companies generate revenue through sales, software products, and complementary services (Riehle, 2020). Furthermore, the service quality dimension is conceptualized to include community service (i.e., technical support by the OSS-community) (Lee, Kim, & Gupta, 2009; Gezici, Tarhan, & Chouseinoglou, 2019) and support from the COSS company (Riehle, 2012,2020).

In addition, whereas user satisfaction is observed in terms of ratings, reviews, and customer satisfaction, software use is measured using popularity and number of downloads (Crowston, Annabi, & Howison, 2003; Gezici, Tarhan, & Chouseinoglou, 2019). Finally, the net benefits dimension has been adapted as COSS company success.

Based on the above relationships, the following hypotheses have been developed and the research model is illustrated in Figure 1.

- **H1**: There is a significant positive relationship between product property and software use.
- **H2**: There is a significant relationship between product property and user satisfaction.
- **H3**: There is a significant positive relationship between software quality and software use.
- **H4**: There is a significant positive relationship between software quality and user satisfaction.
- **H5**: There is a significant positive relationship between service quality and software use.
- **H6**: There is a significant positive relationship between service quality and user satisfaction.
- **H7**: There is a significant positive relationship between software use and user satisfaction.
- **H8**: There is a significant positive relationship between software use and COSS company success.
- **H9**: There is a significant positive relationship between user satisfaction and COSS company success.

![Figure 1. Research Model](image-url)
The purpose of the study was to evaluate the success of COSS companies adapting the DeLone and McLean updated IS success model.

A. Sample Population and Data Collection
The research model was tested by means of data gathered through survey sent to 3,750 randomly selected software development experts and users working in 49 COSS companies. Furthermore, the required sample size was determined by G*Power analysis. Accordingly, a minimum sample size of 176 respondents is required setting statistical power at 95%, effect size at 10%, error probability at 5%, and using 3 predictors (i.e., product property, software quality, and service quality). Thus, a total of 194 valid questionnaires were used for statistical analysis.

Out of the total of 194 respondents 65% have 6 or more years of experience, 32% have 1-5 years of experience, while the remaining 3% have less than 1 year of experience in software development. With respect to roles assumed while working in the present and past jobs 80% have participated in coding, 68% have taken part in software design, 49% have taken part in software requirements, 41% are engaged in software improvement process as well as software testing and integration, 34% have been involved in version management, yet another 24% have taken part in software quality assurance and users.

Finally, the skewness and kurtosis are not close to zero meaning data is not normally distributed. Thus, a nonparametric test is recommended. Among nonparametric tests, partial least square structural equation modeling (PLS SEM) is the most robust statistical tool. Consequently, the study utilizes PLS SEM multivariate analysis tool (Hair, Hult, Ringle, & Sarstedt, 2017). More specifically, a two-stage approach of structural equation modelling using SmartPLS 3.0 is adopted. The two-stage approach as the name implies involves two phases. In the initial stage the measurement model will be assessed. Followed by the evaluation of structural model in the second stage (Sarstedt, Hair, Cheah, Becker, & Ringle, 2019).

Table 1. Mardia’s Multivariate Skewness and Kurtosis

<table>
<thead>
<tr>
<th></th>
<th>b</th>
<th>z</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
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<td>0</td>
</tr>
<tr>
<td>Kurtosis</td>
<td>75.2073</td>
<td>19.33841</td>
<td>0</td>
</tr>
</tbody>
</table>

In contrast, H1, H2, H3, H4, H7, and H9 are all supported and the results are consistent with previous studies (e.g., Lee & Lee, 2012; Romi, 2013; Nugroho & Prasetya, 2018). In addition, the research model explains 35% of the variability in COSS company success, 32.9% in software use, and 44.3% in user satisfaction. This can be considered a good result as compared to Lee, Kim, and Gupta’s (2009) 28% for OSS use and 54% for user satisfaction. Lastly, model relevance assessment revealed Q=0.21 and PLS-predict 71% is interpreted as having medium predictive power (Shmueli et al., 2019). Hence, the adaption of DeLone and McLean Model in the current context was justified.

V IMPLICATIONS
Observing the total effect for the target variable, company success, would allow the examination of the result in a more sensible manner (Hair, Hult, Ringle, & Sarstedt, 2017). Accordingly, COSS company success is strongly influenced by user satisfaction (0.55), followed by software quality (0.26), product property (0.17), software use (0.15), and service quality (0.09). Therefore, COSS companies may need to give priority to the enhancement of user satisfaction by paying more...
attention to customer reviews and ratings, customer needs for features’ enhancement, and software bug reports.

Secondly, internal quality assurance alone may not impact company success. Consequently, higher quality value propositions to customers should be supported with an effective and efficient marketing strategy such as word-of-mouth (WOM) marketing (Riehle, 2020). Thirdly, frequently launching new complex software products excites customers. Hence, COSS companies may opt to not only use rapid release cycles but also swiftly handle issues and fix bugs that may cause customer dissatisfaction (Costa, McIntosh, Kulesza, & Hassan, 2016). This also has implications to the improvement and promotion of software use. Finally, service quality can be enhanced through the provision of suitable support tools such as forums, wikis, documentation and self-help materials (Riehle, 2020).

VI CONCLUSION

The main aim of this study was to evaluate the success of COSS companies by adapting the updated DeLone and McLean Information Systems (IS) Success model. A review of previous studies revealed that a success model for assessing COSS companies is not yet available. Moreover, past studies have focused on the success of very few prominent COSS companies individually, instead of a more robust empirical study of a group of companies. Hence, a comprehensive empirical study incorporating 49 COSS companies of variable sizes, types, and prominence were analyzed. The result showed that product property, software quality, and user satisfaction significantly affect COSS company success, while service quality seems to have a partial influence. Additionally, the adaption of the updated DeLone and McLean Information Systems (IS) Success model is encouraging since all Q-value, Q-predict, and RMSE values demonstrate medium predictive relevance and predictive power. Finally, the findings advocate enhancement of user satisfaction, improvement of software quality efforts, rapid release, and prompt handling of issues and bugs.

VII LIMITATION AND FUTURE RESEARCH

Although the study contributes towards the application of the updated DeLone and McLean Information Systems (IS) Success model to a unique set of COSS companies that use a hybrid business model, it has some shortcomings that could be useful inputs for future research. First, the current study uses a quantitative survey; therefore, future studies could use a qualitative study to gain a deeper understanding of the diversity of COSS company success. Second, using a cross-sectional survey may not capture causality very well, hence a longitudinal study would further validate the use of the updated DeLone and McLean Information Systems (IS) Success model in the context of COSS companies.

REFERENCES


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Trust, Commitment, Motivation and Knowledge Sharing Behaviour Among Business Service Professionals

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ABSTRACT
Professional employees in the business service organizations are important resources when they share their knowledge. In the pursuit to leverage on employees’ knowledge and in supporting knowledge sharing, business service organizations are using knowledge management system’s platform. Although knowledge management systems are vital, the reality in the actual implementations have shown that technology could not be assured that knowledge would be shared. Professional employees have option in sharing their individual intelligent knowledge. There are many determinants of knowledge sharing behaviour. Thus, an objective of the study was to search for the determinants for knowledge sharing behaviour of professional employees in the business service organizations. The sampling unit of this research are professional employees working in business service sector within the context of Malaysia National Key Economic Area” (NKEA). The collection of the primary data was through the questionnaires that stratified chosen from the sampling. The survey findings are analysed using the SPSS and SMART PLS. Knowledge sharing behaviour was predicted by professional employees of the business service organizations’ on the intention of their knowledge sharing. Thus, the intention was predicted by professional employees of the business service organizations perceived behavioural control, subjective norms and attitude. The professional employees of business service organizations perceptions of motivation and commitment were positively associated with favourable intention towards knowledge sharing. Alternately, different results indicated insignificant relationships.

Keywords: Knowledge sharing, trust, motivation, commitment, business service.

I INTRODUCTION
With the emerging megatrend of industry 4.0, the global economic landscape is changing rapidly, presenting both opportunities and challenges. Opportunities appear for those with better knowledge exploitation and challenges await those with uncertainty. Assuming that knowledge is an important element for organization to stay competitive in business lies within their professional employees. The failure to manage professional employees’ knowledge, accordingly, would lead to less competitiveness and disadvantage to the company. With the advancement of technology such as the so called Fourth Industrial Revolution, emergence of digital knowledge-based economy, and dynamic business environment, knowledge management is still regarded as one of the strategic tools for business sustainability. Organizations incorporate knowledge management into their professional employees and practices to differentiate their services, existence and gain competitive edge.

There are barriers and challenges for organizations to implement and maintain all knowledge management initiatives and practices effectively. In getting better outcome, organizations would strategically facilitate knowledge sharing framework among professional employees. The likelihood of retaining the knowledge shared for later use in the organization by professional employees must be accomplished if they are willing to share and must take place before they leave for good (Abdelwhab, et al., 2019; Becerra-Fernandez, & Sabherwal, 2014). However, for the tacit knowledge from the individual intelligence, the success is difficult to be predicted. There could be other way to encourage knowledge sharing to happen between the individuals through another context. Many researchers have tried to identify for constructs that could determine indirect ways for knowledge sharing to occur among individuals (Chennamaneni & Teng, 2012; Hooff & Ridder, 2004; Nguyen et al., 2019; Ozlati, 2012; Samadi, 2015; Tohidinia & Mosakhan, 2010). Therefore, organizations are still striving and pushing very hard to engage knowledge sharing among professional employees to happen voluntarily (Abdelwhab, 2019; Lekhawipat, 2018; Wang & Hou, 2015; Youssef et al., 2017). To understand of what would determine any individual to engage towards knowledge sharing behaviour need to be investigated further (Chennamaneni, 2006; Gillani et al., 2018; Nguyen, Nham, & Hoang, 2019; Lee & Hong, 2014).

Furthermore, the role of individual’s knowledge sharing in business service sector contributes towards
the business decision making, business planning for strategic business direction, and repelling against business competition among others should also be recognized as well (Dayan et al., 2017; Gupta, 2018; Razak et al., 2016). Furthermore, the perimeter within the Malaysia business service sector, are looking for findings of what determines knowledge sharing behaviours has been neglected as limited published research paper can be found in the scholar databases (Abdelwhab et al., 2019; Fathi, 2011; Jain, 2015; Razak, 2016; Tangaraja et al., 2015; Safa & Von Solms, 2016; Teh & Sun, 2012; Yi & Jayasingam, 2012).

II LITERATURE REVIEW

The scope of knowledge within organizations included the nature of knowledge and the activity of knowledge being shared (Ipe, 2003). Knowledge sharing itself is the agreeable to exchange and creating the newly knowledge (Hooff & Ridder, 2004). What were discussed by both Hooff and Ridder (2004), knowledge sharing is a two-direction activity where knowledge interchange between individuals involving giving or “donating” and receiving or “collecting”. It would involve interaction between individuals to achieve the same strategic goals (Boland & Tenkasi, 1995).

There are number of factors that could influence knowledge sharing behaviour. The attitude, subjective norms and perceived behavioural control of a person mediates the knowledge sharing intention (Mafabi, et al., 2017; Samadi, 2015). Other factors such as trust (Casimir et al., 2012; Yoo et al., 2018), commitment (Curtis & Taylor, 2018; Hashim & Tan, 2015) and motivation (Law et al., 2017; Rajput & Talan, 2017) would have influence towards knowledge sharing. However, common research was merely on factors that influence the knowledge sharing especially on the surroundings or contextual factors that affect the knowledge sharing behaviour of a person (Akhavan et al., 2013; Nguyen et al., 2019).

This research is to examine the influence of the above-mentioned factors on the knowledge sharing behaviour of individuals who are working in the business service sector in Malaysia. Davenport and Prusak (1998) supported that a trust is vital in the process of knowledge sharing. This research zoomed into the individual of trust only, the trust that exists connecting colleagues in the organization. As trust is important in social communication than in economic communication (Bartol & Srivastava, 2002; Mariotti, 2011), trust can therefore lead thorough the knowledge sharing with others is a social communication (Montoro-Sánchez et al., 2011; Soliman & Spooner, 2000). The challenge in knowledge sharing is to encourage an individual’s insight to involve in knowledge sharing behaviour or motivation. Fishbein & Ajzen, (1975) mentioned that motivation is the main layer for individual behaviour in the Theory of Reasoned Action (TRA).

Self-determination theory (SDT) is as an established theory of motivation and has been generally embraced to research where specific individual conduct is prompted (Deci, Ryan, & Koestner, 1999; Deci & Ryan, 1985). SDT suggests that individual practices might be empowered either by remotely prompted impetuses, called controlled inspiration, yet additionally by inside evoked motivators, known as self-governing inspiration. SDT demonstrates that self-sufficiency arranged inspirations have moderately more elevated levels of value than control-situatned inspirations regarding encouraging a specific conduct (Wang et al., 2015). Another issue that organizations needs to tackle is that when individuals refuse of sharing their intelligent knowledge among others. The employee’s acceptance towards their organizations and other co-workers are basic determinant of knowledge sharing (Soliman & Spooner, 2000) just like an apparent expense of the shared individual knowledge. Individuals would reckon their valuable time, energy, and loss of expert power that hinder them to commit with other employees. Knowledge sharing needs peoples’ willingness to work together within the organizations (Casimir et al., 2012; Curtis & Taylor, 2018) on the grounds that rejection of knowledge sharing may bring about wrong information, lack to complete reports, late responses to customers, and the worst cases, falsification, viral shared.

In any case, taking into account that knowledge is an individual who has unlimited authority, the choice on whether to share knowledge subsequently is dependent upon an assessment of the expenses and advantage (Cabrera and Cabrera, 2005). Individuals may find that the expense of knowledge shared exceeds the potential advantages for doing as such. As the apparent expense of knowledge sharing incline, the probability that knowledge will be shared voluntarily should therefore decline. Individuals’ commitment to share knowledge with others would determine actual knowledge sharing behaviour occurs. It acts as a mediator to continuous knowledge sharing behaviour (Hashim & Tan, 2015). Commitment mediates the connection of participation within individuals by enhancing other feelings of liking and bonding with other employees that lead to ever lasting relationships (Wu et al., 2010). According to Goo & Huang (2008), commitment is a vital mediating factor that influences relationship consistency as strong commitment can decrease high turnover and establish
stable relationships. As it is explained earlier, some theories have been used to support the Conceptual Framework.

A. Conceptual Framework

![Figure 1. Conceptual Framework of Knowledge Sharing Behaviour among Business Service Professionals.]

B. Hypotheses

H1: An individual’s attitude towards knowledge sharing has a positive and significant relationship on the intention to share knowledge.

H2: An individual’s subjective norms towards knowledge sharing have a positive and significant relationship on the intention to share knowledge.

H3: An individual’s perceived behaviour control towards knowledge sharing has a positive and significant relationship on the intention to share knowledge.

H4: An individual’s intention to share knowledge has a positive and significant relationship on the individual’s knowledge-sharing behaviour.

H5: An individual’s attitude over knowledge sharing intention has a positive relationship on the individual’s knowledge-sharing behaviour.

H6: An individual’s subjective norms over knowledge sharing intention has a positive relationship on the individual’s knowledge-sharing behaviour.

H7: An individual’s perceived behaviour control over knowledge sharing intention has a positive relationship on the individual’s knowledge-sharing behaviour.

H8: Trust has a significant mediating effect on the relationship between individual’s intention to share knowledge and the individual’s knowledge-sharing behaviour.

H9: Motivation has a significant mediating effect on the relationship between individual’s intention to share knowledge and the individual’s knowledge-sharing behaviour.

H10: Commitment has a significant mediating effect on the relationship between individual’s intention to share knowledge and the individual’s knowledge-sharing behaviour.

H11: The demographics’ factors have a significant moderating effect on the relationship between individual’s intention to share knowledge and the individual’s knowledge-sharing behaviour.

III METHODOLOGY

The conducted study was to investigate the determinants of knowledge sharing behaviour among individual professionals working at the business service sector in Malaysia. The unit of analysis of this study was the business service professional employees in Malaysia. The stratified sampling was used. The questionnaires used a 5-point Likert scale.

IV FINDINGS

Out of 600 questionnaires distributed, 378 were received back, yielding the return rate of 63%. From 378, only 373 were further processed. An analysis of the respondent profile showed that male participants made up of 50.7% of the total participants. Most of the participants (78.7%) had 6 to 20 years of working experience. All the respondents in this study were diploma up to PhD holders.

An internal consistency reliability, rho_A, CR, AVE, and VIF of the research measures are reported in Table 1.

In essence, the findings in Table 1, it shows that the outer model variables which are measured by indicators on each. All the values of the variables after analysing are all reliable since the loading results are fully met the requirement in which the values of variables are more than 0.5.

Table 1. Reliability of Construct.

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<th>CR</th>
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Source: Generated from SmartPLS version 3
Table 2 shows the Construct Correlations where for all the individual construct’s square root AVE value, it was showed that all are above 0.5. This has proved that all the variables’ divergent validity is achieved. By comparing the other constructs of their square root value, the table showed that all variables have a greater value. In a nutshell, the requirements for the Partial Test Least Square Models with Outer size (Measurement Model) are all achieved in this research.

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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Motivation</td>
<td>0.781</td>
<td>0.708</td>
<td>0.643</td>
<td>0.630</td>
<td>0.518</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>PCB</td>
<td>0.636</td>
<td>0.664</td>
<td>0.748</td>
<td>0.474</td>
<td>0.786</td>
<td>0.681</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Subj. Norms</td>
<td>0.618</td>
<td>0.574</td>
<td>0.726</td>
<td>0.488</td>
<td>0.597</td>
<td>0.654</td>
<td>0.721</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Trust</td>
<td>0.412</td>
<td>0.517</td>
<td>0.550</td>
<td>0.340</td>
<td>0.507</td>
<td>0.559</td>
<td>0.481</td>
<td>0.764</td>
</tr>
</tbody>
</table>

Source: Data processing from Smart PLS (2018)

According to Hair et al. (2017), there is a requirement for the discriminant validity assessment to make sure that there are strongest relationships between the reflective construct and its own indicators. For example, the comparison between the reflective construct with any other construct in the PLS path model. The journal authors have stated that the discriminant validity is likely to have existed among the two scales if the HTMT result is less than 0.85 while if the two constructs overlap largely, the HTMT result is greater than 0.85 and it indicates that they are probably measuring the same thing (Campbell & Fiske, 1959).

<table>
<thead>
<tr>
<th>No</th>
<th>Variables</th>
<th>ATT</th>
<th>COM</th>
<th>INT</th>
<th>KSB</th>
<th>MOT</th>
<th>PCB</th>
<th>SVN</th>
<th>TRU</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Attitude</td>
<td>0.624</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Commitment</td>
<td>0.637</td>
<td>0.632</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Intention</td>
<td>0.692</td>
<td>0.520</td>
<td>0.691</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>KSB</td>
<td>0.637</td>
<td>0.520</td>
<td>0.691</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Motivation</td>
<td>0.702</td>
<td>0.708</td>
<td>0.630</td>
<td>0.600</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>PCB</td>
<td>0.635</td>
<td>0.661</td>
<td>0.745</td>
<td>0.474</td>
<td>0.789</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Subj. Norms</td>
<td>0.435</td>
<td>0.569</td>
<td>0.719</td>
<td>0.488</td>
<td>0.594</td>
<td>0.653</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Trust</td>
<td>0.411</td>
<td>0.520</td>
<td>0.554</td>
<td>0.393</td>
<td>0.512</td>
<td>0.551</td>
<td>0.474</td>
<td></td>
</tr>
</tbody>
</table>

Source: Data processing from Smart PLS (2019)

Based on Table 3, it shows that all the constructs are lower than 0.85 clearly. So, this can be concluded by the researcher by showing that the discriminant validity exists among all the constructs. In other meaning, it means that there are no overlapping items appeared in respondents' perception in the affected constructs whereby it proved that the items inside the constructs mostly are not measuring the same thing (Henseler, Hubona, & Ray, 2016).

From the Figure 2, it shows the overall structural

V CONCLUSION

This study tested eleven (11) hypotheses. It also developed a new knowledge sharing behaviour framework. In addition to the current framework, it has included trust, commitment and motivation that related to knowledge sharing behaviour amongst business service professional. There is a relationship between attitude, subjective norms, perceived behavioural control, intention, motivation, commitment and trust, factor that are influencing on knowledge sharing behaviour among individual employees of Malaysian business service professional.

REFERENCES


Students’ Acceptance of Automated Essay Scorer: Reflection on an Initiative to Mitigate Disruption to Writing Lessons during Pandemic

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ABSTRACT

Automated Writing Evaluation (AWE) is an innovation in the field of language teaching and learning with features like portfolio and writing assistant resources has become a useful alternative to support language assessment processes during the pandemic. Like many artificial intelligence-based tools, there is always concern on scoring accuracy, reliability, and acceptance by users. This paper aims to explore language learners’ experience in using an AWE called PaperRater (PR) available from the internet. Data was elicited via a questionnaire designed based on the Technology Acceptance Model (TAM) and it focuses on six variables of acceptance namely perceived usefulness, perceived ease of use, user satisfaction, usability, user behaviour and user profiles. Rasch model and descriptive statistical analysis were used in analysing responses from 62 undergraduates. The respondents are found to have a positive level of acceptance towards the use of AWE as depicted by the -1.21 to 2.07 Rasch logit unit. This tool is also perceived to be beneficial for formative learning purposes via students’ self-assessment, in the absence of educators in physical classes and limited online access to educators during this pandemic.

Keywords: AWE, TAM, writing assessment.

I  INTRODUCTION

Writing tasks are varied in both complexity and purpose, with many elements that encompass the writing process (Roscoe & McNamara, 2013). Being the end user of the technology, most language instructors’ objective of incorporating automated rating or scoring tools for writing (henceforth AES) in the classroom is none other than to ease and expedite the assessment of their learners’ essay apart from taking advantage of the AES which could also become a tool to increase learners’ motivation in writing. Reilly et al. (2014) in their study of comparing instructors’ grading and AES-holistic scores in MOOC courses have found that AES is still found to be useful in the teaching and learning process of writing. Chapelle and Douglas (2006) believe that computerized teaching tools and technologies should be effective aids in language classrooms. This could be seen from the literature and the results of the statistical analysis of user perception on an AES tool in this study.

II  STATEMENT OF THE PROBLEM

Whenever an automated scoring tool is utilized, its reliability should be taken into careful consideration (Warschauer and Grimes, 2008). Shin (2012) stresses that even though web-based language testing may “enhance test authenticity and reliability by making possible a rich contextualized input, various response formats, and automated scoring”, there has still been very little study conducted to investigate whether online testing can actually work in writing classroom (p.277).

III  RELEVANT LITERATURE

Many researchers studied the use of AES in language lessons and identified their potential as well as room for improvement. Peterson (2017), in his study on students at two suburban high schools elicited data on student perceptions of feedback pre- and post-intervention and computer-generated percentile rankings of students’ writing skills. The findings indicated that computer-generated feedback increased students’ writing efficacy and inclination to revise writing. A study by Nguyen (2017) indicates that the reliability of PaperRater is acceptable and that writing teachers can somehow rely on the functions of this tool as a reference in grading papers.

An appropriate combination of traditional and computerized grading methods can generate effectiveness, especially in large classrooms or with a great number of papers. The tandem integration of language instructor roles and the use of AES for future writing teaching practice has also been propagated by a few researchers with a few recommendations and highlights on pedagogical impacts. Due to this teaching innovation still being at an early evolving stage there are limited studies being carried out. Yinghui and Dan (2015), it is recommended that language instructors opt for conventional teaching of writing along with AES to evaluate students’ writing tasks. They found that such a strategy is applicable for classes with a high number of students or for teachers handling a large number of learners and especially in the context of countries like China. This strategy will enable two means of feedback for students’ writings and could be based on students’ learning levels and teachers’ actual needs.
As such AES or AWEs have both merits and drawbacks. This is discovered by Pei-Ling (2015) where approximately two-thirds of her study participants perceived that the integration of machine scoring with language instructors’ input became the recommended implementation method for writing classes.

### IV METHODOLOGY

This study applied purposive sampling techniques where the samples are undergraduate respondents enrolled in a compulsory academic writing course at a public university. The students were briefed on PaperRater on how to use it as well as the benefits that they can gain. Besides, the respondents will also be briefed on how to monitor their own improvement in writing skills based on the report generated by PaperRater. Respondents will be experimenting with PaperRater at their own will in a duration of two weeks. It is important to stress here that the use of PaperRater is encouraged among the respondent but was not made compulsory. However, both lecturers did inform the students that they are welcome to discuss matters regarding their essay and issues regarding the use of PaperRater if they want to during their meetings with the instructor.

For data elicitation, a questionnaire was designed based on TAM with 6 sections representing aspects such as Demographic Information, Perceived Usefulness, Perceived Ease of Use, User Satisfaction, Usability and General Question. A four-point Likert Scale comprising Strongly Disagree, Disagree, Agree and Strongly Agree was employed. The reliability of this tool is validated through Rasch Model Analysis using Winstep 3.72.3 for internal consistency reliability. According to Abdul Aziz (2010), reliability of a questionnaire is verified via Cronbach alpha (α) value, person and item reliability value, person measure and valid responses. Generally Cronbach alpha value for reliability should range from 0.67 to 1.00 which indicates poor up to excellent value (Fisher, 2007). Higher Cronbach alpha value indicates stronger relationship between the questionnaire items.

In Rasch Model, this value is explained by Kuder-Richardson (KR-20) and coefficient alpha value (Cronbach, 1984). Through the analysis, the instrument in this study indicates the Cronbach alpha value of 0.93 putting it to be in the ‘Very Good’ category as determined by Fisher (2007). Other reliability indicators include Person Reliability = 0.87, Person separation index = 2.64, Item reliability = 0.88 and Item separation index = 2.68.

### V FINDINGS

Basically, the 62 undergraduate respondents made up of 25 males and 37 females from four faculties enrolled in two groups for an academic writing course at a public university. The data was tabulated by describing the respondents’ response pattern in all the sections of the questionnaire (Section A to D).

The items per section are listed based on their difficulty level (the most difficult to the easiest) as per Rasch Model Analysis where the higher the position of the item in the Person Item Map (PIM) the more difficult the item is to be endorsed. The results of the additional questions attached to the questionnaire (Section E) were also discussed.

#### A. Perceived Usefulness

This section is to define the degree to which students believe that PaperRater is able to improve their writing skills. Perceived usefulness of PaperRater in the questionnaire is represented by 5 items.

<table>
<thead>
<tr>
<th>SECTION A: Perceived Usefulness</th>
<th>Positive Responses</th>
<th>Logit Value (Rasch)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A3 PaperRater is useful for rapid retrieval of assessment of my essay.</td>
<td>95.1%</td>
<td>-0.21</td>
</tr>
<tr>
<td>A4 PaperRater will save the time of lecturers and writers.</td>
<td>88.7%</td>
<td>-0.21</td>
</tr>
<tr>
<td>A5 Using PaperRater would improve my writing performance.</td>
<td>91.9%</td>
<td>-0.28</td>
</tr>
<tr>
<td>A1 PaperRater enables me to get the assessment/score of my writing quickly.</td>
<td>95.1%</td>
<td>-0.61</td>
</tr>
<tr>
<td>A2 PaperRater allows me to follow up with the errors and weaknesses of my essay anytime and anywhere.</td>
<td>95.1%</td>
<td>-1.21</td>
</tr>
</tbody>
</table>

#### B. Perceived Ease of Use

Section B of the questionnaire focuses on the students’ perceived ease of using PaperRater in improving their writing skills. This section is represented by 5 items.
Table 2. Perceived Ease of Use.

<table>
<thead>
<tr>
<th>SECTION B : Perceived Ease of Use PaperRater(PR)</th>
<th>Positive Response</th>
<th>Logit Value (Rasch)</th>
</tr>
</thead>
<tbody>
<tr>
<td>B5 It is easy for me to become skillful at using PR to benefit my writing.</td>
<td>90.4%</td>
<td>+0.48</td>
</tr>
<tr>
<td>B4 I find PaperRater flexible to interact with.</td>
<td>91.9%</td>
<td>+0.20</td>
</tr>
<tr>
<td>B1 Learning to operate PaperRater is easy for me.</td>
<td>96.8%</td>
<td>-0.28</td>
</tr>
<tr>
<td>B2 I find it easy to get the benefit of using PR.</td>
<td>96.7%</td>
<td>-0.28</td>
</tr>
<tr>
<td>B3 I can easily understand the report generated by PaperRater to improve my writing.</td>
<td>98.4%</td>
<td>-0.34</td>
</tr>
</tbody>
</table>

C. User Satisfaction
User satisfaction is another construct based on TAM included in the questionnaire. This section is used to measure students’ satisfaction in using PaperRater in assisting and improving their writing skills.

Table 3. User Satisfaction.

<table>
<thead>
<tr>
<th>SECTION C : User Satisfaction</th>
<th>Positive Response</th>
<th>Logit Value (Rasch)</th>
</tr>
</thead>
<tbody>
<tr>
<td>C5 I believe that using PaperRater will increase the quality of my writing.</td>
<td>93.6%</td>
<td>-0.15</td>
</tr>
<tr>
<td>C4 I can accomplish writing tasks quickly using PaperRater.</td>
<td>95.1%</td>
<td>-0.21</td>
</tr>
<tr>
<td>C1 I am completely satisfied using PaperRater.</td>
<td>93.6%</td>
<td>-0.28</td>
</tr>
<tr>
<td>C2 I feel very confident in using PaperRater.</td>
<td>95.2%</td>
<td>-0.34</td>
</tr>
<tr>
<td>C3 I found it easy to share information about my writing assessment using PaperRater.</td>
<td>98.4%</td>
<td>-0.54</td>
</tr>
</tbody>
</table>

D. Usability
Usability is a construct to which students’ responses to the items are gathered to reflect how they are able to utilize the elements of PaperRater in effort to improve their writing skills. This construct is represented by 4 items.

Table 4. Perceived Usability.

<table>
<thead>
<tr>
<th>SECTION D : Usability</th>
<th>Positive Response</th>
<th>Logit Value (Rasch)</th>
</tr>
</thead>
<tbody>
<tr>
<td>D1 It is easy to follow the suggestions/report of PaperRater.</td>
<td>96.8%</td>
<td>-0.28</td>
</tr>
<tr>
<td>D3 I found the report in PaperRater to be comprehensive and able to guide me in improving my writing.</td>
<td>93.6%</td>
<td>-0.34</td>
</tr>
<tr>
<td>D4 I will use PaperRater in my next writing assignment.</td>
<td>95.2%</td>
<td>-0.34</td>
</tr>
<tr>
<td>D2 By using PaperRater, I can easily identify the areas of my writing that need to be improved.</td>
<td>95.1%</td>
<td>-0.61</td>
</tr>
</tbody>
</table>

E. General Question
A number of general questions were also included. Here, in terms of frequency of submission to PaperRater, it was found that 17.7% submitted once, 41.9% submitted twice, 12.9% submitted three times and 27.4% submitted more than 3 times. Other findings reveal that 66.2% are reluctant to share their scores with friends (logit +1.39). Furthermore, the students generally did not agree if PaperRater is used to score essays in final examination (logit +2.07) and they also found it difficult to use PaperRater through their smartphone.

F. Profiling of Respondents
Profiling of the respondents was made based on their responses in the questionnaire. In the Rasch Model, there is a specific formula to calculate the strata value based on the person separation index (2.64). Therefore, the calculation is as (2.64 x 4 + 1 ÷ 3 = 3.85). This means the respondents can be divided into 3.85 or 4 groups based on their patterns of response in the questionnaire. These 4 groups are labelled as ‘Extremely Receptive’ (16 or 25.8%), ‘Very Receptive’ (18 or 29.03%), ‘Receptive’ (26 or 41.9%) and ‘Resistant’ (2 or 3.2%). Overall, majority of the respondents or 96.7% showed that they are receptive of the idea of using PaperRater as a tool in improving their writing skills. However, their acceptance level varied...
based on their endorsement of items in the questionnaire. These differences have categorized them into 3 different categories as described earlier. Additional information on the profiling is tabulated in the table below:

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extremely Receptive</td>
<td>16</td>
<td>5</td>
<td>11</td>
</tr>
<tr>
<td>Very Receptive</td>
<td>18</td>
<td>7</td>
<td>11</td>
</tr>
<tr>
<td>Receptive</td>
<td>26</td>
<td>12</td>
<td>14</td>
</tr>
<tr>
<td>Resistant</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

G. Instructors' feedback

Generally, the instructors are quite satisfied with the acceptance of the use of PaperRater among their students. Those who used PaperRater were found to be more aware of their mistakes and sections of their essay that need to be upgraded, improved or even corrected based on the report generated from PaperRater. They are seen to have a better control of their own work, more independent and motivated. The instant feedback received by the students from PaperRater, its consistent report and grading were able to provide the students with a sense of direction in their learning and on the instructors’ side, an “extra pair of eyes” assisting them with instant feedback on numbers of drafts submitted even though the final grading of the assessment is still done by the instructors themselves.

VI DISCUSSION

Data from this study suggests that PaperRater is reliable, easy and practical to use by both teachers and students. It has the potential to develop a sense of autonomy within language learners and is generally beneficial to students. As such, PaperRater is a good alternative to support lessons in academic writing courses during pandemic. Such automated tool is able to mimic the classroom assistance offered by language instructors where sometimes students might need to ask for feedback to ensure that they are making good progress and confidently proceed with more writing tasks (Likkel, 2012). In fact, the latest version comes together with a plagiarism checker. This makes PaperRater really suitable for tertiary students as good writing processes and originality are aspects emphasized in academic writing courses at universities. The reliability and consistency in grading by the PaperRater compared to human rater were proven through the work by Nguyen (2017) where it was recommended to be used by writing instructors especially those who are dealing with large classes. Similar claims were made by Manap, et al. (2019) where they found a moderate positive linear relationship between PaperRater and a group of language instructors in grading of written works of the students.

The use of such automated tools like PaperRater becomes more handy during Covid-19 pandemic due to closure of campuses, movement controls and lockdowns. Apart from relying on online interaction with lecturers, tertiary students can now develop learner autonomy by using tools like PaperRater. Sing et al. (2016) believe that AES is also good to be used in tandem by lecturers as physical raters of writing and by students such as for self-study, formative assessment and assessment for learning purposes.

VII CONCLUSION

The use of automated rater tools in language teaching and learning is still not that widespread in Malaysia based on the dearth of literature on such innovative practice. This form of digital technology integration has become timely and highly necessary as a measure to mitigate the disruptions to previous traditional routines of teaching and learning brought about by Covid-19 pandemic. This study has shed light on the reliability and benefits of using PaperRater as vouched by the undergraduates and the language instructors for the academic writing courses. It is able to effectively fulfill functions as an artificial intelligence-based tool that facilitates rating processes, fosters independence learning and guides learners to improve as writers.

REFERENCES


An Image-based Fall Detection System using You Only Look Once (YOLO) Algorithm to Monitor Elders’ Fall Events

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ABSTRACT
Fall is one of the primary causes of fatal as well as non-fatal injuries in the elderly community. The falls in the elderly may cause different consequences and in serious cases, it may cause death. Timely treatment is critical where immediate treatment may reduce the risk of serious injuries. The detection should be taken out in an automated way and detect fall events accurately. This paper presented the image-based fall detection system which integrated the YOLO object detection algorithm with the Image-based Fall Detection system algorithm in detecting fall events. The system will first get track of the person in the video frame with the object detection algorithm and the fall detection algorithm will be used to get track of the person’s height and to detect fall events immediately and accurately to notify the caregivers. The system was evaluated with different use cases and conditions. The result shows the system can detect fall events with the accuracy of 92% under the daylight condition and 60% under the low light condition. An email notification will be sent as an alarm to notify the caregivers when any fall events were detected by the system. The quick fall detection and notification of system able to ensure the safety of the elderly were well monitored and timely treatment can take place when fall events were detected by the system.

Keywords: Fall Detection, You Only Look Once, Image-based fall detection, Object-based detection.

I INTRODUCTION
Fall is one of the main life-threaten factors for humans, especially the elderly who live alone. It is caused by the inability of their muscle to support and balance their body due to the aging process. Fall events may cause serious injuries especially in the elderly community and some may be fatal. Several fall prevention solutions had been deployed by different manufactures and industries, but they are still some falls that are unpreventable. Following a fall event, immediate help and treatment are extremely critical. Therefore, fall should be noticed immediately to prevent life-threatening risk (Milat et al., 2011). The outcomes of fall events are far beyond physical injuries as they may also lead to psychological, medical, and social consequences (El-Bendary et al., 2013).

Currently, the improvement of healthcare technology had led to an increase in the average life expectancy of the world population to 80 years old (OECD, 2011). In other words, the percentage of the population with disabilities also growth linearly as people grow older (Iliev et al., 2011). Therefore, due to aging problems, falling events in the elderly increase dramatically. Based on the Public Health Agency of Canada, 12.5% of the population was 65 years old and above in 2001. In the year 2026, the percentage of elderly in the population estimated to increase to 20% (Rougier et al., 2006). The risk of falling for the elderly with age around 65 years old had increased because of the loss of nutrition in their body. Based on the study by Auvinet et al. (2011) and Tinetti (2003), each year, 30% of the elderly community experience a fall event, and half of them fall repeatedly. Immediate aid and treatment are critical and important. Fall without timely treatment could be fatal. To resolve that, fall events should be detected as soon as possible to provide timely treatment for the patient. The immediate treatment could be life rescue for the elderly (Yu, 2008). Therefore, detection of fall events is important for the elderly and people who care for them.

This project aims in developing an automated image-based fall detection system utilizing the YOLOv3 algorithm that can help monitor elderly activity. The fall events will be detected and notified upon detection. Our project proposed to integrate the YOLOv3 object detection algorithm with the IFADS fall detection algorithm to achieve low cost, high accuracy, and real-time computing requirements.

II RELATED WORKS
There are few methods to detect fall events as depicted in Table 1. The wearable device method is impractical for the elderly due to the need for frequent battery and sensor replacement as well as other maintenance work. Besides, the elderly is more likely to be forgetful to wear the device. While the environmental sensor-based method is impractical and not recommended due to the high cost in implementation and maintenance.
Table 1. Different methods for fall detection

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
<th>Draw-back</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wearable device method</td>
<td>Utilize sensors (i.e., accelerometers, posture sensors) to detect the activity of the users’ body (e.g., wrist band) (Estudillo-Valderama et al., 2009; Doukas et al., 2007)</td>
<td></td>
</tr>
<tr>
<td>Environmental sensor or ambient device method</td>
<td>Detect fall by applying environmental sensors such as pressure sensors and radar sensors (Feng et al., 2016)</td>
<td></td>
</tr>
<tr>
<td>Image-based methods</td>
<td>Employing real-time video images and image processing technology to get track of human’s activities. (Lu &amp; Chu, 2018)</td>
<td></td>
</tr>
<tr>
<td>Posture recognition with surveillance camera</td>
<td>Using the greatest number of moving pixels in the video or images to track a moving person, integrated with the application of posture recognition and classification to classify the fall event (Yu et al., 2012)</td>
<td>False alarm when lying down</td>
</tr>
<tr>
<td>Mathematical formulation</td>
<td>Adopting the calculation of aspect ratio and orientation of the person in detecting fall events, then combine with background and multiple person subtraction in a scene to increase the accuracy (Agrawal et al., 2017)</td>
<td>False alarm when lying down</td>
</tr>
<tr>
<td>Wearable camera-device with image processing</td>
<td>Utilize a pattern recognition algorithm namely Histograms of Oriented Gradients (HOG) and gradient local binary patterns, involves extracting density grid from an input image and passed to the support vector machine to classify the combined features (Ozcan et al., 2017; Chua et al., 2013; Jamshed et al., 2015).</td>
<td>Large computational time is required; inappropriate while doing real-time tracking. Extra battery maintenance.</td>
</tr>
</tbody>
</table>

A. Object Detection Algorithm

Nowadays, deep learning had gained its popularity with the introduction of the speech recognition approach in 2006 (Deng L. et al., 2010 and Hinton & Salakhutdinov, 2006), growth of large-scale training data (Deng J. et al., 2010), and improvement of computation power as well as enhancement in network structures design (Zhao et al., 2019). Haar Cascade algorithm was proposed to detect an object with simple Haar-like features. The algorithm implies three main features, i.e., integral images, Adaboost learning algorithm, and cascade classifier (Mohsen Abdul Hossein et al., 2017). Those features had contributed to achieving a high detection rate and rapid capability of image processing for the algorithm (Viola & Jones, 2001).

YOLO object detection algorithm is an algorithm introduced by Redmon et al. (2016). This algorithm uses the one-step scanning approach which differs from the traditional multiple correlated stages approach that is time-consuming and requires high computing power. It is devised to use a single regression method and will only look once at the image. Therefore, the name was short formed as YOLO. This algorithm started by setting the input image into a fixed 2-dimension grid. For each of the grid that contains an object, the grid cell will then predict the bounding box and count the confidence value of the object in the predicted bounding box. While in the bounding box, the predicted bounding box will contain the x and y coordinate, height, and width of the bounding box, and lastly the confidence value of the object. The confidence of the object is calculated by calculating the intersection over the union of the bounding box with the grid cell. While the number of bounding boxes was set while testing, each grid cell will be responsible for predicting only one object hence only the object with the highest confidence value will be shown (Redmon et al., 2016).

B. Fall Detection Algorithm

The fall detection algorithm is introduced by Lu et al. (2018). The Image-Based Fall Detection System (IFADS) algorithm is designed to detect fall events based on the frames captured by a camera. It focuses on tracking the posture state of the person in every frame and fall events will be declared when any suspicious posture changes were detected. It is designed for the detection of fall in real-time video and can be integrated into any of the surveillance cameras. It involved a combination of object detection and a fall detection algorithm. IFADS compares the human’s posture states frame by frame and get track of the posture states in every frame. The IFADS algorithm included a process of person detection and fall detection and carried out by a different algorithm (Lu & Chu, 2018).

III METHODOLOGY

The scrum framework (Mellor, 2001) is applied during the development of this system. The main
reason is due to the short period of development time. Beside that, it also able to simplify a complicated system into smaller sprint, thus simplified the development process. Figure 1 shows the scrum framework applied in this work.

Figure 1. Scrum Framework

The scrum framework will first start by identify the product backlog which carries the used stories about system requirement and each of the requirement will be divided into sprint based on the priority. And once the sprint was developed and reviewed, the product increment can be delivered to the user or client.

IV RESULT AND FINDINGS

Figure 2 illustrates the system flow diagram for the proposed system. The system started with the input camera feed. The video frames will be captured by the camera in real-time. The captured frame will then be extracted into a single frame and to be sent for person detection in the YOLOv3 algorithm. After that, the frame will then be sent to be processed with the fall detection algorithm. If any fall events are detected by the system, an email notification attach with the captured frame will being sent to the caregivers as an alarm to notify them.

The YOLO algorithm used in this system is to detect a moving person and to draw a bounding box surrounding the detected person to get track of the person’s movement. The fall detection algorithm will then be calculated based on the tracked person’s bounding box. The YOLOv3 which is the enhanced version of the YOLO algorithm was chosen for the proposed system due to the higher accuracy and higher fps to detect an object in real-time (Redmon et al., 2016).

Figure 2. Image-Based Fall Detection System Flow Diagram

The YOLO algorithm used in this system is to detect a moving person and to draw a bounding box surrounding the detected person to get track of the person’s movement. The fall detection algorithm will then be calculated based on the tracked person’s bounding box. The YOLOv3 which is the enhanced version of the YOLO algorithm was chosen for the proposed system due to the higher accuracy and higher fps to detect an object in real-time (Redmon et al., 2016).

Figure 3. YOLO Algorithm

Figure 3 demonstrates the process of the YOLO object detection algorithm. The input image is first set with a fixed S x S grid. An example of 7 x 7 grid cells is used in Figure 2. Once the grid cell was set, each grid cell then predicts a number of the bounding box. As for this case, 2 bounding boxes are used for each grid cell. Within each of the predicted bounding boxes, there are 5 values which are the x,y,w,h, and the confidence of the detected object. Hence, the non-max suppression will be taken out based on a calculation to refine the bounding object and to localize the object. The IFADS algorithm needs to obtain information detected by the YOLOv3 algorithm to detect fall events.

Figures 4 and 5 reveal the fall detection algorithm using the data generated from an object detection algorithm. The frame loaded from video capture will first appended into a data array. The objective is to store the current frame that is being compared with the data in the frame of 1.5 seconds before because human fall occurred within the maximum time of 1.5 seconds. Fall that happened within 1.5 s are critical and are most likely to affect injuries. Therefore, if the bounding box of that person in the current frame is smaller than 5.5/8, which means lower than 5.5 head of the previous frame, a fall event was identified and detected (Lu & Chu, 2018).

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Evaluation on the system accuracy were conducted with different test cases and condition. The proposed system was tested with different scenarios and test cases to evaluate on the accuracy of fall event detection. The different cases that were carried out to be evaluated are: (1) fall events that occurs while standing under a daylight condition, (2) fall events that occurs while sitting under a daylight condition, (3) fall events that occurred under a low light condition. Beside of different lighting condition, different camera distance had also been used to evaluate the detection accuracy. The evaluation results will be reveals in next sections.

A. Fall events occurred while standing under daylight condition.

As to ensure the fall detection system can work under different situations and use cases, different test cases had been carried out in evaluating the accuracy and performance of the system. Table 2 depicts the evaluation result for the fall events that occurred while standing under a daylight condition. It shows 28 fall scenes were evaluated with the system under the day light condition. For the 28 fall events, 23 was detected accurately and notification was sent by the system. The accuracy was 82% in detecting the fall events.

<table>
<thead>
<tr>
<th>Test Cases</th>
<th>Actual Fall</th>
<th>Fall Detected</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Cases</td>
<td>28</td>
<td>23</td>
<td>82%</td>
</tr>
</tbody>
</table>

B. Fall events occurred while sitting under day light condition

Besides of fall events while standing, fall events occurred while sitting were also evaluated. As shown in Table 3, 25 fall scenes were being evaluated with the fall detection system. Out of 25 actual fall scenes, 23 of them managed to be detected by the system. Hence the accuracy of fall detection for fall events occurred while sitting under daylight condition can reach up to 92%. The other 2 fall events that were not able to detect by the system was due to the view angle of the fall events was no obvious and hence the fall events were not being detected by the system.

C. Fall events occurred under lowlight condition

Furthermore, low light condition will also need to be evaluated as fall events might happens during nighttime or low light condition as well. Fall occurred at night is more critical and dangerous as it may happen when everyone is at sleep and could cause the fall events not being noticed by the caregivers. Therefore, 10 fall scenes under low light condition had been evaluated by the fall detection system as shown in Table 4. Out of 10 fall events, only 6 fall events were detected by the system. The accuracy of fall detection only reaches up to 60% under low light condition. This is because the low light condition caused a loss detection on the scenes due to the noise of pixels captured under low light condition. The accuracy however could be improved by implementing a night-vision camera which can capture clear scene event under low light condition.

D. Efficiency Evaluation

The efficiency testing is done to test the frame rate per second and the confidence value of the YOLOv3 algorithm in detecting person. The input image is resized into different resolution before sending into the YOLOv3 algorithm. The resolution may affect the confidence and performance of the real-time tracking. Therefore, this test was carried out to identify the resolution with highest efficiency. Table 5 and Figure 6 shows the evaluation result for the confidence of the YOLOv3 object detection algorithm in detecting person in different resolution.

The results revealed the image that is resized to 224 x 224 resolution has the highest confidence in classifying object. This means that the YOLOv3 object can detect object in this resolution more accurately. The efficiency rate of the overall object
detection performance was calculated by multiplying the average confidence rate with the frame rate per second during run time. The efficiency with highest rate is more efficiency and will be chosen to be implement into the fall detection system. Equation to calculate the efficiency rate:

\[ \text{Efficiency rate} = \text{confidence} \times \text{fps.} \]

Table 5. Fall events occurred under low light condition

<table>
<thead>
<tr>
<th>Resolution</th>
<th>Confidence rate</th>
<th>Frame rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>90(^2)</td>
<td>0.983417</td>
<td></td>
</tr>
<tr>
<td>190(^2)</td>
<td>0.991568</td>
<td></td>
</tr>
<tr>
<td>224(^2)</td>
<td>0.999103</td>
<td></td>
</tr>
<tr>
<td>320(^2)</td>
<td>0.998200</td>
<td></td>
</tr>
<tr>
<td>700(^2)</td>
<td>0.994267</td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 6. Camera Distance Evaluation

<table>
<thead>
<tr>
<th>Distance</th>
<th>Fall Detection Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.5 Meters</td>
<td>93%</td>
</tr>
<tr>
<td>3 Meters</td>
<td>87%</td>
</tr>
<tr>
<td>4 Meters</td>
<td>67%</td>
</tr>
<tr>
<td>&gt;4.5 Meters</td>
<td>53%</td>
</tr>
<tr>
<td>Average</td>
<td>75%</td>
</tr>
</tbody>
</table>

Table 6 depicted the fall scene tested by implementing the camera in different distances from the victims. There are 4 distance ranged from 1.5 meters to 4.5 meters and above. This evaluation is important because the distance of the camera will affect the fall detection accuracy due to the pixels which represented the person in the captured frame will be smaller as a person move further from the camera. The optimum distance would be 1.5 meters as the accuracy in this distance can reach up to 93% while the accuracy decrease as the camera goes further and the maximum distance that can be captured by the system will be less than 4.5 meters. Any fall events occurred further than 4.5 meters will not be detected accurately. Figure 8 presents the overall accuracy for the fall detection system running in different conditions while Figure 9 reveals the test graph for different camera distance.

E. Accuracy evaluation with different camera distance

Besides of lighting condition, the location of the camera is also one of the main factors that may affect the accuracy of the fall detection system. Therefore, the system was also being evaluated by placing camera in different location with difference distance to test on the optimum distance to implement the camera with highest accuracy of fall detection.

V CONCLUSION AND FUTURE WORK

The combination of YOLOv3 and the Image-based fall detection system proposed in this paper is one of
the sub-modules created to detect swift movement for a knowledge-based and integrated security system. The proposed fall detection system is easy to integrate to any camera. One of the examples of implementation is to integrate it with a surveillance camera. Besides, the propose system is very cost efficient because no additional device are needed. Only a camera and a processor unit are needed. The accuracy of the detection can reach up to 92% during daylight condition. However, there are several limitations are identified, such as the performance issue and false detection when there are too many people captured by the camera. These limitations will be resolved in the future work.

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Monopoly-based Game with Augmented Reality Intervention in Higher Education

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ABSTRACT
The gamification intervention is a pedagogical approach of learning activities that introduces game mechanics in a non-game context to drive the learning outcomes. In the era of technology and recent advances, the education system has evolved significantly, by adopting many software, tools, and gamification elements to learning. This concept paper will discuss how board games could be developed based on the typical gamification mechanics, specifically adopting the concepts of Monopoly. The application of board games with Augmented Reality (AR) elements in learning among undergraduate students is a new approach that can be taken in the classroom. By implementing AR into any gamification-based intervention, it gives the player better immersion and a different experience than they are used to. This study proposed that any subject in Higher Education will be better understood through the elements of gamification using board games. Additionally, the utilization of gamification in the education context exerts the element of fun in learning, through motivation and enthusiasm.

Keywords: Gamification, Augmented Reality, student-based learning.

I INTRODUCTION
In the new era of technology, the teaching and learning of undergraduate students in higher education should be suited and represented following the development of IR4.0 to achieve better learning outcomes in their core subjects. Many instructors are reluctant to include activities in the form of games, be it online or offline (during classes) in undergraduate courses, as it is time-consuming and seems difficult to accustom to new methods of teaching and learning.

For instance, courses such as Computer Application in Management that is offered in Universiti Utara Malaysia (UUM) as one of the program core courses, involves students from different backgrounds and programs of studies such as Law, Communication, Business Administration in Logistics and Transportation, Entrepreneurship, Marketing, Public Management, International Business Management, and Human Resource Management. These programs require a certain level of understanding and competency from the students in basic knowledge of the latest technologies as these technologies are used as intermediary means to assist in many management-related applications, which are popular among professionals in their respective fields.

Thus, upon completion of the course, students are expected to be able to describe basic knowledge of computer technology and the evolution of it concerning the current Industrial Revolution 4.0 (IR4.0). Students will be able to classify, present, and apply the appropriate technological applications into different business and management situations as they have been exposed to the evolution of technologies and future trends prediction. Thus, it can be said that the subjects of Computer Application in Management can be quite a challenge to keep up with the exponential pace of technology change that rolls out in quick succession, impacting all aspects of professional organizations and society. Knowledge and Information Technology (IT) skills need to be developed to cope with the growing demands for the latest technology skills. It requires a lot of reading, research, and the ability to predict technology trends to stay relevant. Currently, Computer Application in Management uses a mixed-method between teacher-centered and student-centered in teaching and learning. However, it is difficult to discuss the rapid changes of technologies without much interest from the students to delve into the matter by themselves. Students are restricted from having the opportunity to get hands-on experience dealing with many new technologies such as the use of sensors in the Internet of Things (IoT) and smart campuses which have not been implemented in UUM due to many constraints. Learning the concepts and theory, together with hands-on approaches can enhance the students learning experience especially in the area of technology.

II LITERATURE REVIEW
Gaming has evolved to the point of being used as an approach to learning in various disciplines. By 2020, it is estimated that there are 2.7 billion gamers around the world (Gough, 2020). This high number shows that games can be used as an effective means for learning with great potential as it is more appealing to millennials and generation Z. A survey that was conducted by Adobe Education Creativity Study (2016) found that 93% students consider that it is essential to adopt technology as part of learning as they rely on technology for interconnectivity and
access to information which can be more interactive with the correct tools. Games are one of the tools that can be used to attract the interest of the new generation in learning as it can utilize traditional and technological-based learning through the infusion of classic games and technologies. Games are engaging as it modifies the learner’s behavior to reach the desired experience such as finishing game levels or achieving higher scores (Powers, 2016). It can capture attention, engage in a target activity, and influence behavior. There are two different methods of utilizing games for education, through gamification such as adapting the concepts from classic board games as part of the learning process or game-based learning such as role play and simulation games.

Simulation games have been validated as effective teaching and learning tools (Anderson & Lawton, 2009; Faria, 2001; Faria et al., 2009; Hofstede et al., 2010). Simulation games may also improve social problem-solving skills, as proclaimed by Ahmad, Mitrovic, Najmi, and Rucklidge (2015). In their study, TARLAN was developed as a simulation game to teach social problem-solving skills to ADHD children. Their results show that simulation games can be beneficial to ADHD children or children with social skill deficits. Additionally, simulation games also provide dynamic interaction, competition, and novelty which can boost learners’ attitudes (O’Neil, Chen, Wainess & Shen, 2008). Pellias and Vosnakis (2018) found in their quasi-experimental study that students from the experimental group performed significantly better, both in measures of problem-solving and algorithmic thinking; where they were able to gain a greater understanding of skills related to Computational Thinking for developing, implementing, and transforming their solution plans into code based on their computational problem-solving strategies.

Technical subjects such as Programming can be complicated and difficult to learn. It is important to learn computer programming as we are shifting priorities towards the use of automation and interconnecting technologies. This helps to equip students and graduates to be ready for the IR4.0 workplace. Most professionals in the labor force are required to master programming skills, which is a highly sought skill of university leavers. Thus, institutions of higher education have begun offering programming courses as an extension to their major programs. However, several of these major programs are not computer-related (Ortiz, Chiluiza, & Valcke, 2017) which causes a major setback for students with little or no background in Information Technology (IT). Thus, these novice learners of programming may experience certain problems while attaining programming terms and contents. Due to these setbacks, the students have shown ineffectiveness in learning, showed very little interest in the course, and lacked motivation (Khaleel,ashaari, & Wook, 2019). To combat these problems, several researchers have proposed a myriad of solutions to create better engagement for their students in learning programming related course, such as mobile learning application, visualization, Web-based Java Programming, game-based learning, and 3D animation (Tsukamoto, Nitta, Takemura, & Nagumo, 2012; Chang, 2020; Dai, Zhao, & Chen, 2010; Tan, Ting, & Ling, 2009). It is suggested that the utilization of gamification could assist students to better acquire the concepts of a particular subject. Thus, the use of gamification is hoped to bring the game elements into the education context, and simultaneously exert the element of fun in learning.

A. Gamification

Gamification is defined as the process of including game elements or mechanics to a pre-existing experience to improve learners’ engagement and enjoyment (Orlig, 2019). Gamification is the process by which services are enhanced utilizing motivational affordances to arouse gameful experiences and advance outcomes in behavior (Hamari, Koivisto & Sarsa, 2014). Another way to look at gamification is that it employs the same aspect of video games but in non-game applications (Su & Cheng, 2015). Thus, it can provide a more engaging and interactive method to study or revise for a rapidly changing technology as the game mechanics are added in the non-game context. It encourages and capitalizes on the technological progression of millennial and generation Z learners which can further enhance the educational benefits using gamification-based education.

The Computer Application in Management course, for example, broadens students’ knowledge of the study of the emerging technology revolution. It covers among others, the IT infrastructure, the Internet, information management, digital markets and goods, IR4.0, and IT security and ethics. This will allow students to investigate the ways in which technology impacts them professionally and towards organizations. However, it is more impactful when learning about these technological advancements in fun ways rather than through typical lectures and classroom settings as it involves history and the future information of the technological revolution from the 18th century to the current, 21st century.

Gamification uses game-like features including points and various levels in a way that is not meant to entertain (De Byl, 2013). Its main goal is to foster more engagement in people by helping to create more robust experiences by utilizing game mechanics (Kim & Lee, 2015). Gamification is a great way to make mundane activities such as understanding the concepts and theories of any subjects and make them more
interesting and engaging. It transforms the passive learning environment and regular activities into a game to promote learning and deepen the understanding of the subject matter.

A study on gamification among Postgraduate students found that gamification-based educational intervention was well accepted among millennial learners (Nevin, Westfall, Rodriguez, Dempsey, Cherrington, Roy, Patel, & Willig, 2014). It was found that they enjoyed the opportunity to compete for both individuals and teams to progress further on the leaderboard as it motivates them to be competitive.

Gamification concepts and techniques are used to engage and motivate the players to behave in a particular way in the pedagogical context through serious games (Sawyers & Smith, 2008), experiential learning theory (Kolb, Boyatzis & Mainemelis, 2001) and also Gamified Learning Theory (Landers & Landers, 2015). A basic and important distinction in any setting involves differentiating between intrinsic and extrinsic motivation. Intrinsic motivation occurs when a task is inherently interesting or enjoyable, whereas extrinsic motivation occurs when performing the task is a means to attain a desirable outcome (Ryan & Deci, 2000). In terms of gamification, as a motivational influence, players can be awarded an extrinsic prize or satisfy an intrinsic need such as the desire to succeed as a result of the game elements. The basics of any game involve working within a set of rules to achieve an objective, provide engagement, learning, and problem-solving.

B. Gamification vs Game-based Learning

Gamification and game-based learning are similar in the way that both learning approaches promote engagement and motivation in learning through game mechanics. In game-based learning, the learning activities are designed based on game characteristics and principles. It is meant to provide training and practice, for example, role-playing games. It is the process and practice of learning using games from the point of view of the learner. In game-based learning, the game itself is the lesson or is used as part of the lesson while gamification uses the game elements to reflect the learning context rather than the lesson itself. Game-based learning is the approach of participating in learning while playing which is making the learning process more interesting by adding the fun characteristics of games. It can ascertain that the basic idea of the subject can be better understood as the theory of it is changed into practical knowledge. Through the game, it helps to increase the learning effectiveness, this improves the learning aspects. Game-based learning typically focuses on using commercial video games or creating full-fledged video games for education, such as role-playing games, strategy games, and simulation games that reflect the real environment and situations into the lessons.

C. Board Games

Numerous studies have been conducted on the effectiveness of board games in learning (Berland & Lee, 2011; Laski & Siegler, 2014; Carter et al., 2014; Cutumisu et al., 2019). Board games can help in various subjects and skills. Bayeck (2020) proposed that board games are spaces where people can learn many contexts and even mathematics. Board games are also capable in bringing possible interactions such as creativity, teamwork, and computational thinking. Moreover, board games aid to simplify complicated issues and systems.

A study done by Carter et al. (2014), analyzed a Warhammer 40,000 (W40K) board game. This game assists players to involve in critical and strategic thinking. The players are required to find descriptions for every army to draft their armies by using books provided by the designer of the game. The players can study from fiction books or conduct research before they play and use the knowledge when they play the board game. During the game, the players can use their own strategy based on the background story that they have.

Another board game is called Pandemic helps in complex computational thinking (Berland & Lee, 2011). By playing this game, players are able to comprehend the meaning of ‘debugged’ and form rules to create strategies and lead the game. This is done by communicating with the other players as the players need to form rules and complex logic together. Furthermore, another board game which brings benefit to learning is The RETAIN board game by RETAIN Labs Medical Inc. Edmonton, Canada. The board game is a real-life delivery room simulation. In a study by Cutumisu et al. (2019), they found that the RETAIN board game helped in enhancing participants’ knowledge and performance of neonatal resuscitation scenarios. The finding of the study also supports the use of board game simulations in clinical training.
D. Monopoly Game

Many educational sectors and organizations have employed the Monopoly board game as a template reference to build their own games. For instance, The National Park Service has adapted its own version of Monopoly (Smith, 2008) with their National Parks Edition. It has also been applied to the world of business, which takes into account real estates through a board game entitled Heritage of Oshkosh (O’Halloran & Deale, 2010). In education, the monopoly games have been adapted to be applied to different fields, such as psychology (Schoen, 1996), sociopoly (Jessup, 2001), economy (Wiener, 1989), lodging development in tourism and hospitality (O’Halloran & Deale, 2010), business education (Tao, Hong, Yeh, 2010), and so on.

Collectively, the findings have shown that incorporating games such as Monopoly, or Monopoly-based games provide positive feedback from both the learners and instructors. For instance, the use of Monopoly in an introductory course in Financial Accounting are found to increase the competitiveness amongst the students which improves the classroom engagement where students are actively involved in grasping the nature and purpose of the financial accounting system compared to other pedagogical approaches that were previously used (Shanklin & Ehlen, 2017). Similarly, positive results were found by Gazdula and Farr (2019) by incorporating the monopoly game in teaching Risk and Probability, which students can reflect on decision making in risk environment using both formal and informal approaches which prompts for discussions, collaborative learning, and self-analysis among students.

E. Augmented Reality

Augmented Reality (AR) is a new element in education research, which helps educators to apply virtual objects into the classroom context. Based on the definition of AR, there are three main technological elements which are the combination, alignment, and real-time interaction of the real and virtual objects in the real environment and amongst the objects (Khan, Johnston, & Ophoff, 2019, p. 587). By implementing AR into any gamification-based intervention, it gives the player better immersion and a different experience than they are used to. It enhances traditional games with virtual elements which enables the virtual part of the game to stay hidden.

Some of the earliest studies which applied augmented reality to games include the work by Ohshima, Satoh, Yamamoto and Tamura (1998) and Govil, You and Neumann (2000). However, since the introduction of augmented reality to games, several drawbacks have been identified, which includes the Head Mounted Devices (HMDs) for visualization being too uncomfortable for the wearer, this was then replaced by handheld devices, but this too seemed impractical as the device requires the players to hold it in an uncomfortable position. Other drawbacks include the use of markers on the board games, which was replaced by natural features.

Newer technology and improvements have allowed more updates to be made towards the use of augmented reality to boardgames. For instance, Molla and Lapetit (2010) use a simple webcam and Computer Vision Techniques to turn a board game into augmented reality.

III MONOPOLY-BASED GAME WITH AR

Based on the studies on this matter, it shows that gamification is an interesting matter to be explored as part of the assessment in education. A board game will be developed based on the typical gamification mechanics, specifically adopting the concepts of Monopoly. AR will be implemented as part of the board game for interactive content. The AR marker will be included on the Monopoly play cards to hide information from the players. The information is only revealed when the AR marker is scanned using any supported devices. It can reveal videos, text content, and other types of media. This enables the players to gain more knowledge from various sources through the AR code without revealing any information prior to playing the board game. By adding the AR implementation, the board can be designed with basic look-and-feel visuals, and changes to the game can be done through the AR, which means the gameplay of the board can be altered easily without having to change the physical element of the board.

A. Transfer of Learning

The objective of this Monopoly-based game with AR intervention is to assess the effectiveness of it towards the students’ comprehension level in terms of their ability to make explicit references to previous learning, demonstrate and apply the knowledge in the game-based situation, in comparison to the traditional method of self-revision. It is expected that by introducing the elements of gamification using the board game, it can attract the students’ interest in the course in addition to improving students’ understanding. The game is used as a revision method to remind the students of the topic that has been covered during lectures. Students are expected to relearn the concepts that have been covered in the lessons through the question cards, discussions and voicing their opinion based on prior knowledge and critical thinking amongst the players and the answers (AR) provided in the board game as a benchmark of their understanding.
B. Intervention

A Monopoly-based board game with an AR element is introduced. A few factors need to be considered when designing the board game such as the game rules, theme, background story and questions that are suitable which enable students to focus on playing the game. To play the game, a dice is rolled for the players to move around the game board. The players will take turns to move. As an initial design, the board consists of fourteen spaces containing eight properties that contain questions. This is shown in Figure 2.

On the player’s turn, the player who successfully answers the question from the question card will own the property. To make the game more interesting and to encourage discussion, other players who agree with the current player’s answer can invest in the property. Each player is given four opportunities to invest in any property. The correct answer to the question is checked by scanning the AR code provided behind the question card. If the player and investors answer correctly, in the next round, they can charge other players who trespass on the property. However, if the answer is wrong, the property can be taken by another player. Players who invested in the property (wrong answer), will lose one of their investment opportunities. Therefore, this forces the players to understand and know the answers to the questions before taking the risk of investing.

This Monopoly-based game with AR intervention is currently being created and at its initial development state. The improvements expected towards it will be in terms of the game theme or background story, question cards, and the properties or spaces on the board game which are planned to be expended so that it can cover more topics of the selected subject and course. It currently covers the topic of the Industrial Revolution which is part of the syllabus within the Computer Application in Management course in UUM.

IV CONCLUSION

In this paper, a monopoly-based game with AR intervention is proposed in attempting to utilize gamification into the education context to exert the element of fun in learning. It is expected that this gamification method can assist the students’ comprehension level in acquiring important concepts and ideas in any subject in higher education, along with any program, field or discipline.

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The Influence of Crisis Response on Social Interaction and Public Resilience Based on Importance-Performance Map Analysis (IPMA)

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ABSTRACT
This study aimed to investigate the influence of crisis, crisis response, and social media interaction on public resilience by using the importance-performance map analysis (IPMA) method. Data collected through empirical study consists of 167 observations; comprising Malaysians that have experienced Covid-19 lockdown. The reliability and validity of the measurement models were assessed by Cronbach’s alpha, coefficients rho A, composite reliability, and discriminant validity values. The IPMA compares the constructs and indicators level from the performance scale mean value against the importance. The result shows that all the constructs and most of the indicators are important and reveal good performance. Thus, future research activity should be focusing on maintaining the constructs and indicators' at the performance level. Therefore, our findings revealed that the overall constructs and indicators' should be having high priority by crisis management and communication authorities and researchers.

Keywords: Crisis communication, crisis response, social media, social interaction, resilience, and IPMA.

I INTRODUCTION
The emergence of Coronavirus (Covid-19) has made people exposed to digital interaction through social media platforms worldwide. Physical interactions have been difficult and challenging due to contaminations. The condition deteriorates as experts and authorities encourage and force residents to reduce movement for several weeks to contain the virus from spreading. Public resilience to avoid panicking due to the crisis has become very important, while social media provides the environment where people communicate, help the affected citizens, and an information source (Groen et al., 2017). Despite its importance, Moller et al. (2018) is only the study that investigated how social media usage could improve community resilience after a crisis. Therefore, this study intends to add to the literature on the discussion of resilience-building through social media usage and social media-based crisis communication.

Therefore, this research endeavor aims to analyze the influence of crisis, social media interaction, and crisis response on community resilience based on the importance-performance map analysis (IPMA) used in previous studies (Rosenbusch et al., 2018; García-Fernández et al., 2020). The study presents as follows; section II discussed the theoretical framework, section III discussed the study design and data measures, section IV presents the assessment of the results, section V discusses the implications of the findings, and section V concludes the study.

II THEORETICAL FRAMEWORK
Crisis informatics is a term used to show the application of technology (information systems, social media, etc.,) in crisis management and communication which is founded by Hargar (2006; 2007) (Sigala, 2012; Hagar, 2013; Pipek et al., 2014; Palen& Anderson, 2016; Tan et al., 2017; Reuter & Kaufhold, 2018). The field explained the overlapping factors of social, technical, and information in disaster/crises (Hagar, 2013). Crisis management relied on effective communication (Gascó et al., 2017) that described how strategic communications are applied to limit the negatives effects of crisis (Coombs, 2018). The advent of social media tool has presented new ways in which communications take place (Liu et al., 2011; Graham et al., 2014; Palen& Anderson, 2016; Gerken et al., 2016) by offering people the ability to engage in crisis response and communication (Li et al., 2011; Graham et al., 2015; Gerken et al., 2016) by offering people the ability to engage in crisis response and communication (Li et al., 2011; Fortunato et al., 2018). The crisis communication matrix distinguishes between four patterns of interactions and communication on social media (Reuter et al., 2012). It shows that communication took place between authorities (A) and citizens (C) comprising A2A, A2C, C2C, and C2A.

Several crisis communication models existed in the literature. The introduction of social media as a crisis
communication medium forced researchers to review the traditional models to address the dynamic nature of social media (Liu et al., 2011; Stewart and Wilson, 2016; Panagiotopoulos et al., 2016; Möller et al., 2018; Lambret & Barki, 2018; Sjöberg, 2018; Cheng, 2018; Grover et al., 2018). Nevertheless, the traditional SCCT remained the most dominant theory (Bukar et al., 2020), while SMCC, STREMII model, ICCM, and SMDR as emergent social media-based models.

Thus, referring to the discussion available from the literature (Bukar et al., 2020), this study adopted the favorable variables identified from the previous research toward the introduction of social media crisis communication and its impact on community resilience. When a crisis occurs, the crisis information initiate and encourages stakeholders to engage in crisis response as founded in the dominant theory of crisis communication, the situational crisis communication theory (SCCT) (Coombs, 2007) and supported by the social-mediated crisis communication model (SMCC) (Austin et al., 2012; Jin et al., 2014). Social media serve as a medium of communication that provides an environment where people gathered for a specific purpose. The two constructs (crisis, crisis response) are the main variables influencing public formations on social media. According to Goggins et al. (2013), the people formations on the social media platforms reveal the unsatisfactory issues and challenges of modeling qualitative and quantitative research data to recognize the stakeholders’ interaction, stakeholders’ leadership, and stakeholders’ social structure are represented in digital trace data. Bukar et al. (2020) conceptualized the interactive crisis communication model (ICCM) (Cheng, 2018) to represents the online setting (social media) in which stakeholders interact as social interaction (social media interaction) as a result of crisis responses. The crisis respondents participate and work together as groups by pressuring the authorities to do more or enlighten the community. The ICCM emphasized the significance of the interaction between the organization and public stakeholders involved in crisis responses, while the social media disaster resilience (SMDR) model (Möller et al., 2018) has illustrated social media usage for building hotel resilience. Hence, Bukar et al. (2020) proposed constructs explain how social media interactions and social media crisis response can improve community resilience. The interactions between stakeholders (management and public) through social interaction or crisis responses can show the intensity of crisis communication and management effort toward managing the crisis. Figure 1 illustrates the constructs in the conceptual model under investigation.

Therefore, this study is grounded upon SCCT, ICCM, and SMDR to evaluate the influence of crisis, social media interaction, and crisis response on resilience. Also, it illustrates the use of the IPMA procedure with empirical data. The goal of IPMA is to demonstrate the importance and performance of crisis, social media interaction, and crisis response on community resilience, and also to disclose the performance of the indicators adapted for the survey. The models include four constructs; crisis (CRISIS), crisis response (CRISISRES), social media interaction (SMI), resilience (RESILIENCE).

III STUDY DESIGN AND DATA MEASURES

The design and development of the research survey followed a series of steps and activities. These include an expert review by four experts in the field of crisis communication and information system. The expert’s review was conducted to examine the validity of the research instrument during the initial stage of the study, after the early validation phase, a pilot test that consists of 32 participants was carried out to verify the reliability of the instrument to improve the items of the questionnaire, and partial least square structural equation modeling (PLS-SEM) approach was adopted to analyze the survey data. Moreover, the IPMA was applied to enrich the PLS-SEM analysis (Ringle & Sarstedt, 2016) and understand the influence of different variables. However, this study only reported the measurements model and was supported by the IPMA analysis. The IPMA analysis of the models was conducted based on the guidelines available from the literature implemented with SmartPLS 3 (Ringle et al., 2015 cited in Ringle & Sarstedt, 2016; García-Fernández et al., 2020).

The sample size was calculated on G*Power statistics that resulted in 119 sample sizes as the minimum sample required for the study (Faul et al., 2007; Faul et al., 2009). All the measurement items are reflective and were measured on a five-point Likert scale. The survey was conducted online through Google Form that resulted in 190 responses from people who
regularly used social media during a crisis such as a pandemic (covid-19). A total of 23 responses were discarded for further analysis due to straight-line issues, missing values, outliers, and multivariate normality in the data (Osborne, 2013). The final responses consist of 167 observations which primarily consist of Malaysians between 21 and 40 years, who have experience Covid-19 lockdown and are observing social distancing rules either to avoid a crowded area, self-isolate or quarantine. Most of the respondents used social media during the Covid-19 movement control order (MCO) to engage virtually with friends and relatives and also received updates from crisis management and communication authorities.

IV RESULTS ASSESSMENT
The assessment of the result was conducted in two folds. These include the analysis of the measurements model and evaluation of the IPMA results.

A. Analysis of the Measurement Model
The assessment of the reflective measurement models was conducted by following recommendations available from the literature (Hair et al., 2017; Chin, 2010). The result of the reflective measures is presented in Table 1 and Table 2. The result indicates that the measurements are reliable and valid. Specifically, all the Cronbach’s alpha, coefficients rho A, and composite reliability (CR) have values above 0.7 (Sarstedt et al., 2017). Lastly, the assessment of the discriminant validity was conducted based on the study by Henseler et al. (2015) (heterotrait-monotrait ratio of correlations (HTMT)) and is supported. Hence the assessment indicated that the HTMT values are significant at < 0.85 (Franke and Sarstedt, 2019).

<table>
<thead>
<tr>
<th>Constructs</th>
<th>Cronbach’s Alpha</th>
<th>rho A</th>
<th>CR</th>
</tr>
</thead>
<tbody>
<tr>
<td>CRISIS</td>
<td>0.743</td>
<td>0.763</td>
<td>0.824</td>
</tr>
<tr>
<td>CRISISRES</td>
<td>0.739</td>
<td>0.747</td>
<td>0.822</td>
</tr>
<tr>
<td>RESILIENCE</td>
<td>0.877</td>
<td>0.886</td>
<td>0.898</td>
</tr>
<tr>
<td>SMI</td>
<td>0.824</td>
<td>0.833</td>
<td>0.869</td>
</tr>
</tbody>
</table>

B. Importance-Performance Map Analysis
Since the main focus of this research is to evaluate the influence of the constructs and predictors under investigation, and to assist the researchers to learn the research data with a view to improved crisis management and communication decisions efforts during a crisis.

The independent variables’ performance on public resilience has been presented in Figure 2. From the result obtained, social media interaction (SMI) constructs have a performance value of 79.7%, while it's rated below the crisis and crisis response constructs for the importance. These indicate that the crisis management and communication authorities should be giving much importance to social interaction on social media. Secondly, the crisis construct has a performance of 77.8%, while it's rated below SMI construct for the importance axis. Finally, the crisis response construct is the lowest-performing construct on resilience at 75.0% on a scale of 0 to 100. But the results indicated that it is the most important construct compared with crisis and SMI. The IPMA allows the researchers to examine the critical indicators (Hair et al., 2018; Ringle and Sarstedt, 2016) of the people’s ability to quickly return to normal after crisis occurrence.

Further, the performance of the constructs and indicators are shown in Figure 3 and Figure 4. The performance is presented on the horizontal line (x-axis) as labeled resilience, and the vertical line (y-axis) indicating importance is labeled total effects. The IPMA compares the construct indicator level from the performance scale mean value (i.e. resilience on a scale of 0 to 100) with the importance of the indicators (i.e. total effects). The resulting IPMA for the constructs and indicators is divided into...
four parts: “keep up”, “do better”, “reinvestigate”, and “no change” (Rosenbusch et al., 2018; Hsu, 2008; Figure 3 and Figure 4). Rosenbusch et al. (2018) reiterate that the partition of the graph quadrants is dependent on the performance and importance of the mean values (Martilla and James, 1977). The constructs and indicators that are found in the “keep up” quadrant are essentially important and reveal good performance. Thus, any activity should be focusing on maintaining the constructs and indicator’s performance level. The “reinvestigate” quadrant emphasized the need for attention since they portray high performance but low importance.

**Figure 3. Importance_Performance Map of Constructs**

**Figure 4. Importance_Performance Map of Constructs**

Only a few indicators (crisis_2, crisis_3, smi_4, and smi_6) have appeared in this quadrant. Eliminating or reinvestigating the importance of these indicators for this research should be considered since the focus of this research to learn more about the data. The constructs and indicators that appeared in the “do better” section of the quadrant are averagely above both importance and less performance. In this case, the entire constructs and indicators are not found in the “do better” (Figure 3) section. Finally, no constructs or indicators are present in the “no change” quadrant. This means that the overall constructs and indicators should be given high priority in the future.

**V DISCUSSION**

The usefulness of the model was assessed through IPMA. The results show that the measurement models are useful. Remarkably, the findings revealed the role of social media interaction, which supports the gratifications sort by people on social media use through social interaction during a crisis (Whiting & Williams, 2013; Li et al., 2019). Further, this study recognizes the comparative importance of crisis response that influences initial social media response during a crisis. The application of the IPMA method takes the opportunity to rank the constructs and indicators according to their corresponding performance towards the dependent variable. Initially, the primary role of crisis management is communication, which triggers social media usage, while providing the convenience and transfer of crisis response tasks to the public in a dynamic setting (Stewart & Wilson, 2016). The predictors of this study are significant empirically based on empirical data. Thus this study contributes to the existing literature by investigating their relative significance based on the IPMA approach, which was not investigated empirically by emerging social media-based crisis communication models such as STREMII and ICCM (Stewart & Wilson, 2016; Cheng, 2018), respectively. The study was validated through measurement model in PLS-SEM, and enriched with IPMA showing significant results to advance the use of social media in crisis communication and crisis informatics researches.

**VI CONCLUSION**

The study reported the influence of social media crisis communication and its impact on the public resilience model for constructs and indicators based on IPMA. The result indicates that all the constructs (crisis, crisis response, and social media interaction) are important and have a high-performance level. Although four indicators from crisis and social media indicators have not indicated good importance value, calling for additional investigation since their performance is relatively high. The study contributes to the advance in crisis management and communication for effective social media crisis communication. Therefore, stakeholders and policymakers in the crisis management and communication domain are equipped with empirical evidence about the constructs and indicator’s performance level and importance to public resilience.

**REFERENCES**


The Design of ScI-oTLS: An Internet of Things Platform to Support Collaborative Learning for Science subject in Primary School

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ABSTRACT
The Science, Technology, Engineering and Mathematics (STEM) initiative in Malaysian Education Blueprint 2013-2025 aims to develop students with necessary skills which could face the challenges of science as well as technology and to ensure Malaysia produces enough qualified graduates in STEM. Nonetheless, the number of students taking STEM subject is declining over the years. Factors that lead to the decline have been investigated by many studies. One of the factors is attributed to student’s experience in class which the students perceived that STEM subjects are boring and dull. This study attempts to propose the use of Internet of Things (IoT) platform as a teaching tool for STEM subjects to make the learning of the subjects more interesting. This paper presents the design of ScI-oTLS, an IoT platform that supports collaborative learning of Science subject in primary school. The objective of this study is to propose the design of an IoT platform that supports collaborative learning in Science subject. The method of this study consists of two phases. The first phase concerns with the distribution of a small survey to teachers to get their preliminary feedback on the use of IoT in teaching and learning of STEM. The second phase concerns with the design of the ScI-oTLS platform. The results indicate that teachers are open to the idea of using IoT platform such as ScI-oTLS as a teaching tool because they feel that it will enhance student’s interest in learning Science. The requirements and system architecture of ScI-oTLS are also presented in this paper.

Keywords: Internet of Things, IoT, Teaching and Learning, Education.

1 INTRODUCTION
The Industrial Revolution 4.0 (IR4.0) has transformed the landscape of the Malaysian economy to a modern wave of global technology economy. Education plays a crucial role in producing future professionals for IR4.0. The scientific as well as mathematical principles understanding, practical knowledge of technology and engineering and; problem solving skills are the quality needed in future workforce (Ramli et al., 2017). Science, Technology, Engineering and Mathematics (STEM) education facilitates Malaysia transformation into this science and technology-driven economy so that the nation is prepared adopt and tackle the challenges in the era of IR4.0 (Saleh et al., 2020). The STEM initiative in Malaysian Education Blueprint 2013-2025 aims to develop students with necessary skills which could face the challenges of science as well as technology and; to ensure Malaysia produces sufficient number of graduates in STEM (Ministry of Education Malaysia, 2013).

According to National Council for Scientific and Research Development, Malaysia would need at least 500,000 scientists and engineers by 2020 but the presents statistics disclose that there are only 70,000 registered engineers, which is only 17% of the figure (Kamsi et al., 2019) but the current circumstances of Malaysia indicated that the number of youngsters who plan to pursue STEM fields in secondary, tertiary education is much less encouraging. Science, Technology, and Innovation Minister Khairy Jamaluddin stated that the number of students taking STEM has fallen short of target. He quoted a report from Science Outlook Report for 2017 which indicates the annual tertiary education enrolment in STEM courses was 40 per cent in 2016 from the targeted 60 per cent (Bernama, 2020). A report by the Ministry of Education stated that only 42% of middle school students in Malaysia chose to do Science, including technical and vocational programs at high schools (Shahali et al., 2017).

There are many studies that have been conducted to investigate the factors that lead to declining number of student's enrolment on STEM education. One of the factors that contributed to these concerns with student's learning experience. To enhance student's learning experience on STEM, the use of technologies in teaching and learning seem to be an opportunity. Technologies such as mobile application, virtual reality, augmented reality have been adopted in teaching and learning. With the current COVID-19 pandemic situation, there is approximately 470 million educational mobile application downloads in the first quarter of 2020 (Clement, 2020). Virtual reality and augmented reality applications enhances student's engagement by transforming the way educational content is being delivered. It can be said that different technologies serve different purpose. The use of Internet of Things (IoT) as a tool in teaching, and learning seems to be unclear. IoT, a technology that is
in line with IR4.0, is not yet common in education particularly in teaching and learning (Digiteum, 2020).

Thus, this study explores the use of IoT in the teaching and learning of STEM subject. The objective of this study is to determine the teacher’s perception on adopting of IoT in their teaching and learning and to propose the design of IoT platform called ScI-oTLS that collects experiment data for teaching and learning. ScI-oTLS also supports collaborative learning because the data captured can be shared and accessed by other teachers and students from different schools. Through ScI-oTLS website, teachers can share learning materials and activities as well.

II LITERATURE REVIEW

This section presents the literature review of the study. This section begins with an overview of STEM. It is reported that the number of students in STEM related courses are declining, thus the next topic discussed in this section is regarding student’s interest in STEM subjects. Lastly, the use of IoT in teaching and learning is discussed.

A. Overview of STEM

Science, Technology, Engineering and Mathematics (STEM) is a curriculum that is based on the four disciplines-science, technology, engineering, and mathematics- in an interdisciplinary and applied approach (Hom, 2014). STEM approach allows students to examine and analyse the environments through investigation and problem solving related to the actual world. STEM education plays a major role to establish the quality of STEM-related professional labour production in a country. STEM is important because of the economy is moving into the era of Industrial Revolution (IR4.0). A report by PwC in 2015 indicates that the adoption rate of IR4.0 by companies is 33% but it will peak to 72% in the year 2020 (PwC, 2015). IR4.0 goes beyond computers and companies is 33% but it will peak to 72% in the year 2020 (PwC, 2015). IR4.0 goes beyond computers and applications in IR3.0 by enhancing it with smart and autonomous systems fueled by data and machine learning (Marr, 2018). Thus, interdisciplinary thinking and qualified skills in the social and technical fields are required thus it is important for these two to be included in the education curriculum to prepare students to IR4.0 (Pereira & Romero, 2017). This indicates that, to prepare the workforce for IR4.0, the interest of students on STEM need to pique in the early stage in their education.

B. Student’s Interest in STEM Subjects

In Malaysia, the STEM education is introduced in 2016 and it was officially implemented in schools in the early of 2017 (Ramli et al., 2017). Although the demand for labour related to knowledge and skills in STEM has increased, interest in science related subjects continues to deteriorate. According to Academy of Science, the number of students pursuing education in science stream in secondary school decreased from 44% in 2011 to 21% in 2014. These statistics are alarming since it is far away from Higher Education Planning Committee’s set target to achieve Science 60: Art 40 by 2020 (Ramli et al., 2017).

One way to increase student's interest on STEM is by organizing programs outside the boundary of the schools. Chittum et al. (2017) studied the effect of an afterschool STEM program among students. Their findings show that the participating student's value for science improves as compared to non-participant and that the experience had a positive impact on their perceptions about science as a field. Roberts et al. (2018) studied the effect of STEM summer learning experience in which the findings shown that such informal learning experience influence student's interest in STEM. Kitchen et al. (2018) stated that student's inclination towards a career related to STEM increases after participating in program that allow the students to experience the relevancy of STEM in the real world. From the literature, it can be seen afterschool programs provides the opportunity for the students to experience STEM and exposing them to the relevancy of STEM in the real world. This increases their interest in STEM and increases the possibility of choosing STEM-related careers. Nonetheless, this experience is achieved outside of the classroom in schools.

Student’s learning experience of STEM subjects in the classroom is different from learning it outside of the classroom. Students feel that STEM discipline subjects are complicated, dull and tedious. Kennedy et al. (2018) reported a study conducted by Pew Research Center which suggested that students do not pursue a STEM-related degree because of the difficulty of the subjects. Other factors include the subjects are not useful in their careers and the subjects are too boring. In addition, the laboratory activities are usually like a recipe book that are highly arranged to teach students to design, execute and analyse data. Lakshminarayanan & McBride, (2015) mentioned that all these create a passive classroom experience and such learning do not encourage creativity nor does it highlight the intellectual of science. This aspect tends to reduce the learning experience of students and discourages them from pursuing their education in the science subject.

C. Collaborative Learning

Collaborative learning can be defined as a set of teaching and learning strategies promoting of students in small groups about two to five students to optimize learning for themselves and for each other (Le et al., 2018). Hence, collaborative learning makes the students depend on each other in their quest for knowledge and makes learning more meaningful and interesting. When students work in a group, they will
be part of the community, and therefore, everybody will give each other support. Studies have also shown that the students will learn better when the learning process is done in a fun yet educational way (Ibrahim et al., 2015).

Existing studies indicated that collaborative learning could facilitate the growth of soft skills, increase academic performance, and enhance the learning experience of students. It is considered as one of the methods which can be implemented in the education learning process with collaborative learning and social engagement (Maria et al., 2018). This study intends to adopt collaborative learning with the use of IoT as its teaching tool to enhance student’s learning experience.

D. The Use of IoT in Teaching and Learning

Internet of Things (IoT) refers to scenarios where network connectivity and computing capability extends to objects, sensors and everyday items not ordinarily considered to be computers, allowing these devices to generate, exchange, consume data with minimal human interventions (Kurelović et al., 2018). IoT is just not a standalone technology, but it is a combination of various hardware and software technologies. There are three IoT component that enables seamless connections which are hardware, middleware, software (Aldowah et al., 2017). Hardware consists of sensors, actuators and embedded communication hardware that used to monitor surrounding environments. Middleware is on demand storage and computing tools which used for data analytics that enables communications between applications and hardware device. While software is used to stimulate visualization that can be widely accessed on different platforms and applications. In last it offers a solution that focused on the integration of information technology which used to store, retrieve, and process data and communication technologies.

IoT in education can be classified into two categories. The first category is about providing courses to teach essential knowledge on computer science and the second category is about using IoT as a platform to enhance academic infrastructure of a subject (Gul et al., 2017). Using IoT as the platform to enhance teaching and learning involves the use of sensors to capture data that can be used in teaching and learning. In the classroom, sensors can be used to capture data as parameters. These data can be used as part of a science experiments, tutorials, or assessment. This can only materialize with an IoT platform that capture, store and access collected data.

There are many studies on IoT as a subject at schools or using IoT devices for managing classroom. Smart classroom is an example of this. Smart classroom is an intelligent classroom environment fitted with a range of IoT device and application to monitor various parameters of the physical environment (Bagheri & Movahed, 2016). Nevertheless, there seems to be lack of study that uses IoT as a teaching and learning tool let alone supporting collaborative learning. A good example of the use of IoT as part of collaborative teaching and learning is by Satu et al., (2018). The authors proposed a tier-based platform which is more holistic in nature. The author's solution consists of three main components which are Smart Management, Smart Contents and Personal Devices. Smart Management concerns with classroom management. Smart Content focuses on the learning management system, pedagogy, learning analytics, assessment, and digital library. Students use their personal devices outside of campus to access Smart Content. Collaborative learning approach is practiced on campus. The collaborative learning is achieved through flipped classroom approach. IoT devices such as camera, microphone, sound sensor and others are used in the classroom to monitor learning process, identify problems, find the different type of students can use this to identify their progress, compare their knowledge with other students.

III RESEARCH METHOD

The methodology of this study involving two main phases namely Phase 1: Preliminary study and Phase 2: IoT-based Learning System prototype. Figure 1 shows the methodology of the study.

![Figure 1. Methodology for Sci-oTLS](image)

Phase 1 concerns with reviewing existing literature on the use of IoT in education and sending questionnaire to students and the teachers on their perception on the possibility of using IoT to support collaborative learning in Science subject for Year 6. Phase 2 is the design phase of the prototype. The system development methodology is based loosely on the agile concept. The development phases consist of two
sub phases namely Analysis and Design and development. For the analysis, the use case and activity diagram were developed based on the functional requirements that were obtained from Phase 1. The design phase includes the identification of the tools and the development of a system architecture, hardware, and software design. The components needed to develop the IoT hardware is shown in Table 1.

<table>
<thead>
<tr>
<th>Components</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arduino board</td>
<td>The microcontroller board to read inputs from sensors</td>
</tr>
<tr>
<td>GPS 6M module</td>
<td>GPS receiver. This module detects the position of an object</td>
</tr>
<tr>
<td>ADXL 3xx</td>
<td>This module detects the acceleration of objects.</td>
</tr>
<tr>
<td>WI-FI module ESP 8266</td>
<td>To connect and send data through Wi-Fi network</td>
</tr>
</tbody>
</table>

Table 1: Hardware Components for the IoT Device

The scope of this study is Year 6 Science subject. Two topics under Science were selected as the pilot for this study. The topics are Unit 6: Force and Unit 7: Speed. These topics were selected because of the content which seems possible to embed the use of IoT hardware and software in the teaching and learning. Using GPS and accelerometer sensors, data can be gathered, used, and shared with other schools. The system design focuses on the design of the ScI-oTLS learning website in which teachers can upload data required for speed and acceleration calculation and learning materials. The tools to develop the website includes Visual Studio, XAMPP localhost as the web server, Laravel framework as the framework to support front-end and back-end development. PHP, HTML, CSS and Javascript are the programming languages used in the web development. MySQL is selected as the database management system.

IV RESULTS AND DISCUSSION

This section presents the findings of this study. The findings are divided into two sections. The first section presents the findings of Phase 1. In Phase 1, a preliminary investigation was conducted which includes the distribution of small-scale survey to teachers and students on what they perceived IoT as teaching and learning tool. The second section presents the deliverables of Phase 2 which includes the use case and system architecture of ScI-oTLS.

E. Phase 1 Findings

A small-scale survey was distributed to teachers to know their perception on the use of IoT in teaching and learning in Science subject. The survey was distributed to teachers through personal contacts.

Figure 2 shows a bar chart that depicts teachers' perception in using IoT as a teaching and learning technology.

More than 80% of the teachers have shown interest in using IoT as a teaching and learning tool. For Science subject, all the teachers are open to the use of IoT as a tool to capture, share and use data for experiments in Science subjects. Figure 3 shows the impact of IoT as teaching and learning technology.

Based on Figure 3, 38% of the teachers believes that the use of IoT can provide impact on the student's excitement in learning science thus increasing their understanding on the subject as well. Only 31% of the teacher's response comes from the teacher's perspective. The teachers commented that IoT devices makes the capturing of data easier and quicker.

Teachers have always found ways to make their teaching exciting to the students. When the students feel that the subject is interesting to learn, it could help in their understanding of the subject. Teachers would try various methods which includes the use of technology. Teachers might have used gadgets and other technologies in their teaching thus, the findings of the survey are as expected. Nonetheless, it could be the teachers have not used IoT before so it could be interesting to see how this works out.

F. Phase 2 Findings

This study focusses on Unit 6: Force and Unit 7: Accelerator because these topics are seemingly convenient in embedding IoT as part of the technology for teaching and learning. The name of the IoT platform is called ScI-oTLS. ScI-oTLS consists of three major components namely ScI-oTLS IoT hardware, ScI-oTLS IoT software, ScI-oTLS IoT web-
based learning system. The hardware components of Sci-oTLS consists of the hardware required to develop the IoT device. Table 2 shows the requirements of the system.

<table>
<thead>
<tr>
<th>Users</th>
<th>Feature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teachers and</td>
<td>● Login to the system</td>
</tr>
<tr>
<td>Students</td>
<td>● Update profile</td>
</tr>
<tr>
<td></td>
<td>● Exchange messages</td>
</tr>
<tr>
<td></td>
<td>● View experiment data (i.e speed,</td>
</tr>
<tr>
<td></td>
<td>time, location)</td>
</tr>
<tr>
<td>Teachers</td>
<td>● Upload teaching materials</td>
</tr>
<tr>
<td></td>
<td>● Share teaching materials</td>
</tr>
<tr>
<td>Students</td>
<td>● Perform learning activities</td>
</tr>
</tbody>
</table>

Table 2: Sci-oTLS Website Functionality

Figure 4 shows the system architecture of Sci-oTLS. The users of Sci-oTLS are the teachers and the students from various schools.

Each school will have a number of IoT devices. The IoT hardware consists of sensors to measure speed, distances, and other relevant data. The IoT devices can be attached to any moving objects in the class or outside of the class. The sensors will capture the data such as speed, time, coordinates, and others so that students can use to calculate force or acceleration or any other variables. The Sci-oTLS software concerns with programs to read these data from the sensors and send the data to servers for storage, share and access. Sci-oTLS website is a web-based learning system that relies on the data capture by the IoT devices. This data can be accessed, shared and presented in meaningful way to facilitate teaching and learning of Science. The website also allows teachers to share and update learning activities with teachers and students from other schools. The teachers can be creative in thinking on how the data can be capture. For example, teachers can use radio-controlled car as a moving object and the sensors can capture the car’s speed and distance. These data are stored to the database for the use of other teachers and students from other schools. The IoT-based system will be evaluated in terms of its usability and acceptance. Participating schools will be equipped with the IoT hardware and software. and the hardware will capture the data are captured and stored in the database.

V FUTURE WORK

The limitations of this study will be addressed as the future work. The participants of the survey are small. The intention is to get some insights on how teachers perceived IoT as a tool for their teaching and learning. Generally, the teachers are open to the idea of using IoT in teaching and learning but the sample is small. The future work of this study also includes interview with the teachers on the subject to strengthen the findings on student's perception. Apart from teachers, the Year 6 students need to be part of the survey as well. This is to see the impact of IoT towards their learning of Science.

The development of Sci-oTLS is still a work in progress. Currently, the Arduino board and sensors have been developed and attached to a 2-wheel smart robot car chassis together with its Blynk program on the smartphone as the device controller. For the Sci-oTLS website, the focus is trying to extract the data that have been captured by the sensors and stored on the database.

VI CONCLUSION

The growth of IoT and cloud technologies have opened new possibilities for a smart school in Malaysia. This study presents the use of IoT in facilitating the teaching and learning of Science subject. This study intends to contribute to the declining of interest towards STEM subjects in Malaysia as highlighted by many studies. Existing studies also indicate that, student learning experience is one of the factors that contributing this decline. Thus, this study attempts to make the learning of science more interesting by adopting IoT that provides data that can used and shared to other teachers and students. Schools can collaborate in learning science because IoT not only provides the data but the connection and application as well.

In this study, a small-scale survey was distributed to teachers to know their views on IoT in teaching and learning and most of the participants are open to the use the technology for the sake of student's learning experience. The teacher's perceived that IoT has an impact on student’s excitement in learning science and also enhances student's understanding of the subject. The scope of prototype development is Unit 6: Force and Unit 7: Speed as these two topics opens up opportunity for the use of IoT device to capture data. The Sci-oTLS database store the data and the website displays it for the teacher to use it as part of the
student’s learning activities. The development work will continue, and the limitation of this study will be addressed in future work.

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Challenges in Implementing Online Language Assessment-A Critical Reflection of Issues faced amidst Covid-19 Pandemic

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ABSTRACT
Over the years many literature on language assessment continue to highlight a myriad of issues and challenges. The delivery of tertiary language courses including their assessments components were put to the test during the recent outbreak of Covid-19 pandemic that necessitates total shift to online mode from the previously conventional or partially online. Due to this circumstance, this paper aims to identify the challenges faced by language lecturers in administering assessment in the online mode and the need to plan good mitigation strategies. Qualitative data was elicited from twenty one key language lecturers as purposive samplings from eleven public universities. Based on basic Delphi approach, they were grouped according to three expertise domains namely online language learning, language curriculum and pedagogy. The expert respondents gave inputs and views to questions via structured written interviews as well as follow-up oral interviews. Emerging themes from the qualitative responses point towards ten challenges representing four categories of issues namely infrastructure, lecturers’ online assessment literacy, language learners’ commitment and integrity and absence of specific implementation guidelines for online assessments. The findings also indicate that specific online language assessment guidelines and framework is deemed necessary to ensure best educational practices are applied to ensure attainment of course and programme outcomes.

Keywords: online assessment, literacy, language courses, challenges during pandemic

I INTRODUCTION
The outbreak of Covid-19 pandemic brought about education challenges to the routine physical face to face teaching and learning processes due to closure of institutions, movement controls and lock-downs. Although this phenomenon has been described as a disruption or crisis situation, some see this as the big push for serious technology integration and full online learning adoption (Li & Lalani, 2020). The effort to resort to digital learning via online mode and to substitute physical face to face learning sessions with online learning have been described as desperate damage control effort, crisis management measures and act of innovations to mitigate new arising challenge. Among the crucial area affected is the administration of assessments which have been predominantly delivered via pen and paper, sit-down conventional mode and in particular the summative assessment (Cancino & Capredoni, 2020). As language courses have slightly different nature in terms the learning outcomes to be attained, the need to assess the required real time language performance, abilities and range of skills, it poses great challenges to educators in times of pandemic.

II PROBLEM STATEMENT
Demand for graduate with communicative competence who master lingua franca such as the English language has been escalating due to growth in businesses and economic activities. Even Malaysia Qualification Agency (MQA) and professional bodies like the Malaysian Engineering Accreditation Council (EAC) have emphasized language mastery and communicative competence as part of the 21st century educational goals to be attained by undergraduates. This is pertinent as academic grades churned out for undergraduates through assessments will be the tipping point for decisions on employment purposes by companies (Ahmad Tajuddin, 2015). The emergence of digital education and the increased emphasis for English language mastery for 21st century employability and career growth have yet to increase graduates’ attainment in this area. Studies have shown that the lack of technical competencies, communicative abilities and skills to seek employment as the primary reasons for many graduates to continue to be jobless (Hanafi & Zaid, 2014). During trouble times like the current Covid-19 pandemic, delivery of academic programmes are severely affected and eventually, the credibility of grades awarded for undergraduates, the assessment procedures undertaken and the overall quality of academic programmes will be doubted by the community that comprise parents, employers and the public in general if graduates continue to display poor attainment of the desired attributes.
In relation to the above, Pill and Harding (2013) describe literacy in language assessment as a challenging range of abilities requiring language instructors to acquire assessment knowledge, construct items, assess items and engage in analysis of data from language assessment. Similarly, numerous studies have highlighted gaps in terms of assessment beliefs held by language educators’ as compared to those of assessment professionals’ caused by insufficient assessment engagement, lack of assessment exposure and limited training opportunity (Sheehan & Munro, 2017). Many language educators reported on their minimal roles in assessment matters and this has reduced their engagement within a wider range of assessment undertakings such as in developing and implementing assessments (Plakans & Gebril, 2016). In addition, general perceptions on communication has shifted due to the advent and availability of technology for daily tasks as well as for essential domain like higher education where learners have preference for enhanced communication and additional attention from instructors via digital learning (Kotz, 2016). This is a prevalent trend as 21st century digital natives have higher data and information consumption via daily communication and engagement on digital platform and technologies and the running of conventional classroom teaching and learning is apparently not adequate anymore in meeting the digital needs of learners (Chan & Yee, 2009). All these seemingly negative scenario becomes more critical within the domain of digital learning as it requires a different set of approaches for instructional purposes.

### III RELEVANT LITERATURE

The rapid growth in demand for digital education for learners via flipped and blended platform has become a primary trend in higher education (Norton & Cakitaki, 2016) along with active transformations of institutional digital set up and approaches in educational instructions (Beeker, Cummins & Freeman, 2017). Though student assessment would influence the quality of the graduates produce, many assessment strategies are found to inhibit this intention (Adnan, Wan Abdullah, Muda & Mohd Sallem, 2020). In the context of present digital education scenario, Helfaya and O’ Neil (2019) observe that e-assessment and e-feedback are not still well-developed and widely used methods at many universities. Moreover, many existing management system for online learning have limitations in supporting educational functions such as generating assessment items which are well aligned to and aptly gauge the target course learning outcomes of academic courses (O’ Sitthisak, Gilbert & Davis, 2008). Higher institutions which are not fully embracing this digital transformation will not be well positioned to undertake technology adoption, and integration and shift to digital and remote learning from existing conventional teaching and learning mode (Salmon, 2005). There is an apparent dearth of studies conducted on educational practices of teaching and learning utilised by higher education personnel for academic programmes offered via fully online or hybrid mode like flipped or blended version (Montelongo & Eaton, 2019). Digital learning via online education offer immense potential and outcomes for higher education fraternity like undergraduates, faculty member and administrative staff in terms of avenue for innovation and best practices (Montelongo, 2019).

### IV METHODOLOGY

Data for this qualitative study based on purposive sampling was elicited based on basic Delphi approach that comprised three expertise grouping of key language lecturers who are well versed in online learning, language curriculum and language pedagogy. A number of qualitative educational research have incorporated the basic Delphi approach where experienced personnel or experts are identified and grouped according to domain expertise and get to respond the data elicitation tools for a specific topic. Literature review sources and initial interviews with five experts guided formulation of the interview questions and protocols as well as the choice of coding process and the topic and identification of themes. The transcribed qualitative data was analysed thematically together with member-checking and triangulation procedure to verify their accuracy and validity. This was followed by data presentation in the form of non-linear diagrammes and matrix to assist easier viewing and comprehension of the discovered points. This also facilitated easier analysis of the results juxtaposed with current literature on the subject matter. A total of twenty one academicians from the three expertise grouping responded to written interviews via google form containing structured questions and via follow-up oral interviews.

### V FINDINGS

This study provides essential insights into the present scenario of how the rapid growth in 21st century technological advancements impacts higher education in terms of digital teaching and learning implementation. This is in line with the surge in preference for interactive online education among the present millenials who are considered as digital natives. This echoes the study by Killen, Beetham and Knight (2017) that educational institutions need...
to essentially cultivate and work towards establishing proper infrastructure, responsive policies and positive culture that complement and spur effective digital practices.

Twenty one key language academicians from eleven public universities formed the three expert groups comprising 14 males and 7 females, participated in this study. The Language Curriculum group averages 22.4 years in work experience, followed by the Online Learning group with 18.3 years and the Language Pedagogy group with 19.6 years. These respondents also hold important designations at their institutions such as Deans, Deputy Deans, Head of Programmes, Head of Units, Coordinators and Resource Person. Fourteen are holders of PhDs while seven academicians have Masters qualifications.

Table 1. Respondents’ Demographic Information

<table>
<thead>
<tr>
<th>Expert Grouping</th>
<th>Public Universities North (N), Central (C), East (E) &amp; South (S) Regions</th>
<th>Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Online Learning</td>
<td>MSu (UniN1), IMa (UniN3), AAz, MRMa (UniC2), MMo (UniC3), AA (UniE1)</td>
<td>Dean, Resource Person, Head of Unit 18.3 years average work experience</td>
</tr>
<tr>
<td>6 Unis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 Males</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Female</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Language Curriculum</td>
<td>ISu (UniN1), HDz (UniN2), ZHa (UniC1), HHa(UniC4)</td>
<td>Dean, Deputy, Head of Unit Head of Program, 22.4 years average work experience</td>
</tr>
<tr>
<td>7 Unis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 Males</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 Females</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Language Pedagogy</td>
<td>FZu (UniN1), MMus (UniE1), AA (UniC2), MZO (UniC3), AAM (UniC4), NHa (UniS1)</td>
<td>Head of Unit, Senior lecturers, Resource Person 19.6 years average work experience</td>
</tr>
<tr>
<td>7 Unis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 Males</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Female</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The findings from this study reveal that the previously partially recommended formative online language assessment had to done full-swing in online mode due to the Covid-19 scenario. Even the sit-in summative final examination had to be transformed into a more flexible online version language tasks. All these were done via university based Learning Management System (LMS) along with other synchronous online interaction tools that have multiple functionalities like recording and noting attendance. All expert respondents agreed that the LMS and functionalities of the online communication tools could not fully substitute the personal touch and impact of conventional face to face classroom assessment sessions. All of them also concurred that existing LMS and commonly available online tools are inadequate to replace face to face assessment especially to gauge summative productive skills which are real-time performance based like oral responses, group interaction and writing. Rather, they must be applied in combination via proper selection and planning.

Table 2 Sample Responses and Themes

<table>
<thead>
<tr>
<th>Expert</th>
<th>Sample Responses</th>
<th>Themes</th>
</tr>
</thead>
<tbody>
<tr>
<td>FZu</td>
<td>Creativity in planning, constructing and performing assessment is lacking.</td>
<td>Lecturers’ online assessment literacy</td>
</tr>
<tr>
<td>UniN1</td>
<td>Not exact coherence, probably due to no proper guidelines on how the test should be administered, which platform to ‘park’ the test. The students to sit for, as well as no proper way to monitor the students from copying or cheating as they sit for the test.</td>
<td>Lack of implementation guidelines</td>
</tr>
<tr>
<td>AAA</td>
<td>Questionable as we couldn’t control the students. We have to consider many aspects. First whether to limit the time in order to ensure they do the questions themselves. The same time, we need to consider the internet constraints faced by them.</td>
<td></td>
</tr>
<tr>
<td>UniC2</td>
<td>Learners’ readiness, integrity, validity and reliability of process</td>
<td></td>
</tr>
<tr>
<td>MMo</td>
<td>when you are talking about online assessment, it will incur costing problem for example certain dollars for an online assessment platform that can really observe the candidate in terms of validity of answering the questions.</td>
<td></td>
</tr>
<tr>
<td>UniC3</td>
<td>The need for specific guidelines</td>
<td></td>
</tr>
<tr>
<td>AAr</td>
<td>Costing and quality of online tools</td>
<td></td>
</tr>
<tr>
<td>UniE1</td>
<td>Introduction to the recommended tools and the purpose they serve and how to use them effectively will be useful.</td>
<td></td>
</tr>
</tbody>
</table>

The assortments of relevant responses above do not paint a rosy picture on the state of affairs of online learning and online language assessment at public universities in Malaysia. Every single expert respondent has touched on the crucial issue of internet bandwidth, speed and stability to sustain the online learning sessions. Each respondent also acknowledged that they were aware of the equity and disparity issues in terms of internet access for the majority of their students who were at their respective homes throughout the country. Cases of disruptions and technical glitches to online lessons
experienced both by the respondents and their students were also narrated.

The second pressing issue is the competency in technology integration by language educators as observed and experienced by the experts. The range of familiarity, competency and ease of exploring the full potential that the online tools and online platform or management system offer, vary between educators. Apart from the basic online mode for lecture delivery and interaction, the tentativeness of the less ICT/Online savvy group became apparent during this pandemic. Even for the online savvy language educators, many of them narrated the challenge of conducting assessment in terms of planning, executing and monitoring the reliability and validity of the processes particularly for the summative assessments. For instance, identifying the suitable and balanced assessment tools for the specific language skills be it receptive or productive skills was quite challenging due to issues of tools availability, assessment literacy, online literacy and internet access.

Four categories of issues could be detected from the list of ten challenges that emerged from the qualitative expert response. The first issue is infrastructure that covers access to the internet, bandwidth, speed and stability plus availability of effective management system platform and recommended tools. Second is the issue of literacy and technology competency to effectively plan administer and monitor language assessment via online mode. Third is the rate of participation and commitment of the undergraduates in the online learning and assessment process, as the party most affected and most pressured to undergo the tertiary education and attain the expected goals and outcomes, within a less conducive condition. Fourth, there is an absence of specific online language assessment guideline that explicitly spell out best practices, mitigation strategies, alternative measures and a host of tips for campus fraternities, administrators, language educators and undergraduates to be aware of and rely upon for language assessments. Such guidelines should be able to assist all parties such as less online savvy lecturers to lessen time taken for preparing online materials, improve adoption of technology in classrooms and enhance learners to achieve the intended learning outcomes of the language courses.

The figure above captures the justifications and reasons put forth by the experts respondents from all the three groups for a specific online language assessment guidelines and framework to be developed and put in place.

Stakeholders and higher education authorities were also urged by the expert respondents to be adept at managing issues revolving around technology acceptance in education such as literacy, access, infrastructure and cost. Crucial attention must be paid to the effort to develop guideline that recommends effective implementation best practices for online language assessments.

Findings from this study have high transferability to other institutions with similar contextual set-ups as they are relatable to the current realities of the respective institution. The expert groupings have a general consensus that online learning despite being actively propagated to be the main stream practice was not fully implemented in full-swing by academicians until the outbreak of the Covid-19 pandemic that inevitably forced its use for teaching and learning purposes.
VI DISCUSSION

There is an increasing demand for quality graduates for employment purposes that necessitates assessments and grading done via online and web-based platform to ensure their real competency is properly gauged (M.Ilahi, Cheniti & Braham, 2013). Cancino and Capredoni (2020) believe on the crucial need to expose learners to new assessment tools from the beginning of any programme to enable them to familiarize with differences in terms of tasks and formats as well as allowing them to adapt to the required new strategies for attempting online assessment tasks. Likewise, Phil and Harding (2013) believe that the shift from conventional from paper assessments to digital version could be challenging and not swift for higher institutions that lack technology adoption and not putting in place proper online response systems for assessment purposes.

Despite the immense benefits generated for education as a result of technology adoption and digital tools integration for learning purposes such as for assessing learning attainment via web-based or online mode, disparity and shortcoming could still be detected between summative and formative online assessment tools capability. In addition, there is clear inadequacy in the provision of detailed automated feedback and achievement summary by learning management systems (LMS), particularly for big scale and multiple tasks (Cagliero, Farinetti & Baralis, 2017). Most common is the inability of many online learning tools and systems to automatically generate detailed feedback or summaries for outcomes from online assessment for quick learning input for learners and most importantly for them to be able to follow the recommendations that relate to their learning needs (Killen, Beetham & Knight, 2017).

The current millennial generation who are digital natives are sensitive to even small things from digital media like the online layout of an online instructions. Such minute details could affect their perception on online item usability and may seem difficult for them to follow and understanding what was required from the task. Being users of learning and assessment through online tools would come naturally for this generation as their engagement would be easily elicited as they are able to relate behaviourally and cognitively to the digital materials and platform they are familiar with. Thus, they are more prepared to remember the lessons, retrieve the information required and achieve the intended learning (Cardoso, 2011). Such realities were also captured by Buragohain (2020) who reported that digital immigrant language instructors need to be adept with the whole range of digital necessities of the millennial language learners who are digital natives and develop competency to apply 21st century digital tools in creating interactive online language classroom sessions.

As such, Kent (2019) in his investigation of the efficacy of online response tools for formative assessment, emphasizes on the need to develop teacher-interaction and peer-interaction techniques. This will enable interactive and active learning environment to be created where learners could feel engaged and identify their gaps in online learning. Due to current circumstances, there is also a pressing need for a framework of use or guidelines for implementation of online language assessment that will empower language educators to effectively plan and administer competence-based assessments and adhere to principles of evidence based validity, reliability and feedback (M.Ilahi, Cheniti & Braham, 2013).

All key language lecturers as expert respondents for this study have echoed similar observations and views as depicted in the above scenario and cited literature. They pointed out realities and challenges that require mitigation in the aspect of online assessment literacy of educators, learners’ familiarity and readiness, lack of online assessment implementation guidelines, internet access and stability of internet infrastructure. Generally, all the experts concur that online learning as a whole is not fully embraced by the higher education community as it has not yet become a culture.

VII CONCLUSION

This findings from this study are significant in providing insights into the state of affairs of the online delivery academic courses at universities. Understanding the nature of online language assessment challenges highlighted by this study will pave the way for mitigation measures and lay smooth path in developing effective online language assessment implementation strategies. The Covid-19 pandemic serves as a good wake-up call and has unearthed a whole range of inadequacies that must be addressed. This study also highlights justifications for developing explicit framework or guidelines for best practices in online language assessments to uphold validity and reliability principles and best practices. Such measure is crucial in ascertaining that the grades awarded truly reflects undergraduates’ learning attainment and mastery of the languages that they learn.

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Test Case Quality: Issues and Limitations in Agile Software Development

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ABSTRACT
In the Agile software development environment, continuous changes in user requirements lead to an increase in the importance of a testing process to demonstrate a quality product. As test case is a cornerstone of the testing process, it is important to emphasize the high-quality construction of the test cases. Hence, testing process should be adequately planned and evaluating the quality of test cases can help to explain some important issues associated with software testing. However, findings from literature and the critical analysis of empirical studies revealed that less academic research has investigated the test case quality in Agile software development process. Therefore, with a specific reference to scrum methodology, the purpose of this paper is to identify the problems of test case quality in Agile software development by reviewing the existing work concerning testing quality in Agile. This paper has made a useful contribution by illustrating and clarifying the shortcomings of test case quality in agile projects and pointing out the factors that help to improve it.

Keywords: Agile software development, Agile testing, Scrum, test case quality.

I INTRODUCTION
The nature of test case construction is to obtain the necessary software coverage under testing (Tran et al., 2019; Yamaura, 1998). It is important to get good test cases that have high chance to expose unknown defects at low cost, ability to increase performance and robust to meet the users’ requirements (Gómez et al., 2016; Kamde et al., 2006). This effort will consequently result in producing quality software (Adlmeo et al., 2018; Tran et al., 2019). Assessing the quality of test cases is necessarily important in order understand how much testing is required and where potential testing attempts should be carried out (Ahmed et al., 2016). The test case quality (TCQ) is therefore capable of evaluating the quality of a software system (Pflader et al., 2008). A quality test case is referred to a test case that has a high chance of revealing defects in a minimum effort, providing more detailed results, increasing system performance at a lower cost, and has a high chance of detecting unknown defects (i.e. the higher the quality of a test case, the more the potential to detect failures) (Gómez et al., 2016; Kamde et al., 2006).

The continuous changes in Agile software development methods requires many efforts to be performed on testing activities (Beck, 2003; Humble & Farley, 2010). The efficiency of testing activities depends largely on the TCQ, which directly defines the quality of testing (Causevic et al., 2012; Lai, 2017b). Although TCQ appears to be an effective solution for exposing software defects, in Agile methodology it still has some issues and problems that need to be studied and addressed. Therefore, it is important to identify the shortcomings of TCQ in the Agile testing process, to understand what the underlying issues are, and to identify the potential solutions suggested that require further investigation.

Hence, this paper begins with discussion on the concepts in TCQ and highlights the importance of this concepts in assuring software quality. The second section introduces the Agile software development process. Section 3 is the overview of Agile testing, and testing activities in scrum. Section 4 discusses some current and previous identified issues and limitations of TCQ in Agile software development and proposed solutions while section 5 concludes the paper.

II AGILE SOFTWARE DEVELOPMENT
Agile software development has become a preferred method for developing software with an increased adoption by companies worldwide to meet software complexity and evolving user demands (Matharu et al., 2015; Penmetsa, 2017). Agile software development methodology is a process for workable software which basically divide an entire project into manageable small sizes that can be separately handled for time items change risks and time control (Rajasekhar & Shafi, 2014). Unlike in the traditional development paradigm, Agile process do not have separate coding and testing phases (Gil et al., 2016). Agile software development methodology is a process for workable software which basically divide an entire project into manageable small sizes that can be separately handled for time items change risks and time control (Rajasekhar & Shafi, 2014).
Several iterations, each one the same length, may be needed to deliver an entire theme or epic (Crispin & Gregory, 2009). Customers provide feedbacks to the system, in the form of stories, for a developed and tested iteration. The stories of the customers only stopped when the levels of functionalities required are delivered (Olausson et al., 2013). A new feature may require multiple iterations. Every iteration has to be fully integrated and carefully tested as a final production release (Penmetsa, 2017). Since the iterations make the software development effective and efficient to meet requirements of the customer and contribute in the success of the project, it also make the development process a little more complicated and time-consuming (Javed et al., 2019). The reason for this complication is that each iteration in Agile software development contained many activities (Javed et al., 2019). Short iterations in Agile software development implies that there must be an efficient testing process to avoid too much time being spent in the iteration for test preparation rather than on the actual tests running (Olausson et al., 2013).

A number of Agile methods has been reported in the software domain literature which have been adopted by the software community because of advantages which include focus on quick software delivery, changing requirements and customer satisfaction (Kayes et al., 2016). Notable amongst these methods are Extreme Programming (XP) (Beck, 1999), Scrum (Schwaber & Beedle, 2002), Feature Driven Development (FDD) (Palmer & Felsing, 2001), Adaptive Software Development (Highsmith, 2013), Crystal methods (Cockburn, 2004), Agile Unified Process (Ambler, 2005), and Dynamic Software Development Method (DSDM) (Stapleton, 1997), however Scrum is the most commonly adopted method in Agile software development (Aamir & Khan, 2017; Kayes et al., 2016). As reported in the 14th State of Agile (StateOfAgile, 2020) that the most organizations adopt Scrum (58%) and when calculate this percentage with the hybrid methodologies that include Scrum, it becomes 85% of organizations use Scrum. Therefore, it is important to show the scrum process and activities as example to show the development process and activities in Agile software development methods.

Scrum is one of the Agile software development iterative and incremental methods. It has been developed for managing the systems development process. It is an empirical approach applying the ideas of industrial process control theory to systems development resulting in an approach that reintroduces the ideas of flexibility, adaptability and productivity (Schwaber & Beedle, 2002). It proposes continuous adaptation of the project planning, using cycles called sprints, where each sprint is a time-boxed lasting for between one to four weeks as well as each sprint produces a new version of the product with new features (Gil et al., 2016). The unique features of Scrum according to (2015) are collaboration, daily meetings, product backlog, sprint backlog, and roles. The Scrum team should have skills in designing, developing, testing, and documenting the product (Anwer et al., 2017). See Figure. 1 illustrates the scrum process from (Javed et al., 2019).

The process and standards of scrum process are properly followed by the organizations (Tahir, 2019). And due to the people are involved in the development process, who are product owner, scrum master, developers, and quality assurance engineers (testers) (Abrahamsson et al., 2017; Kayes et al., 2016). Sprints are planned by selecting items from a product backlog, estimating the effort needed to complete each item selected for the sprint, competition, product quality, and available resources (Anwer et al., 2017). During sprints, the team groups up every day for 15 minutes or less for a daily scrum meeting, where the status of the tasks is tracked and they take the corrective action for any speed interruption (Anwer et al., 2017; Matharu et al., 2015). In this meeting, team members tell what they did yesterday, what they would be doing tomorrow and the blocks and obstacles they would face (Anwer et al., 2017; Matharu et al., 2015).

III AGILE SOFTWARE TESTING

Brian Marick provides a philosophy of Agile testing as “a style of testing, one with lessened reliance on documentation, increased acceptance of change, and the notion that a project is an ongoing conversation about quality” (Leffingwell, 2010). Rajasekhar and Shafi highlighted the aim of testing in both Agile and traditional method is same, but the difference is the team constituent, where the testers in Agile are required to give quality infusion support through the entire team (Rajasekhar & Shafi, 2014). The early feedback from testing is the good thing for testers in Agile projects as this helps developers to identify the
issues at an early development stage (Tripathi & Goyal, 2014).

In Agile software development, the whole team is responsible for the quality, every one of the team also can write test cases not only the testers (Laing & Greaves, 2016). This helps the team comprehend that testing is an activity all of them need to be involved in (Laing & Greaves, 2016). Agile testing has five differences with traditional testing (Laing & Greaves, 2016), as represented visually in testing manifesto form in Figure 2.

![Figure 2. Testing manifesto](image)

In Agile software development, testing starts at the project beginning and it is recognized as an integral part of software development with coding (Khan et al., 2016). The testing is done in each iteration, after user stories are prioritized and selected which tasks start to be achieved, it is immediately tested and released to the customer and when all tasks are developed and delivered, all tasks are integrated and tested (Rajasekaran & Dinakaran, 2015). Software testing is vital part of any project which can be designated as a component of quality assurance. Testing process has more value for demonstrating quality product in Agile environment (Harichandan et al., 2014).

Compliance to checklist and requirement documents is not a strict obligation in Agile testing. The goal is simply to comply with basic necessities for completing the requests of the customer (Penmetsa, 2017). The continuous changes of requirements of customer increase the importance of software development and testing practices in Agile software development methods (Penmetsa, 2017). Agile testing enables the organization to be nimble about uncertain priorities and requirements (Penmetsa, 2017). The need for large numbers of tests is magnified in Agile software development practices, that require extensive testing to be performed (Beck, 2003; Gay et al., 2016). Hence, the lack of testing resources leads to poor quality (Chomal & Saini, 2014; Rajkumar & Alagarsamy, 2013).

The testing tasks in Agile methods should be prepared properly to cater for continuous changes in the requirements (Yu, 2018). In order to nimbly test a software system during Agile software development, it is crucial to identify what to test (e.g., requirements) and how to test it (i.e., test cases) (Olausson et al., 2013). The requirements are normally discussed by the developers and testers in order to identify the acceptance criteria test cases that need to be designed (Penmetsa, 2017). The requirements in Agile are described as user stories, which is formulated as one or two sentences in the everyday language of the user (Crispin & Gregory, 2009; Lai, 2017a). Each story is written on a small 3 by 5 inches paper note card to guarantee that it is not too lengthy (Crispin & Gregory, 2009). A well written user story will describe what the desired functionality is, who use it for, and why it is useful (Lai, 2017a). Correct, complete and consistent user story contents can help generate good test cases (Lai, 2017a).

Agile testers are responsible to plan and estimate user stories in a product backlog and specifying acceptance criteria to create test cases for each user story before they can be considered for inclusion in an iteration (Black, 2017; Kayes et al., 2016). Therefore, at the start of all testing processes, it is significant to document and execute test cases. The corresponding relationship of test cases and user stories should be one-to-many, which implies that, a single user story may be attributed to multiple test cases. The complexity of the user story may therefore increase the number of test cases (Aamir & Khan, 2017). Olausson et al. (2013) provides an example of user story, related acceptance criteria and test cases, as illustrated in Figure 3.

![Figure 3. A user story, acceptance criteria and test cases](image)

In Agile software development, test case quality is concept highly regarded as an important testing activity where it is one of the quality features that directly define the quality of testing that can lead to quality software and rapid delivery (Causevic, Punnekkat, et al., 2012; Lai, 2017b). The test cases in Agile must be developed as the requirements evolve...
Initially, any new feature is not known very well for the Agile team, so typically it needs to run test cases on all defined acceptance criteria. When the feature has been completed, it should be tested according to the created test cases and that it works as expected. After that, there is a need only to run tests for requirement changes validation, which means how to know the tests to run are necessary for the team.

Speeding up the process of testing to keep up with the short iterations is another aspect of the Agile story worth of note (Olausson et al., 2013). Testing activities in Agile will be explained in this paper through Scrum testing activities as follows.

Every cycle (sprint) in scrum affects testing. The testing starts during initial stage of a sprint (Kayes et al., 2016). Where, unclear requirements are clarified, system test cases are written, and test data are prepared by the tester with the product owner (Kayes et al., 2016), because the importance of testing in Scrum, Kayes emphasizes role of a tester in Scrum process. To show clearly the activities of the testing in Scrum, the tester role in Scrum will be explained.

The testers focus on ensuring the deliverables quality. Their role is started from the beginning of sprint to reduce the cost of the requirement and design errors (Kayes et al., 2016). The role of testers is more toward guarantee of product quality and not only for writing and run test cases (Kayes et al., 2016). Testers are more integrated to the development team (Harichandan et al., 2014). Itkonen et al. (2005) say that Agile software development can be benefited through a team of professional testers. Most quality assurance and quality control activities are skipped in Scrum because of the absence of a dedicated quality assurance team and its short cycles (Aamir & Khan, 2017). This short duration of sprint leads to Scrum team does not take quality into consideration as well as a developer cannot write a bug-free code when working under pressure (i.e., short duration of a sprint) (Aamir & Khan, 2017).

The activities of Scrum testing are illustrated in Figure 4. In the initial sprint phase, the tester writes test cases, prepares test data, clarifies requirements and conveyes updated requirements to development team and ensures the environment of the test (Kayes et al., 2016). In the sprint period, he writes checklist which is a brief version of a test case. The checklist is written for sprint backlog, which is a set of prioritized items from product backlog. The checklist is executed via developers after the sprint backlog item is developed. The checklist assists to detect bugs early. The tester also assists the developers to write unit test cases and ensure the reviews of the code are done on time (Kayes et al., 2016).

During the sprint halfway, the tester shows to the product owner a sneak peek of the product, which is a demonstration of what has been done until that period. Finally, the developed features are testing under the tester responsibility based on the test cases which he writes. The tester deploys the sprint deliverables to a test server for regression testing when it became developed. The tester prepares test plan and run test cases in test server. When regression testing is completed, the developers perform the smoke test and the tester verifies the release (Kayes et al., 2016).

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**Figure 4. Scrum testing activities**

<table>
<thead>
<tr>
<th>QA prepares</th>
</tr>
</thead>
<tbody>
<tr>
<td>- System test case</td>
</tr>
<tr>
<td>- Checklist</td>
</tr>
<tr>
<td>- Test data</td>
</tr>
<tr>
<td>- Clarify requirements</td>
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<tr>
<td>- Ensure test environment ready</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>Stage Deployment</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Developers perform smoke test</td>
</tr>
<tr>
<td>- QA verifies release</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>Sprint Planning</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Developers start coding</td>
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</tbody>
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<table>
<thead>
<tr>
<th>Feature Freeze</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Test deployment</td>
</tr>
<tr>
<td>- QA prepares test plan for test server</td>
</tr>
<tr>
<td>- QA + Developers test all PBLs in the test server</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>QA</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Developers execute checklists</td>
</tr>
<tr>
<td>- QA + Developers perform local pair testing + Mainline test</td>
</tr>
<tr>
<td>- QA + Developers ensure unit tests are written and passed</td>
</tr>
<tr>
<td>- QA + Developers ensure code review is done regularly</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sprint Retrospective</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Bug fix</td>
</tr>
</tbody>
</table>

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http://www.kmice.cms.net.my/
IV  ISSUES AND LIMITATIONS OF TEST CASE QUALITY

A test case represents the test instructions for a tester. It contains a set of conditions or variables under which a tester will determine whether a system satisfies the requirements or works properly (Bilal et al., 2017; Olausson et al., 2013). In Agile methodology, test cases are written by tester in an initial Sprint phase. He illustrates and clarifies the requirements for each user story just some days or hours before beginning the actual coding (Kayes et al., 2016).

The good-enough testing of software should have sufficient assessment of quality at a reasonable cost (Goeschl et al., 2010), and the good quality of test cases are very important for assuring the quality of software (Tran et al., 2019). Unfortunately, writing good test cases is one of the most difficult and time consuming testing activities (Serra et al., 2019). In writing test cases, it is notable for ensuring that testing could achieve a certain level of thoroughness (Romli et al., 2020). Missing test target, procedures, or expected result lead to reduce the quality of test cases (Jovanovikj et al., 2018).

The test cases help testers to find out problems in the requirements or in the design of software system (Kayes et al., 2016). The requirements in Agile projects are not sufficiently elaborated (Kärkäinen & Pirta, 2018). It can be inconsistent, incomplete and incorrect (Lai, 2015). In addition, both user stories and acceptance criteria, are not usually defined properly and Agile team does not emphasize on the quality standards which makes test cases difficult to be derived (Fischbach et al., 2020; Padmini et al., 2018). According to Uickey (2012), the test cases are never written upfront with the requirements or user stories. Again, there is a lack in traceability between test cases and related acceptance criteria (Fischbach et al., 2020). In addition, unsystematically acceptance tests cause excessive or incomplete test cases (Fischbach et al., 2020).

Although works have been identified in previous studies on Agile testing, however, efforts geared specifically on TCQ are very meager. Investigation into the result of the existing Agile TCQ models reveals a number of gaps that are still required to be filled, as majority of studies related to TCQ focused on traditional methods. In addition, there is misalignment in defining the TCQ among academy, industry, and practitioners (Tran et al., 2019), defining TCQ from practitioners’ perspective is still lacking in empirical studies. Some studies (Adlomo et al., 2018; Bowes et al., 2017; Jovanovikj et al., 2018; Kamde et al., 2006; Kochhar et al., 2019; Tran et al., 2019) focused on the TCQ and most of them identified the factors based on practitioners’ perspective. Unfortunately, these studies are conducted on traditional development methods. Where, the traditional development does not support requirement changing, not fast delivery, not iterative, and not incremental. Hence, these models can be difficult to apply for the current practices in Agile methods. Rajasekaran (2015) stated that the Agile team sometimes does regression testing repetitively without a clue on when to stop a particular sprint and deliver. Moreover, they reported that Agile methods (like Scrum) faced many testing issues such as inconsistent and inadequate unit testing, the huge and quickly changing in requirements.

On the aspect of continuous changes of requirements, Agile methodology was adopted by many companies nowadays (StateOfAgile, 2018). The requirement changes lead to changes in user stories, which lead to changes in the testing scope (Padmini et al., 2018). Changes of user stories lead to changes in test cases, and this consequently wasting a lot of time and resources (Beer & Felderer, 2018; Padmini et al., 2018). To address the issues of Agile testing, a number of researchers have undertaken many approaches to increase the quality of Agile testing.

For example, Shrivastava and Jain (2010) proposed automated test case for unit testing (ATCUT). This study specifically focused on the testability of test cases and its effects when applied in TDD as well as ATCUT design metrics are not sufficient to measure TCQ which is designed for unit testing, which has less bug finding effectiveness (25% to 30%) as compared to System testing (85%). Thus it may cause some problems related to the software quality (Rajasekaran & Dinakaran, 2015). Kayes et al. (2016) also proposed a metric called Product Backlog Rating (PBR) to measure and monitor the testing process in Scrum, but this metric need further evaluation and it is focused on the testing process not on the TCQ. Aamir and Khan (2017) proposed an enhanced quality-focused model of scrum via performing start-of-the-art testing activities in Scrum in which they account for a test backlog to sustain test cases and to deliver quality work. However, this study focused on the quality of product backlog to enhance the quality of product without referring to the quality of test cases which are used to catch the defects.

Fischbach et al. (2020) identified 16 quality factors for six Agile test artifacts. However, they focused on the Agile test artefacts in general and they proposed only one quality factor of unit test cases is code coverage which is not enough to measure the quality of test cases. Unudulmaz and Kalipsz (2020) and Harichandan et al. (2014) proposed models to improve the Scrum process but they are not focused on TCQ. Causevic et al. (2012) conducted an
experiment to investigate the TCQ in TDD and traditional test approach by using three criteria which are not enough to measure TCQ in Agile software development as well as they used students as subjects in their experiment who do not have enough experience in this field.

In sum, these studies did not clearly address the issues of the quality of test cases in Agile software development. On the other hand, the study that clearly focused on TCQ in Agile is Lai (2017b). Lai proposed a test case quality measurement (TCQM) model based on four quality factors of TCQ which are qualified document, manageable quality, maintainable quality, and reusable quality. Even though, TCQM model is able to define the TCQ but there are some critical factors for the quality test cases which are still missing. For instance, complete and precise requirements which are crucial for writing effective test cases (Ahmad et al., 2019; Fischbach et al., 2020).

There have been studies focused on the efficiency of test cases (Adlemo et al., 2018; Kochhar et al., 2019; Shrivastava & Jain, 2010; Tran et al., 2019), effectiveness (Adlemo et al., 2018; Kochhar et al., 2019; Tran et al., 2019), readability (Adlemo et al., 2018; Bowes et al., 2017; Grano et al., 2018; Kochhar et al., 2019). Further, test cases should be repeatable to be high quality (Adlemo et al., 2018; Kamde et al., 2006). Also test case should be self-contained (Adlemo et al., 2018; Bowes et al., 2017; Kochhar et al., 2019), and understandable (Bowes et al., 2017; Jovanovikj et al., 2018; Kochhar et al., 2019; Shrivastava & Jain, 2010; Tran et al., 2019).

Other limitations of Lai’s TCQM model such as, it did not define the factors based on practitioners’ perspective, nevertheless, it is very important to define the quality of test cases (Tran et al., 2019). In addition, Lai’s TCQ model adapted Linear Combination Model (LCM), which does not define the measurement goal. Defining the measurement goals are important to clearly guide the practitioners in organizations to derive metrics for each factors (Fenton & Bieman, 2015).

In sum, majority studies utilize traditional development approaches but are unable to tackle the challenges and limitations of balancing the quality of software and rapid delivery. A second frequently encountered problem by prior studies is that there is no clear description how to measure and access the quality factors. Therefore, first, it is a need for further research on effective test cases quality based on very clear requirements and organizational goals. Secondly, since Agile software development is placing more emphasis on organizational goal and human expertise more research is needed to look into a wider or organizational artifact, that may strengthen the future findings.

V CONCLUSION

Software testing is a very important activity in Agile methods. A great influence on the testing process is writing and managing of test cases. It is crucial for Agile teams to understand the drawbacks of test cases, as this helps to write successful test cases in a short time. Therefore, this study concentrated on identifying the issues of test case quality in the Agile environment.

The test cases quality in Agile methods face some challenges such as the test cases are not written based on the requirements, limited requirements coverage, unclear requirements, less experience of the team members to write test cases, and missing some critical quality criteria that improve it such as requirement quality, tester experience, test case readability, understandability, specific, performance efficiency, independence, repeatability, and accuracy. These issues being clearly identified in this paper will serve as the basis for developing our test case quality measurement model that will aid in assessing quality test cases in Agile projects.

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Impact of Knowledge Management, Financial Resource, Innovation, and Foreign Direct Investment on Entrepreneurship

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2New Era University College, Malaysia, {shyuechuan.chong@newera.edu.my}
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ABSTRACT

The recent “Black Swan” event, Covid-19 is dramatically transforming the landscape of industry and business that will further damper the survival of necessity-driven entrepreneurs. The objective of the present study is to examine the roles of knowledge management, financial resource, innovation, and foreign direct investment on necessity-driven entrepreneurship. By using a sample from 37 countries spanning from the year 2010 to 2016, the panel regression random effect model finds that financial resource is the most critical factor as financial capital supports necessity-driven entrepreneurship in the venture creation process. The results show that knowledge management, innovation, and foreign direct investment are negative and significantly related to necessity-driven entrepreneurship. We also attempt to investigate the interaction between financial resource and knowledge management when analysing the relationship between knowledge management and entrepreneurial outcomes. The impact of knowledge management on necessity-driven entrepreneurship is contingent on the financial resource. The implications of the study reveal that: (1) financial credit from the banks cannot effectively enhance the survivability of necessity-driven entrepreneurship, which requires government-backed financial and support. (2) the stimulation on innovation and foreign direct investment may not benefit necessity-driven entrepreneurship as it is pushing them towards marginal market niches. (3) In the absence of adequate financial capital, necessity-driven entrepreneurship unable to reap the benefit from the cultivation of knowledge management. Hence, policymakers should ensure commensurate amounts of financial support and knowledge spillovers to reduce bankruptcy risk among necessity-driven entrepreneurs.

Keywords: Necessity-driven entrepreneurs, knowledge management, financial resource, crowding effect, economic crisis
According to the resource-based view (RBV) theory proposed by Barney (1991), the performance of entrepreneurs is primarily dependent on the availability of human capital, information, financial innovation and resources. A significant number of papers (Albulescu & Tămășilă, 2016; Berrill, O’Hagan-Luff, & van Stel, 2020) have documented the performance of entrepreneurs could be explained by the externality effects, which are knowledge spillover theory (the diffusion of knowledge can take place directly through the mobility of managers and employees, who are engaged by foreign-owned firms) and crowd out theory (negative impact may emerge when international companies compete with the same customers and domestic companies crowd out). The literature has unanimously agreed that knowledge management, financial resources, innovation and FDI are critical components of entrepreneurship. Most of the available empirical studies use OE as the focus of study to measure entrepreneurial activities (Fuentelsaz, Matías, & Montero, 2018; Pathak, Laplume, & Xavier-Oliveira, 2015) or investigating the issue of entrepreneurship in a developed region (Millán, Congregado, Román, Van Praag, & Van Stel, 2014; Rusu & Dornean, 2019). Notably, there is, yet no consensus on the theoretical benefits of these elements in the entrepreneurial ecosystems on NE. When it comes to NE, the presence of these factors in affecting their performance are different from OE.

Therefore, the objective of this article is to investigate the impact of knowledge management, financial resource, innovation, and foreign direct investment on necessity-driven entrepreneurship. Our research builds on this existing literature by providing an empirical assessment of the relationship between necessity-driven entrepreneurship, knowledge management, financial resource, innovation, and foreign direct investment. The relative lack of entrepreneurship research based on necessity-driven entrepreneurship and empirical approximation offers us the chance to contribute both through a theoretical and realistic approach to literature.

Using a cross-country sample consists of 37 countries from 2010 to 2016, the panel random regression model reveals that the financial resource is the most vital factor to support NE in the risk-creation process. The findings indicate that knowledge management, innovation and foreign direct investment are unfavourable and significantly linked to NE. We are also looking at the interaction between financial capital and knowledge management while examining the relationship between knowledge management and entrepreneurial outcomes. The effect of knowledge management on NE depends on financial capital. The novelties of this study could offer new insights for research with both a theoretical and empirical approach. From the theoretical point of view, although studies about entrepreneurial ecosystems are increasing, little research is based on NE and specifically in the case of cross-country analysis. From the practical perspective, we demonstrate that knowledge management, financial resource, innovation and foreign direct investment react differently on NE, which may be beneficial for the implementation of government policies and initiatives to promote an entrepreneurial spirit for NE.

**II LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT**

In this section, we will establish conceptual elements that are essential for understanding some systematic factors based on the broad resource-based view (RBV) theory and market imperfections theory that could boost entrepreneurial dynamics. The RBV theory in the work of Barney (1991) explains the presence of knowledge, financial resource and innovation are crucial to determine the start-up of a business. The market imperfections theory notes that businesses often pursue their decision to invest abroad through foreign direct investment is a plan to leverage on capacities which rivals in foreign countries do not share (Morgan & Katsikeas, 1997). Hence, in this research, we emphasise the roles of knowledge management, financial resource, innovation, and foreign direct investment (FDI) on necessity-driven entrepreneurship.
A. Knowledge management and entrepreneurial activities

The human capital theory by (Becker, 1962) states that education enhances competitiveness may clarify the possible advantages of information management for entrepreneurship. Entrepreneurs may need formal education as a signal, for example, for customers, workers or capital lenders. Highly-educated businessmen are well known to be more capable of capturing and leveraging abundant entrepreneurial opportunities than those with less education. The cognitive capacity of a person in the form of knowledge has an effect that drives the overall productivity and efficiency of an organisation. The human capital of the entrepreneur relates to the range of skills acquired over many years through training and work experience, which contribute to generating tacit and codified knowledge that drives high performance. (Costa, Fernández-Jardon Fernández, & Figueroa Dorrego, 2014; Engelman, Fracasso, Schmidt, & Zen, 2017) generally support that an effective start-ups by education alone could not be sufficient to drive NE. Offers the skills necessary to manage projects, relates to the range of skills acquired over many years through training and work experience, which contribute to generating tacit and codified knowledge that drives high performance. (Costa, Fernández-Jardon Fernández, & Figueroa Dorrego, 2014; Engelman, Fracasso, Schmidt, & Zen, 2017) generally support that an effective start-ups by human capital help entrepreneurs to make use of their knowledge, training, experience and skills to gain other tools to facilitate the risk development procedure. In contrary to these findings, Alfalah (2019) argues that without in the job training which offers the skills necessary to manage projects, education alone could not be sufficient to drive NE. Therefore, we formulate the first hypothesis as follows:

H1: Knowledge management is negatively related to NE.

B. Financial resource and entrepreneurial activities

In the venture formation process, successful financial development provides financial resources to start-ups business. A sound financial structure facilitates the mobilisation of savings to support these idea exploration by the entrepreneur. In the same vein, (Kutan, Samargandi, & Sohag, 2017; Tayssir & Feryel, 2018) explain that financial growth directly affects efforts to alleviate poverty by providing access to credit and other sources of funding for the venture-building process. This means that the entrepreneur would not have to rely on costly funding sources, which may ease their business operation. Based on the discussion above, we form the second hypothesis as follows:

H2: Financial resource is positively related to NE.

An exciting finding brought up by (Dutta & Sobel, 2018) which explains in the absence of adequate financial capital, entrepreneurs cannot benefit from a rise in tertiary enrollment as. They argue that the previous literature has incorrectly overlooked the non-linear effect of human capital on entrepreneurship. Knowledge management and financial resource can jointly impact entrepreneurship. The relationship between knowledge management and entrepreneurship is positively moderated by a country’s level of financial accessibility. With regards to this argument, we establish the third hypothesis as follows:

H3: Financial resource is moderating knowledge management in affecting entrepreneurship.

C. Innovation and entrepreneurial activities

In the Schumpeter’s theories, innovation as a modern synthesis of the technical, marketing and operational facets of the topic may lead to an increase in the quality of products and a new or improved system of production (Schumpeter, 1934). The innovation output brings incremental improvements and radical inventions can improve the competitive and dynamic entrepreneurship practices. Amorós et al. (2019) and Fuentelsaz et al. (2018) deliberate that innovation in the form of innovative technological processes, product-market innovations, innovative technological processes, novel organisational design or imitative product serves as a tool that speeds up the diffusion of technology to improve the efficiency of entrepreneurial activities. Thus, the fourth hypothesis is formed as follows:

H4: Innovation is positively related to NE.

D. Foreign direct investment and entrepreneurial activities

The strength of local companies over the foreign countries is clarified by market imperfections that is attributed by FDI. An analysis of the positive impact of trade on entrepreneurship indicates that inbound FDI raises the rates of indigenous entrepreneurship through an information spillover process is known as knowledge spillovers (Albulescu & Tămășilă, 2016; Pathak et al., 2015). In this vein, global companies are introducing new goods to the market, providing new possibilities for local entrepreneurs to form new projects to sell them. International companies will often demand raw materials from the host country, which provides openings for entrepreneurs to start up new projects to supply them. The contrary theory, crowding effect states that the presence of foreign firms competing with local entrepreneurs in factor and product increases player density. Crowding effect have been correlated with “business theft” conduct in which multinational businesses enter domestic markets and steal their clients. We argue that FDI stimulates the exit of NE entrepreneurs that crowds out possible entrants as identified by
Venâncio and Pinto (2020). Thus, we form the fifth hypothesis as follows:

H5: FDI is negatively related to NE.

Drawing from the above literature review and hypotheses, we form the research framework as described by Figure 1. The existing literature is examining the direct impact of knowledge management, financial resource, innovation and FDI on NE. We close the literature gap by introducing H3 where financial resource is moderating knowledge management in affecting entrepreneurship.

**Data and Methodology**

The present study is an attempt to examine the impact of knowledge management (KNOW), financial resource (FR), innovation (INNO), and foreign direct investment (FDI) on necessity-driven entrepreneurship (NE). By using a sample of 37 countries\(^1\) ranging from the year 2010 to year 2016\(^2\), we use panel regression random effect model with all the variables transformed to natural logarithm, that is analogous to typical determinants of entrepreneurship activity model (Albulescu & Tămăsîă, 2016; Alfalih, 2019; Rodrigues Brás & Soukiazis, 2018) as illustrated in Eq. (1). Data for KNOW, FR, INNO and FDI are obtained from the World Bank, and the data for NE are extracted from Global Entrepreneurship Monitor.

\[
\ln NE_{it} = \beta_0 + \beta_1 \ln KNOW_{it} + \beta_2 \ln FR_{it} + \beta_3 \ln INNO_{it} + \beta_4 \ln FDI_{it} + \varepsilon_{it} \quad \text{Eq. (1)}
\]

where,

- \(NE\) = % of adult age 18-64 to population are nascent entrepreneurs due to necessity motive
- \(KNOW\) = knowledge management of country \(i\) at time \(t\) with the indicator: % of total education expenditure over total expenditure in public institutions (TOTEX), or % of educational attainment least Bachelor’s over population (EDUB)
- \(FR\) = financial resource of country \(i\) at time \(t\) with the indicator of: domestic credit to private sector over GDP (DCPS), domestic credit provided by financial sector over GDP (DCFS), or domestic credit to private sector by banks over GDP (DCPSB)
- \(INNO\) = innovation of country \(i\) at time \(t\) with the indicator of: patent applications by nonresidents (PANR), patent applications by residents (PAR), researchers in R&D per million people (RRD)
- \(FDI\) = foreign direct investment of country \(i\) at time \(t\)

**IV DATA ANALYSIS AND INTERPRETATION**

The descriptive statistics of this study are shown in Table 2. The lowest NE is at 0.05% that comes from Norway in the year 2013 and 2014 while highest NE comes from Colombia in the year 2015 at 5.26%.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Obs</th>
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<th>Std Dev</th>
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<th>Max</th>
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</tbody>
</table>

The results of the whole sample based on Eq. (1) are presented in Table 3. Model 1 is the baseline model with the independent variables where the percentage of total education expenditure over total expenditure in public institutions (TOTEX), patent applications by nonresidents (PANR) and foreign direct investment (FDI) are negative and significantly related to NE, domestic credit to the private sector by banks over GDP is positive and significantly related to NE. The findings from this study show that education expenditure might be inappropriate knowledge management to help NE to gain the necessary knowledge to manage the business. The clarification could be explained from the findings of Alfalih (2019) and Costa et al. (2014) where entrepreneurs gain the skill through training and work experience to drive the performance of the business but not through the delivery of education. Another plausible reason could be the low emphasis on entrepreneurial training in the education system. Next, DCPSB is positively related to NE and supports that financial credits offered by banks to the

\(^1\)Argentina, Australia, Belgium, Brazil, Canada, Colombia, Croatia, Czech, Estonia, Finland, Germany, Ghana, Guatemala, Hungary, Indonesia, Ireland, Israel, Italy, Jamaica, Japan, Latvia, Lithuania, Luxembourg, Malaysia, Mexico, Netherlands, Norway, Peru, Poland, Portugal, Romania, Singapore, Slovenia, Spain, Sweden, Switzerland, Thailand.

\(^2\)Data begin from the year of 2010 to due to the fact that NE has risen after the 2008-2009 crisis. The data stop at the year 2016 as it is the latest available data provided by Global Entrepreneurship Monitor (GEM), which the datasets are only made available to the public 3 years after data collection.
private sector could allocate financial resources to assist NE in business startup and scale-up phases (Kansheba, 2020). However, innovation by nonresidents (PANR) is negatively related to NE, which proposed that the accumulated tacit knowledge and culture developed by nonresidents unable to create wealth for local NE as they might transfer the innovative output back to their home country. FDI is negatively related to NE due to FDI creates a competitive environment and crowd out the NE as foreign entrepreneurs steal their customers.

Model 2, 3, 4 and 5 are the robustness check for the baseline Model 1. Percentage of educational attainment least Bachelor's over population (EDUB) replaces TOTEX as another indicator for knowledge management in Model 2; researchers in R&D per million people (RRD) replaces PANR and PAR as another indicator for innovation in Model 3; domestic credit provided by financial sector over GDP (DCFS) and domestic credit to the private sector over GDP (DCPS) replaces DCPSB in Model 4 and 5, respectively as another proxy for the financial resource. Generally, the results are robust to support the findings from Model 1. Interestingly, DCPS in Model 5 postulates negative and significant relationship with NE and suggests that domestic credits provided by the financial corporation may not be sufficient to alleviate financial constraints of the NE. The explanation could explain this result that the efforts to help NE from the private institutions are not enough; therefore, the financial incentives and entrepreneurial programmes by the government is necessary (Fuentelsaz et al., 2018).

### Table 3. Regression results from the panel regression random effect model

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>(1) NE</th>
<th>(2) NE</th>
<th>(3) NE</th>
<th>(4) NE</th>
<th>(5) NE</th>
<th>(6) NE</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTEX</td>
<td>-3.46**</td>
<td>-2.76*</td>
<td>-3.43**</td>
<td>-3.12**</td>
<td>0.32**</td>
<td>0.09</td>
</tr>
<tr>
<td></td>
<td>(1.52)</td>
<td>(1.64)</td>
<td>(1.52)</td>
<td>(1.55)</td>
<td>(0.39)</td>
<td>(0.14)</td>
</tr>
<tr>
<td>PANR</td>
<td>-1.01**</td>
<td>-0.70*</td>
<td>-1.00**</td>
<td>-0.98**</td>
<td>-0.76*</td>
<td>-0.20*</td>
</tr>
<tr>
<td></td>
<td>(0.43)</td>
<td>(0.39)</td>
<td>(0.43)</td>
<td>(0.47)</td>
<td>(0.15)</td>
<td>(0.15)</td>
</tr>
<tr>
<td>PAR</td>
<td>-0.30</td>
<td>-0.15</td>
<td>-0.30</td>
<td>-0.30</td>
<td>-0.30</td>
<td>-0.30</td>
</tr>
<tr>
<td></td>
<td>(0.25)</td>
<td>(0.24)</td>
<td>(0.25)</td>
<td>(0.28)</td>
<td>(0.25)</td>
<td>(0.28)</td>
</tr>
<tr>
<td>DCPSB</td>
<td>0.32**</td>
<td>0.09</td>
<td>0.38**</td>
<td>0.14</td>
<td>-0.64***</td>
<td>-0.71***</td>
</tr>
<tr>
<td></td>
<td>(0.15)</td>
<td>(0.14)</td>
<td>(0.15)</td>
<td>(0.13)</td>
<td>(0.16)</td>
<td>(0.16)</td>
</tr>
<tr>
<td>FDI</td>
<td>-0.39**</td>
<td>-0.12</td>
<td>-0.40**</td>
<td>-0.39**</td>
<td>-0.14</td>
<td>-0.14</td>
</tr>
<tr>
<td></td>
<td>(0.17)</td>
<td>(0.15)</td>
<td>(0.18)</td>
<td>(0.16)</td>
<td>(0.13)</td>
<td>(0.16)</td>
</tr>
<tr>
<td>EDUB</td>
<td>-0.64***</td>
<td>-0.71***</td>
<td>-0.71***</td>
<td>-0.71***</td>
<td>-0.71***</td>
<td>-0.71***</td>
</tr>
<tr>
<td></td>
<td>(0.14)</td>
<td>(0.16)</td>
<td>(0.16)</td>
<td>(0.16)</td>
<td>(0.16)</td>
<td>(0.16)</td>
</tr>
<tr>
<td>RRD</td>
<td>0.88</td>
<td>0.33**</td>
<td>0.09</td>
<td>-0.20*</td>
<td>-0.20*</td>
<td>-0.20*</td>
</tr>
<tr>
<td></td>
<td>(1.13)</td>
<td>(0.15)</td>
<td>(0.15)</td>
<td>(0.08)</td>
<td>(0.08)</td>
<td>(0.08)</td>
</tr>
<tr>
<td>DCFS</td>
<td>0.01*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.01)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DCPS</td>
<td>18.49**</td>
<td>5.049**</td>
<td>6.53</td>
<td>18.32**</td>
<td>18.18**</td>
<td>5.11**</td>
</tr>
<tr>
<td></td>
<td>(7.58)</td>
<td>(2.30)</td>
<td>(9.61)</td>
<td>(7.563)</td>
<td>(7.89)</td>
<td>(2.54)</td>
</tr>
<tr>
<td>R2</td>
<td>0.30</td>
<td>0.46</td>
<td>0.20</td>
<td>0.30</td>
<td>0.42</td>
<td>0.46</td>
</tr>
<tr>
<td></td>
<td>(0.30)</td>
<td>(0.46)</td>
<td>(0.20)</td>
<td>(0.30)</td>
<td>(0.42)</td>
<td>(0.46)</td>
</tr>
<tr>
<td>Observations</td>
<td>169</td>
<td>175</td>
<td>155</td>
<td>169</td>
<td>160</td>
<td>173</td>
</tr>
<tr>
<td>Country</td>
<td>37</td>
<td>37</td>
<td>33</td>
<td>37</td>
<td>35</td>
<td>36</td>
</tr>
</tbody>
</table>

Note: ***, ** and * indicate that significant at p-value at 0.01, 0.05 and 0.10 respectively. NE = necessity-driven entrepreneurship, TOTEX = % of total education expenditure over total expenditure in public institutions, PANR = patent applications by nonresidents, PAR = patent applications by residents, DCPSB = domestic credit to private sector by banks over GDP, FDI = foreign direct investment, EDUB = % of educational attainment least Bachelor's over population, RRD = researchers in R&D per million people, DCFS = domestic credit provided by financial sector over GDP, DCPS = domestic credit to private sector over GDP (DCPS)

Model 6 shows the interaction effect of knowledge management on financial resource to influence NE. The positive coefficient of EDUB*DCFS (0.01*) suggests that with the adequate financial resource, the bachelor degree holders venture creation process is smoother as they are equipped with the stronger skill to determine risks better, future failures and ideas challenges, lead founders to refrain from “bad ideas” and do a successful business. This results is consistent with the findings from Alfalih (2019) that demonstrate a deficiency in the level of knowledge management in the Middle East and North Africa region does not encourage NE. However, the availability of financial resource could remove the barriers of credit access. Then, the delivery of entrepreneurship education could boost the knowledge base of entrepreneurs and the cognitive capacity to risk the process of venture formation.

**V CONCLUSION**

The objective of this article is to study the impact of knowledge management, financial resource, innovation, and foreign direct investment on necessity-driven entrepreneurship. We also explore the interaction between financial resource and knowledge management when analysing the relationship between knowledge management and entrepreneurial outcomes. The findings reveal that knowledge management, innovation, and foreign direct investment are unfavourable and significantly linked to need-driven entrepreneurship. The effect of knowledge management on entrepreneurship guided by the need to depend on financial capital.

The results of this research indicate that banks’ financial credit does not efficiently boost the survival of necessity-driven entrepreneurship, which needs financial and help funded by the government. Furthermore, innovation and foreign direct investment stimulus can not benefit from necessity-driven entrepreneurship as it drives them into marginal niches of the market. In the absence of ample financial resources, necessity-driven entrepreneurship cannot reap the benefit from the cultivation of knowledge management. Therefore to minimise bankruptcy risk among necessity-driven entrepreneurs, policymakers should ensure proportionate amounts of financial support and information spillovers. Through doing so, entrepreneurs could establish successful ventures to
create jobs that would have an impact on poverty reduction in achieving sustainable development goals (Venâncio & Pinto, 2020).

This research could be improved by using the updated data and covering more countries by considering the impacts of Covid-19 on NE.

REFERENCES


Strategies to Enhance Commercialisation Activity: Researcher Perspective

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ABSTRACT
Commercialisation is a platform to recognise the findings of local researchers and develop the reputation of local universities in Malaysia. The purpose of this research study is to gain the perspective of researchers on the factors that facilitate and motivate research commercialisation activity. This study is limited in the setting of Malaysian private university. The study uses quantitative method incorporating questions that is based on a research model developed by the authors. Survey was deployed to the researchers in order to gain their feedbacks and opinion on strategies for commercialisation. The study discovered factors that contribute to the success and failure of product commercialisation in a university setting. In general, majority respondents with more than 80% strongly agree on the need of good marketing and overcome marketing strategy issues highlighted are critical factors that hinders success in commercialisation. Respondents also acknowledged the delineated factors that could enhance commercialisation and the need of professional productivity with 64% and 67% votes respectively. In conclusion, the key issues and challenges in commercialisation by researchers and managing university-industry technology transfer are identified and validated through the responses. These findings are anticipated to equip students, researchers and academia to strategise based on the factors that may impede research commercialisation. Furthermore, commercialization technology could be translated into sales revenue, additional profit, and job creation as tangible item.

Keywords: technology; transfer; commercialisation, enhance; researcher.

I INTRODUCTION
Recently, research commercialisation in universities has become one of the crucial factors that drives the economic and national development, where it was involved in several stages to establish new products, knowledge and expertise in innovation. Malaysia and several other developing countries tend to develop new product based on economic demand through the universities’ Research and Development (R&D) activities as source of economic growth.

Commercialisation is a process to transform research knowledge to new and improved features of products or services to secure market potential (Ismail & Mohamed, 2016). Current business services and research institutes are facing hostility from clients to pull-off the economic growth (Mueller, 2006).

According to the New Straits Times newspaper by Mustafa (2019), the benefits are numerous via the enhancement of research and innovation through joint research project, delivery of innovative commercial product, improvise teaching style, and learning and enrichment of students’ knowledge. Academic researchers get to collaborate with industry to take their research products to another level of commercialisation. For example, a university which has expertise in semiconductor field that plans to produce graduates for electronic industry, will need to engage with a specific company through collaborative project. Thus, the company shall be able to provide financial support by covering the cost of facilities and laboratories. In summary, engagement between university-industry is important to boost innovation performance and increase the market competitiveness (Freitas et al., 2013).

Collaboration between university-industry usually have different modes. The five types of modes engagement between university and industry in Malaysia shows their effectiveness to the objectives of collaboration (Markman et al., 2008).

• Expertise exchange
• Research and Development (R&D)
• Training of firm employee
• Consultation work
• Product commercialisation
Furthermore, it is crucial to understand the market orientation to secure success in the R&D commercialisation activity. The constructs of market orientation were identified as customer orientation, inter-functional coordination and competitor orientation (Chang et al., 1998). This concept of market orientation was later incorporated into R&D commercialisation studies as researchers endorse the need of the inventions to marketplace.

Some studies reported that strategic market orientation is a successful factor in R&D commercialisation activities (Kadir et al., 2019; Tan et al., 2019; Kamaruddin et al., 2013). Universities have developed the market strategies by producing technologies industry to produce more product to fulfil market potential for more successful in sectors commercializing (Kadir et al., 2017).

II  METHODOLOGY

This study will be focusing on the third domain in Figure 1 which is the researcher perspective on productivity, marketing strategy, factors that hinders and contributes to successful commercialisation.

On the other hand, technology transfer office is responsible to guide academic research in developing new research study according to protocols, whether for intellectual property (IP), licensing, patenting benchmarking, copyrighting and writing commercialisation proposal. This eventually contributes to advancement of science and technology in the country. This study analyses four elements that provide impact to the research commercialisation activity in Malaysian universities. The survey was designed based on massive literature review from previous research studies and tailored to suit with the environment of the academic institutions in Malaysia.

Thus, the data obtained from this study are further analysed to obtain clarity on the current setting in research commercialisation. There are four sections designed in the survey for the researchers:

i. Professional productivity and commercialisation perspectives

ii. Impediments to research commercialisation

iii. Factors that could enhance research commercialisation

iv. Initiatives related to the marketing strategy

All valid responses were collected, and the data were analysed to conduct a descriptive analysis. Questionnaire for researchers consists of four sections that are represented in Likert-scale format. Based on the demographic profile of the respondents, 60% of them are Senior Lecturer and Lecturer with doctorate, 20% of them are Professor, 10% of them are Associate Professor and the last 10% are Lecturer without doctorate from different research institutes.

The graphical distribution on the type of research by the respondents of this survey is in Figure 2. Half of the respondents reported their research experience as Basic research (fundamentally curiosity-driven research), while another 40% conducted their research as Applied Research (the relationship and applicability of theories or principles to the solution of a problem) and the remaining 10% are involved in Translational research (new information or knowledge that is created in one area to another application).
III RESULTS AND DISCUSSION

Prior to the questions on factors of research commercialisation, researchers were provided with six questions on their opinions regarding their current research goal and their professional productivity. On another note, the questions were designed to encourage awareness and motivation to commercialise among the researchers, regardless of their research profile. Table 1 indicate the mean response for each question in the first section.

Table 1.: Descriptive analysis for true-false questionnaire of professional productivity and commercialisation perspective.

<table>
<thead>
<tr>
<th>Question Text</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>[Do you feel that your research results are sufficiently utilised through the generation of publications, grants, and other forms of professional productivity?]</td>
<td>0.7 (True)</td>
<td>0.153 0.483</td>
</tr>
<tr>
<td>[Do you intend to commercialise your research in the future?]</td>
<td>0.9 (True)</td>
<td>0.100 0.3162</td>
</tr>
<tr>
<td>[Do you think research commercialisation is important to promote within an academic setting?]</td>
<td>0.7 (True)</td>
<td>0.153 0.483</td>
</tr>
<tr>
<td>[Do you think the university places an emphasis on research commercialisation to department?]</td>
<td>0.3 (False)</td>
<td>0.153 0.483</td>
</tr>
<tr>
<td>[Do you think your research field places an emphasis on research commercialisation?]</td>
<td>0.6 (True)</td>
<td>0.163 0.516</td>
</tr>
<tr>
<td>[Does your research project give benefits to community, industries and government agencies?]</td>
<td>0.8 (True)</td>
<td>0.133 0.422</td>
</tr>
</tbody>
</table>

By carefully examining the data, it is found that 70% of the private university researchers agreed that their research fields, engineering and sciences, do place the need of research commercialisation. After rigorous examination, it was found that 90% of the respondents are interested to commercialise their research. While there is a low percentage of 30% who agreed that the university has vision in commercialisation activity, however, majority of the researchers disagreed that there is an emphasis on technology inventions in their current department. In summary, there is a varying set of results that consists of a similar percentage, which is 80% for both outputs, and one of them strongly support the importance of promoting research commercialisation among researchers within an academic setting and the benefits of inventions to the community, industries, and government. The next three sections further discuss on impediments and strategies for successful research commercialisation.

A. Impediments to research commercialisation

The research and development challenges are broad with competency as one of the main factors which refers to both entrepreneurs and academic personnel that have not reached the level required in business and technical commercialisation skills in order to successfully market the research output. There are other common issues that lead to impediments in commercialisation activities such as lack of linkages between government agencies, lack of expertise amongst government agencies, no policies and regulations, lack of manpower and lack of support in terms of funds as stated by Ee Shiang & Nagaraj (2011). On another note by Ajagbe et al. (2015), there is a lack of knowledge in the market, difficulties in finding the industry partner, lack of facilities (e.g.: equipment, machine), lack of communication with research institutions (SIRIM, FRIM, universities) and costly in innovation.
This section discusses the issues and impediment factors experienced by the researchers before entering the commercialisation process. Table 2 shows the descriptive analysis summary for each question in this section which is represented in Likert-scale format with statistical values.

<table>
<thead>
<tr>
<th>Question Text</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>[There are no barriers to commercialising research at the university.]</td>
<td>2.7</td>
<td>0.3</td>
<td>0.949</td>
</tr>
<tr>
<td>[There is unwanted risk associated with research commercialisation.]</td>
<td>3.8</td>
<td>0.2</td>
<td>0.632</td>
</tr>
<tr>
<td>[I lack the expendable time.]</td>
<td>4</td>
<td>0.258</td>
<td>0.816</td>
</tr>
<tr>
<td>[There is excessive expense.]</td>
<td>3.5</td>
<td>0.342</td>
<td>1.080</td>
</tr>
<tr>
<td>[There is a lack of investors.]</td>
<td>3.8</td>
<td>0.291</td>
<td>0.919</td>
</tr>
<tr>
<td>[There is a lack of infrastructure including facilities and staff to help in the commercialisation process.]</td>
<td>4.2</td>
<td>0.327</td>
<td>1.033</td>
</tr>
<tr>
<td>[Unsupportive University policies, procedures and/or regulations.]</td>
<td>3.8</td>
<td>0.359</td>
<td>1.135</td>
</tr>
<tr>
<td>[Unsupportive federal policies, procedures and/or regulations.]</td>
<td>3.1</td>
<td>0.233</td>
<td>0.738</td>
</tr>
<tr>
<td>[There is a lack of industry partners.]</td>
<td>3.3</td>
<td>0.300</td>
<td>0.949</td>
</tr>
<tr>
<td>[Limited or no commercial application of my research exists.]</td>
<td>2.4</td>
<td>0.427</td>
<td>1.310</td>
</tr>
<tr>
<td>[There is a lack of importance to academic.]</td>
<td>2.8</td>
<td>0.416</td>
<td>1.317</td>
</tr>
<tr>
<td>[There is a lack of importance to my field.]</td>
<td>2.1</td>
<td>0.277</td>
<td>0.876</td>
</tr>
<tr>
<td>[There is a lack of benefit to society.]</td>
<td>1.9</td>
<td>0.379</td>
<td>1.197</td>
</tr>
<tr>
<td>[There is a lack of importance to my field.]</td>
<td>2.4</td>
<td>0.371</td>
<td>1.174</td>
</tr>
</tbody>
</table>

Based on Figure 3, it is clearly seen that most of the researchers faced several challenges on commercialisation activities in university. A high percentage of 84% respondents highlighted the lack of infrastructure including facilities and competency.
of staff. After rigorous review of the dataset, it was discovered that 76% voted the presence of unwanted risk linked with research commercialisation and innovation as a contributing factor. Additionally, other impediments highly agreed by the respondents are the lack of industry partners to commercialise their products and unsupportive university policies and regulations. Among the respondents’ personal opinions are regarding the university and federal policies, as the researchers do not have adequate information on the present policies and the policies are not made known.

Razak and Saad (2007) highlighted the difficulties envisioned by universities are in finding the right industrial partners and rigid regulations and terms. This is reflected in the findings where 48% of the respondents agreed that the application to commercialise the product is limited, while another 38% agreed that there are no benefits to the end-users. Only few respondents showed a lack of interest on commercialisation activities as they are seeking for clarity in research directions of their capability to contribute in technology transfer area.

B. Factors that enhance research commercialisation

This section discusses on researcher motivational factors that could stir intrinsic motivation for research commercialisation in terms of time, information, financial aids, facilities and policies.

Some researchers have stated that university plays an effective role in promoting commercialisation activities in terms of facilities, management and training (Ismail et al., 2016). Table 3 reported the summary response for factors that could enhance research commercialisation activity. Based on the results, all of them agreed the function of the research management centre to help commercialisation process. Majority respondents with 82% agreed with the need to have subscription protected time in order to enhance commercialisation activities. This finding complements with Vanderford et al. (2015) that highlighted the importance of having a protective time.

Table 3.: Descriptive analysis for Likert-scale question of factors that could enhance research commercialisation.

<table>
<thead>
<tr>
<th>Question Text</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>[Offering protected time specifically for commercialisation activities]</td>
<td>4.1</td>
<td>0.277</td>
</tr>
<tr>
<td>[Information on how to commercialize]</td>
<td>3.9</td>
<td>0.314</td>
</tr>
<tr>
<td>[Increasing financial support]</td>
<td>4.5</td>
<td>0.224</td>
</tr>
<tr>
<td>[More infrastructure including facilities and staff to help in the commercialisation process]</td>
<td>3.9</td>
<td>0.277</td>
</tr>
<tr>
<td>[Amend university policies, procedures and/or regulations.]</td>
<td>3.3</td>
<td>0.213</td>
</tr>
<tr>
<td>[Enhances links to industry.]</td>
<td>4.3</td>
<td>0.213</td>
</tr>
<tr>
<td>[Increasing emphasis placed by academia and/or my research field on the importance of research commercialisation]</td>
<td>3.7</td>
<td>0.335</td>
</tr>
<tr>
<td>[Greater personal benefits including more royalty pay.]</td>
<td>4.3</td>
<td>0.260</td>
</tr>
<tr>
<td>[Greater social benefits.]</td>
<td>4.3</td>
<td>0.260</td>
</tr>
<tr>
<td>[Nothing would help.]</td>
<td>2.3</td>
<td>0.300</td>
</tr>
</tbody>
</table>
Based on Figure 4, 80% agreed that financial support from government and private sector should be increased to overcome the difficulties to search for collaborators with industry. Usually universities require huge investment at early stage of commercialisation to attract collaborator (Ismail et al., 2016). On another note, having conducive facility to conduct research study is quite important to the academia to develop their research commercialisation. Most of the respondents which is 78% agreed with the point of information on how to commercialize the product. Hartono et al. (2019) clearly stated that information on new technologies is crucial to achieve innovation on products.

Next, 78% seek for amendment of university policies, procedures and/or regulations and 66% seek for amendment of federal policies, procedures and/or regulations. The researchers in this private university suggested that if the royalties paid to the inventors is higher than the present allocation, it would boost research commercialisation activity. On the other hand, 86% of respondent agreed with notable distinctive personal benefits including more royalty pay seems imperious by universities to have a conventional reward system to the researchers (Yaakub et al., 2011). Last but not least, 86% of respondents agreed with the point on the capability of the product to provide societal benefits is one of the successful factors for commercialisation.

### C. Initiative related to marketing strategy

There are numerous studies investigated on the factors that contribute to the success of new product development (Connell et al., 2001; Sidek et al., 2014). Key success factors for new product development process are cross-functional teams, management support and supportive organizational structure (Schimmeoller, 2010).

According to Tidd et al. (2001), market knowledge is crucial for those who wants to start a business. Pre-development preparation including initial screening, market assessment, preliminary market appraisal, business and financial analysis are vital. Innovator must empower the needs of assessment before starting any business to avoid failure in commercialisation. Significant part in the market analysis is competitive analysis.

This section further discusses on initiatives that are able to deliver marketing strategies successfully and communication tool to reach potential consumer. Table 4 indicate the list of mean response for each question in the marketing strategy section.

<table>
<thead>
<tr>
<th>Question Text</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>[Realign research commercialisation and product (package and promotion).]</td>
<td>4.1</td>
<td>0.180</td>
</tr>
<tr>
<td>[Innovation development centre and effective support group to conduct product development.]</td>
<td>4.0</td>
<td>0.211</td>
</tr>
<tr>
<td>[Market analysis should be given a priority at the beginning (market potential, market needs and research product).]</td>
<td>4.0</td>
<td>0.211</td>
</tr>
</tbody>
</table>
Based on Figure 5, 88% of the researchers agreed that market analysis before commercialisation of a product is deemed crucial. Next, 82% had agreed the need of realignment research commercialisation and product (package and promotion) to achieve product sales target. On another hand, 80% respondents highlight the need of innovation development centre and effective support group to conduct product development. However, 20% respondents provide suggestions to improve strategy to the market through collaboration between support group with researcher to promote product to market.

According to the respondent’s experience, software and system engineering has difficulty in finding industry partner, due to high number of companies originated from US, Japan and Europe. These companies do open branches worldwide, but most are resellers.

The development of new products to the markets involves high risks. Companies with good business knowledge and strong production need to enter a market to exploit their capabilities to advanced heights. Therefore, new product development is a malleable subject that provides a company the ability to adapt with any changes in the marketing environment and to yield a competitive advantage (Goulding, 1983). Improvements to existing products may improve performance or greatly discern values from old products. This product type can represent up to 26% of all new products introduced in the market for commercialisation. Imitative of existing products are known as new items added to the product line which fit within the existing product manufactures that are already entered the marketplace with new add-on features (Owens, 2009).

For commercialisation, researchers need to have the opportunity to engage with foreign developers as some research area could not secure local developers that have the expertise or resources to commercialize projects in local universities. There are open-source communities that researchers can collaborate, however, the outcome will be an open-source software, which may not be considered as commercialisation. For software, the definition of commercialisation was suggested to redefine by including open source as long as there are users for the open-source software.

D. Summary

In summary, Table 5 presents the reliability studies of the measurement scales. The Cronbach’s alpha coefficients were calculated in SPSS. The Likert scales show the highest alpha value at 0.890 for initiatives related to marketing strategy while the impediments to research commercialisation at 0.708. The Cronbach’s alpha values are shown to be 0.708 and above, the variables distributed in this study showed a high of consistency thus meeting the reliability assessment.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Cronbach’s Alpha</th>
<th>Internal Consistency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impediments to research commercialisation</td>
<td>0.752</td>
<td>Fair</td>
</tr>
<tr>
<td>Impediments to research commercialisation</td>
<td>0.708</td>
<td>Fair</td>
</tr>
<tr>
<td>Factors that could enhance research commercialisation</td>
<td>0.592</td>
<td>Poor</td>
</tr>
<tr>
<td>Initiatives related to marketing strategy</td>
<td>0.890</td>
<td>Good</td>
</tr>
</tbody>
</table>

IV CONCLUSION

The study presented has investigated the opinion of researchers and motivation factors to participate in the research commercialisation process of a private university. Researchers provide feedbacks on the importance to market their ideas and secure the attention of industry player in order to collaborate and
progress in research development. In conclusion, securing a partner industry player, and marketing strategy with facilities and support from institute contributes to encourage participation in commercialisation. These findings are hoped to prepare researchers and institute to strategise based on factors that may enhance research commercialisation. Further study is recommended to promote on know-how to conduct successful marketing strategy for researchers.

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Insights of Research Commercialisation through University Technology Transfer Office

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ABSTRACT

In university, technology transfer office (TTO) acts as a merger between the industry and academia for research commercialisation activity. The purpose of this research study is to gain insights of TTO on the factors contribute to commercialising research products in a Malaysian university based on Soares et al. (2020) maturity model efficiency for TTO. This includes a sharing experience from TTO handling issues related to the commercialisation. The study uses qualitative method incorporating components in Soares et al. (2020) maturity model efficiency for technology transfer office. Interviews were conducted with the technology transfer office personnel to obtain qualitative findings in terms of organisation management, technology, industry links and networking as a technology management centre. The study discovered insights that contribute to the evolutionary development of technology transfer in a university setting. Active engagement is required between researcher and TTO to unfold and resolve the issues faced in commercialisation. In conclusion, strategies, framework and organisation structure determine the success implementation of research commercialisation. These findings are anticipated to equip researchers and management in academic setting to strategise based on structure and administration, that leads to efficiency and achievement of the desired goal.

Keywords: technology, transfer, commercialisation, insights.

I INTRODUCTION

Technology transfer office (TTO) is a major stakeholder in universities that provide several services to the researchers such as managing licensing, introducing intellectual property, build personal engaged with inventor, assist on proposal, distinct opportunities and security, encourage academia to disclose invention and industry technology requirements. Khademi et al. (2014) had clarified that TTO is responsible to help the researchers decide whether the technology suit for product commercialisation or not and facilitate the activities of IP protection before undergo commercialisation process.

Some studies have been reported regarding technology transfer office (TTO) roles (Khademi et al., 2014; Arenas, 2018). University Technology Transfer Offices (TTOs) need a wide range of abilities to facilitate commercial exploitation of research outputs; however, we know relatively little about how these important abilities are developed and refined over time (Weckowska, 2015). McAdam et al. (2012) stated that TTO consolidates the university technology transfer activity in a regional area. TTOs has been developed in universities to guide researchers regarding commercialisation process and establish linkages between industry and university.

However, academic research faces problem to transfer the IP product into commercial applications. Furthermore, other challenges for TTO is the process of IP commercialisation in the university which includes lack of support, lack of skilled manpower and lack of information on commercialisation process (Manap et al., 2017). In the past few years, several studies has examine the role and effectiveness of TTO in managing researchers to start technology invention (Xu et al., 2011).

Figure 1 shows the micro-level structure for national innovation system involving three major actors such as government (institution and policies), economic (firms and labour) and the academia (including education and researchers).
According to the maturity model efficiency by Soares et al. (2020), there are several elements in technology transfer office that contribute to achieve successful product commercialisation and their findings was delineated based on weightage. Human resource (100%), Intellectual property (IP) management strategy and policy (80%), Organisation structure, internal management and design (20%), Technology (40%), Networking (60%) and Industry links (60%) are the elements that are highlighted in the study. Based on the maturity model efficiency, the questionnaire for TTO in a university was designed and the response was interpreted and supported with other research studies. The face-to-face interview with TTO personnel in a university has revealed their development, and the issues and challenges in educating researchers with policy and regulations to enter commercialise market which complements Soares et al. (2020) maturity model efficiency.

II TECHNOLOGY TRANSFER OFFICE

Currently, universities have established technology transfer office (TTO) to protect, promote, guide and commercialise the research outputs of researchers. TTO require strong connection with public and private sectors on R&D and transformation strategies for research output from academia to industry. Recent studies have reported that TTO is responsible for educating academician with knowledge business through interaction via a network of industrial partners. There are three main domains that defines TTO efficiency which are organisation, technology and networking.

A. Organisation

Establishment of division labour is important in order to deliver the outcomes of the organisation. This section discussed on the evolutionary flow of a matured organisation structure that strives for improvement and efficiency. Transformation of inputs to outputs depend on the designed framework to deliver solutions. In an organisation process usually comprised of resources such as materials and manpower, tools and system.

Organisation Structure, Internal Management and Design

The critical success factor of TTO staff is to understand the academic environment and have established insights and experience regarding the business environment for knowledge transfer to society. Despite this, the professionalism of TTO staff to serve the business and academic community is crucial. There is no specific background to recruit manpower under TTO, since most of it could be learned and going through practical (Nguyen, 2020). To summarize, the TTO department has expanded into several units due to their expanding responsibility through time based on demand of the functional unit, which consists of intellectual unit, commercialisation unit, and consultancy unit. Moreover, TTO is responsible to develop the researcher’s know-how on the research product before the commercialisation process. Table 1 shows the summary findings from the TTO that has been more than a decade in technology transfer arena.

<table>
<thead>
<tr>
<th>Maturity Model Elements (Soares et al. 2020)</th>
<th>Questionnaire</th>
<th>Concluding findings</th>
</tr>
</thead>
</table>
| Organisation structure, internal management and design | What is the evolution of university technology transfer ability in the process of innovation? | • TTO department was expanded into several units because of wider scope.  
○ Intellectual unit  
○ Commercialisation unit  
○ Consultancy unit  
• TTO is responsible to develop researcher’s know-how on the... |
How many researchers were success in inventions last 3 years from 2017-2019 and how many units involved?

- Only 5 researchers succeed in inventions.
- Early 2000s Starting in 2008, manager is responsible just to manage research. Research and innovation office built in 2010 until 2017 that consists of two units:
  - Management unit (provide funding)
  - IP associate research (filing IP paper)
- Both units combined as: Research and Management Center (RMC)
  - Manage funding
  - Technology Transfer Office (TTO)
- Expand due to broader scope of duties.
- Develop researcher’s know-how in research
  - IP unit (manage IP)
  - Commercialisation Unit
  - Consultancy unit

In what field (Product/Processes/research field) has the TTO been most active in?

- TTO is most active in product field. Every technology will produce a new product to enter the market.

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Intellectual Property (IP) Management Strategy and Policy

According to Hegde & Luo (2017), patent applications were 20% able to be licensed after conducting research and it is more significant to be licensed in the phase between publication and research completion. Thus, the percentage of disclosure results in patents commonly depends on researchers how much they would like their findings to be disclosed. If the content is completely to be published in publication, it cannot be patented.

Managing conflicts of interest in the commercialisation of inventions are important for a successful commercialisation process (Van Norman & Eisenkot, 2017). A sharing by the technology transfer office highlighted that the invention policies involved address the ownership of invention will not have any conflict of interest. If the research was conducted with the university resources and facilities, the outcome belongs to the university. For start-up, if the university is going to initiate a start-up and it is owned by one of the university staff, the university staff must declare upfront on the shareholder of that company. If not being declared, the process will be terminated.

If the inventor moves to another institution and wants to improve their license or follow-on IP, the institution will negotiate on how IP right for marketing and licensing (Van Norman & Eisenkot, 2017). Thus, it is mandatory to seek permission from previous universities if the researchers move to another university.

SRAs is an agreement between a commercial entity and a university researcher to develop and commercialise a product technology invention. Identifying suitable SRAs for the inventor is another role of the TTO (Van Norman & Eisenkot, 2017). SRAs benefit the university by...
developing research opportunities and as a crucial source of university income. Kadir & Shamsudin, (2019) stated that most research opportunities in R&D Malaysia were funded by Ministry of Science, Technology, and Innovation (MOSTI), and by the Malaysian Technology Development Corporation (MTDC) in the form of Technology Acquisition Fund (TAF). Table 2 indicate the summary findings with the established TTO on IP management strategy and policy.

Table 2. Findings Summary based on IP Management Strategy and Policy of the Studied Technology Transfer Office.

<table>
<thead>
<tr>
<th>Maturity Model Elements (Soares et al. 2020)</th>
<th>Questionnaire Concluding findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intellectual property (IP) management strategy and policy</td>
<td>How has the university generally handled IP rights and licences when researcher leaves the university?</td>
</tr>
<tr>
<td>Do patents create barriers that hinder innovation and research?</td>
<td>• Strategy is crucial to empower research and innovation. • Mutual market is good to have protection to enter market sector. • TTO has experienced in monitoring technology that has an impact to the market and TTO role is important to evaluate whether the technology directly enters the market or through technology patent.</td>
</tr>
<tr>
<td>What has the TTO experience for software patents, copyrights, trademarks and licences?</td>
<td>• Mostly is from software patents because it is easy to commercial compared to engineering product and the software development advances rapidly. • TTO will give a licence once the product is ready to enter market.</td>
</tr>
<tr>
<td>How does TTO manage disclosures of invention TTOs?</td>
<td>• Disclosure of invention ○ Fill in disclosure form, then submit to TTO. TTO will decide on the IP whether it is patentable or not. ○ Patent (costly but more valuable) ○ If TTO exploits patent, we could get more income similarly with copyright.</td>
</tr>
</tbody>
</table>
TTO will disclose to community for decision, whether the product is valuable or not.

<table>
<thead>
<tr>
<th>How do you decide which inventions to patent?</th>
</tr>
</thead>
<tbody>
<tr>
<td>• TTO conduct evaluation on the invention patentability, review on title of the invention and file a patent application. Gain information on fund availability for the application and consideration on the duration taken for the patent application.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>What is the level and quality of resources that the TTO offers to support commercialisation?</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Networking with agency</td>
</tr>
<tr>
<td>o MESTEC</td>
</tr>
<tr>
<td>• Provide internal support facilities</td>
</tr>
</tbody>
</table>

According to Malhal (2010), and academic researchers who disclose an invention to the TTO becomes dependent to the efficiency of the TTO to market it. Some researchers stated that inventions tend to be disclosed at the early stage of development before entering the commercial phase (Thursby et al., 2001) and give a positive impact on university patenting and licensing (Wu et al., 2014). However, to avoid issues on disclosure that might lead to patent failure, engagement with TTO in disclosure activity is crucial because TTO is more capable of solving applicability problems related to the invention (Wu et al., 2014). Furthermore, high amount of research funding, might lead to higher numbers of licenses and licensing income (Chapple et al. 2005). Ho et al. (2014) highlighted that patent applications are closely related to funding and licensing. Based on the findings, TTO staff is best to decide on the IP whether it is patentable or not. If TTO exploits a patent, they could get more income similar with a copyright as patent is costly but more valuable or impactful.

The interaction of TTO with academic staff is significant regarding royalty sharing and reward to the achievement (Siegel et al. 2007b; Anderson et al. 2007). Higher royalty shares to the academic researchers are associated with greater licensing income (Friedman and Silberman, 2003; Lach and Schankerman, 2004). TTO provide royalties to the inventors after considering all costs and factor in the source of funding whether internal or external. The remaining cost will be given to investors. For example, the net profits of above RM 101 will provide a 50% profit to both inventors and the university. The challenges before commercial start-up in the commercialisation of technology innovation require developed model, justified production facilities, market value, target market, cost structure, profit potential, and partner networking (Kadir & Shamsudin, 2019). University technology transfer offices do not govern commercialisation before start-up and provides licensing from an industrial partner.

B. Technology

There are several dimensions involved that can lead to success and failure in the process of commercialisation such as technology, market, organisation, product, strategy, and environment (Kim & Ko, 2014; Jung et al., 2015). According to the interview with TTO, characteristics that lead to the success and failure in the commercialisation are the cost to produce a product, invention that is sustainable, able to compete with other investors, right timing to penetrate the market, no product testing but claimed ready to market and high probability of failure could occur if researchers did not benchmark with others in the field.
Universities always face severe structural problems to gain venture capital funding to help start-ups process technology innovation (Van Norman & Eisenkot, 2017). The interests of universities and venture capitalists are needed and usually relied to a technology transfer office to publicize and brainstorm new ideas until commercial stages (Samila & Sorenson, 2010). By contrast, the lack of a local venture capital community and the government funding of academic research will give an effect on the patenting process (Hsu, 2006). To highlight at this point, the TTO respondent does not provide any venture capital to academic research. The term “technology transfer” itself had described the process of movement of technology and refers to several strategies that promote the transfer of innovations, knowledge, technologies, and skills from one setting to another. Some examples to promote technology innovation to the local community by developing skills in entrepreneurship, marketing strategies for marketing products, and strategies on rural and regional development based on needs and trends (Vac & Fitiu, 2017). Table 3 indicate the summary insights based on technology domain in the technology transfer process.

Table 3. Findings Summary based on Technology Aspect of the Studied Technology Transfer Office.

<table>
<thead>
<tr>
<th>Maturity Model Elements (Soares et al. 2020)</th>
<th>Questionnaire</th>
<th>Concluding findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technology</td>
<td>What does the TTO observe based on the inventor's responsibility in finding commercialisation funds?</td>
<td>TTO assist to match the inventor with the industry, whereas the inventor's role is to support the technical innovation.</td>
</tr>
<tr>
<td></td>
<td>How does the university typically allot royalties to inventors?</td>
<td>University provides royalties to the inventors after considering all cost and factor in the source of funding whether internal or external. Remaining cost will be given to the investors. For example, the net profits of above RM 101 will provide 50% profit to both inventors and university.</td>
</tr>
</tbody>
</table>

Invention and innovation that could overcome current problems in industry. Invention that is sustainable and able to compete with other investors. Costing to produce a product. Right timing to penetrate the market. Probability of failure could occur if researchers did not benchmark with others in the field. No product testing but claimed ready to market.
declared, the process will be terminated.

C. Industry Linkages and Networking

Technology transfer processes are being set up to promote research commercialisation (Belitski et al., 2019). Thus, TTO is deemed important in the product field. Every technology will produce a new product to enter the market. Technically, any process will become a product in the future. Universities do not provide incentives to the company. However, universities need to collaborate with the industry to market their research product. A matured TTO with established experience more than a decade, contributes opinion based on the decision-making environment, in stages to reach the desired end. This section aims to provide an overview of possible strategies related to commercialisation activity.

Universities do not provide incentives to the company to develop a commercial product. Therefore, universities need to collaborate with the industry to market their research product. Besides, TTO gives an exclusive license to the company and the company decides whether to downgrade or upgrade the product, as long as it is within the specific region approved by the university. Past studies have reported that exclusive licenses are commonly used when researchers are making a high-risk investment (Van Norman & Eisenkot, 2017).

According to Sithole & Rugimban (2014), the models of the incubation process consist of three important stages such as pre-incubation (to identify tenants for the incubator and brainstorm ideas), the incubation (entrepreneurs provide facilities and strategic support), and post-incubation (take-off stages when the business can continue working outside the incubator) are important for successful commercialisation. TTO in incubation phase is important to develop relationship between universities and industry to identify and screen technology (Hess & Siegwart, 2013). The main issue in the pre-incubating process is industry expectation. Most industry players usually prefer ready product to commercialise. Table 4 shows the summary findings based on the insights from the studied TTO based on industry linkages and networking.

<table>
<thead>
<tr>
<th>Maturity Model Elements (Soares et al. 2020)</th>
<th>Questionnaire</th>
<th>Concluding findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industry links &amp; Networking</td>
<td>What are the problems in pre-incubating process?</td>
<td>The main issue in pre-incubating process is industry expectation. Most industry players are interested to product readily available to commercial. Thus, TTO will only highlight the products that is ready to market.</td>
</tr>
<tr>
<td></td>
<td>What is the process of technology commercialisation before start-up?</td>
<td>Technology transfer office do not govern commercialisation before start-up. They provide with licensing from industrial partner. For example, for start-up to commercialise it must have a concept, prototype, intellectual property and eventually upscale to the market.</td>
</tr>
<tr>
<td></td>
<td>What are the strategies the university utilize to</td>
<td>• Participation in exhibition</td>
</tr>
</tbody>
</table>

Table 4. Findings Summary based on Industry Links Aspect of the Studied Technology Transfer Office.
Promote the dissemination and utilization of discoveries made in research on campus?

- Technology with industry (selected industry)
- Partnership with university in ASEAN countries
- Innovation technology day

Process Imagining stage to the incubating stage is a challenge as majority researchers do not have entrepreneurial skills. Lee et al. (2012) stated that most public universities are not involved in commercializing technology product compared to industries due to the commercialisation process among academician is complicated than industry in managing responsibilities and business activities (Ab. Aziz et al., 2012; Perkmann et al., 2013; Salter et al., 2014).

TTO directs potential industrial funding for the development of technology by university researchers (Guerrero et al., 2016; Theodoraki and Messegem, 2017).

**III CONCLUSION**

This research study shared the insights in context of research commercialisation process and activities of academic research in a university. Technology transfer office (TTO) performance impacts the university commercialisation activities. TTO acts as a merger between the industry and academia. In conclusion, an effective TTO is capable to accelerate the commercialisation process by providing services in several aspects such as facilitate IP, provide licensing, mismatch partner industry, organizing spin off company, marketing strategy to the researchers and supporting proposal in the context of commercialisation. The study successfully discovered insights that contribute to the evolutionary development of technology transfer in a university setting. These findings are hoped to motivate researchers and management to strategise based on factors that may impede research commercialisation.

**ACKNOWLEDGEMENT**

The authors are thankful for the support from Technology Transfer Office especially Zaimizi Bin Hamdani @ Hj Othman and Sharizul Azlan Azizi, Institute of Hydrocarbon Recovery (IHR) Director, AP Dr Syahrir Ridha, fund from International Collaborative Research Fund (ICRF) Grant No. 015ME0-115 and Universitas Islam Indonesia (UII) for their support to the project.

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Sentiment Analysis of Arabic Tweets on the Great March of Return using Machine Learning

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ABSTRACT
Social media platforms such as Twitter and Facebook are becoming powerful sources of people’s perception of major events. Most people use social media to express their views on various issues and events and develop their information on a diverse economic, political, technical, social and occurrences related to their life. The overarching aim of this paper is to apply machine learning techniques to extract Arab users’ opinions from 500 Arabic tweets on the Great March of Return rallies in the Gaza strip (Gaza border protests) collected over a two years span from 2018 to 2019. The majority of Sentiment Analysis (SA) studies concentrate on the English language, while other popular languages, such as Arabic, are seldom covered. In addition, on the Internet, publicly accessible Arabic datasets are hardly found. Three Arabic sentiment analysis datasets were used to train and evaluate four machine learning algorithms, namely, Support Vector Machine, Logistic Regression, Decision Tree, and Neural Network. In term of accuracy, logistic regression outperformed the other three algorithms with a percentage of 83%. Application of logistic regression on the sample tweets revealed that 85.8% of the tweets opposed the Great March of Return, whereas 14.2% of the tweets supported it.

Keywords: Opinion mining, sentiment analysis, Arabic language, machine learning.

I INTRODUCTION
The Great March of Return (GMR) rallies (Arabic: مسيرات العودة الكبرى) started on the 30th of March, 2018 with a series of demonstrations held on every Friday in the Gaza Strip. This event marked peaceful protests of 40,000-50,000 Palestinian men, women and children at the border fence separating the Gaza Strip from Israel. The purpose of the Great March of Return rallies was to demand the right of Palestinian refugees to return to cities and villages of origin from which they had been displaced by what is now called Israel (Khoury et al., 2018). They also protested in rejection to the tight blockade imposed on the Gaza Strip by the Israeli occupation. The weekly protests lasted for a year and attracting broad and diverse audiences, including men, women, teenagers, the elderly, civil society leaders, political activists and public figures. However, the GMR activities evolved during the past twelve months to include night-time disruptions along the fence in addition to demonstrations along the Gaza coastline (MSF, 2019). At least 110 Palestinians were shot dead between 30 March to 15 May, 2018 (Sanchez, 2018).

Nowadays, sentiment analysis is gaining special emphasis due to the widespread use of social networks. Sentiment analysis is a natural language processing (NLP) field that attempt to classify and extract opinions within a document. In this respect, the phrases ‘study of sentiments; and ‘mining of opinions' are quite the same. Whereas the word "opinion" is broader in use than the word "sentiment," yet the two words have been used interchangeably by prior researchers. When evaluating opinions and sentiments, an audience’s views and beliefs are tracked on the web to assess whether the audience perceives certain ideas or events positively or negatively. The purpose of this evaluation is intended to help companies and other concerned entities to define the various methods to enhance the quality of their goods.

With more users sharing more information across various platforms, the popularity of social media has expanded exponentially. This vast wealth of data offers unique opportunities for data mining professionals. Currently, there are over 2.50 billion active Facebook users worldwide and more than 300 million active twitter users (Clement, 2020). Fig. 1 shows the social networks users in April 2020 (in millions). Furthermore, Figure 2 shows a timeline with the number of monetizable daily active Twitter users worldwide as of the second quarter of 2020.

The political sphere and the identification of peoples views and attitudes towards ongoing political activities are one of the most important areas of opinion mining. In this regard, one of the advantages of analysing political opinions is that it does not require much time and effort, and it returns acceptable results. Therefore, an experiment was designed to evaluate Arabs’ opinions on the Great March of Return rallies using simple models. It is worth remembering that Arabic is one of the worlds most significant languages and is used by more than 290 million people every day (UNESCO, 2012).
this paper, four supervised learning algorithms were trained using three sentiment analysis Arabic tweet datasets. Then, the four algorithms were evaluated in terms of accuracy. Finally, the algorithm with the highest accuracy was used to predict opinion mining of Arab people on the Great March of Return rallies in the Gaza strip. The Arabic tweets were collected using social media APIs and were then preprocessed and prepared to train the most accurate algorithm.

The rest of this paper is organized as follows: Section 2 reviews some opinion mining techniques. Section 3 explains the methodology, section 4 demonstrates the experiments and results, and the conclusion is presented in Section 5.

II RELATED WORKS

The related works are divided into three categories which are, sentiment analysis on Arabic tweets, sentiment analysis on English tweets and analyze reactions on social media about Palestinian and Israel conflict. The works achieved by classifying opinions about Arabic tweets were based on opinion mining approaches such as machine learning, semantic orientation and deep learning. A classification model was proposed by Pak & Paroubek (2010) to identify tweets as objective, positive and negative. They created an Arabic Twitter corpus by gathering tweets using the Twitter API and by automatically annotating those tweets. Using that corpus, they created a sentiment classifier that uses features like n-gram and POS-tags, based on the multinomial Naïve Bayes (NB). Rushdi Saleh et al. (2011) used Support Vector Machines (SVM) method to train systems for testing different domains of data sets with numerous features. Also, the SVM-based framework was designed for subjectivity and emotion analysis for Arabic social media genres (Abdul-Mageed et al., 2012) for both Modern Standard Arabic and dialectal Arabic. The results indicated that solutions for each domain and task should be created. In addition, Omar et al. (2013) used an ensemble of machine learning classifiers; NB, SVM, and Rocchio classifiers to deal with the sentiment analysis of Arabic customer reviews. They found that NB algorithm outperformed the other algorithms on the basis of comparing the efficiency of the algorithms. The work of Duwairi et al. (2014) utilized three machine learning classifiers, namely, SVM, NB, and k-nearest classifier (KNN). The corpus encompassed data in Modern Standard Arabic. The best performance of NB was achieved when no filtering of stop words and no stemming were used. Moreover, an Arabic lexicon stored on the device was given by Badaro et al. (2015). The text is stemmed at first, and then the words are compared to their own existing ArSenL. In this respect, ArSenL is the first large-scale Standard Arabic sentiment lexicon available to the public (ArSenL). On a published collection of Arabic tweets, the method was tested, and an average accuracy of 67 percent was achieved. Recently, in order to predict the feeling of Arabic tweets, Heikal et al. (2018) implemented an ensemble model by integrating Convolutional Neural Network (CNN) and Long Short-Term Memory (LSTM) models. More recently, Al Omari et al. (2019) suggested a logistic regression method combined with the term frequency and inverse document frequency.
(TF*IDF) for the Arabic evaluation arrangement in the Lebanon nation for administrative reviews. Their model was biased in predicting adverse sentiment reviews. In addition to that, we discuss the sentimental analysis related works on English language based on opinion mining approaches. As an example, Alrehili & Albalawi (2019) used a sentiment classification model to classify customer reviews using ensemble voting method which combined NB, SVM, random forest (RF), Bagging and Boosting. Moreover, there are subject related works that aims to analyze reactions on social media about a specific issue. As for Palestinians, social media is used as a tool to allow them to express their voice and opinion (Siapera, 2014). Since Palestinians people don't have their cultural and sociality equality. And the work of Siapera et al. (2015) explore the “proliferation of Palestine content in online spaces,” which they claim has kept Palestine's “memory and current issues alive” in the global arena since the Gaza War of 2014. Both studies illustrate the extensive role of digital media in the Israel-Gaza conflict, which can be incorporated into a larger theoretical context on the 'mediatisation' process. Deegan et al. (2018) discussed in his paper how to use twitter as a tool to represent the conflict between Palestine and Israel and how much the Palestinian side suffers.

As far as the Palestinian-Israeli problem is concerned, very few studies have exploited the content of social media to catch trends or patterns relevant to the ongoing conflict (Siapera 2014, Siapera et al. 2015, Deegan et al. 2018). However, these studies focused on systematic statistical reviews, rather than on data mining or sentiment analysis. In our work, we use text mining techniques including some machine learning classifiers to predict the opinions of Arab people on the Great March of Return rallies in the Gaza strip during their trending on Twitter.

III METHODOLOGY

This section discusses people’s opinions on “The Great March of Return” using "#اﻟﻜﺒﺮﻳا_اﻟﻌﻮدة_ﻣﺴﯿﺮة" twitter hashtag. Our framework consists of three main steps: data collection, preprocessing of the collected data and classifying the analyzed data into either positive or negative data. Fig. 3 demonstrates the basic overview of sentiment analysis framework.

A. Dataset for Training

To conduct our experiments, three sentiment analysis Arabic datasets (predefined data), as shown in Table 1 were used to train four machine learning algorithms. The first dataset is AJGT, which is Arabic Jordanian General Tweets Corpus consisted of 1,800 tweets annotated as positive and negative (Dahou et al., 2019). The second dataset is ASTD, which is Arabic Sentiment Tweets Dataset from (Dahou et al., 2019). The third dataset is Twitter, using a tweet crawler, 2,000 classified tweets were used on various topics such as politics and arts (1,000 positive tweets and 1,000 negative ones). These tweets contained opinions written in both Modern Standard Arabic (MSA) and the dialect of Jordan (Abdulla et al., 2013).

Table 1. Sentiment Analysis Arabic Datasets

<table>
<thead>
<tr>
<th>Name</th>
<th>Positive</th>
<th>Negative</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>AJGT</td>
<td>900</td>
<td>900</td>
<td>1800</td>
</tr>
<tr>
<td>ASTD</td>
<td>799</td>
<td>1684</td>
<td>2483</td>
</tr>
<tr>
<td>Twitter</td>
<td>1000</td>
<td>1000</td>
<td>2000</td>
</tr>
</tbody>
</table>

B. Machine Learning Classifiers

Machine Learning (ML) systems are categorized into three different types: supervised, unsupervised, and semi-supervised learning which combines supervised and unsupervised methods (Almunirawi & Maghari, 2016). Text classification is often performed using supervised machine learning algorithms due to the large number of labeled text datasets. The four used supervised classifiers are described as follows:

Artificial Neural Networks (ANN). ANN are a representation of a network of interconnected "neurons" that can use an objective function to calculate a set of values as inputs to generate the desired output (Irsoy & Cardie, 2014).

Decision Tree (DT). DT begins by selecting a feature as a root node, and then generates a leaf for each possible level of that feature (Trstenjak et al., 2014), (Zoroub & Maghari, 2017).

Logistic Regression (LR). LR is one of linear binary classification methods. It depends on the probability that the object belongs to a particular class (Firyulina & Kashirina, 2020). LR performs a statistical analysis to test for associations, or relationships, between variables. LR is a predictive analysis where the model
is tested to find out whether the value of one or multiple variables, can predict the value of another variable (Frey, 2018).

Support Vector Machine (SVM). SVM is a supervised algorithm for machine learning. It builds a hyper plan in the training process of opinion mining in which it divides positive emotions with a maximum margin from negative feelings. It classifies reviews according to their position in the built hyper plan during the test process (Andrew, 2001).

C. Classifiers Evaluation

Three Arabic opinion datasets were used to train the four machine learning algorithms (classifiers) which are SVM, LR, DT, and ANN. The algorithms were evaluated in terms of accuracy. Then, the classifier with the highest accuracy score was used to predict opinion mining of Arab people on the Great March of Return rallies in the Gaza strip.

D. Data Collection

For data collection, a python code was used to collect data for the hashtag “#اﻟﻜﺒﺮى_اﻟﻌﻮدة_ﻣﺴﯿﺮة (The Great March of Return). We collected approximately 500 tweets which were stored individually in a text file. Then, these files were assembled in one folder to be used later in classification. Table 2 shows a sample of the collected tweets. It is worth noting that these 500 tweets constituted all the possible tweets that were available for us to collect.

Table 1. Sample for the Collected Tweets and their English Translations

<table>
<thead>
<tr>
<th>Arabic Tweet</th>
<th>English Translation</th>
</tr>
</thead>
<tbody>
<tr>
<td>هذه المرة وجدناهم يعبرون الأرض. هي وجوه مست RegExp نبتلهم باستماثرها. ستراهم الله، كما دُفِّعُوا بهما إلى النصر</td>
<td>This is the occupied (land) and these are its children emerging from the salt of Earth, uprising from the agony of the years, feeling the solidarity of God, and swearing by God: We will return.</td>
</tr>
<tr>
<td>نآم معة قوة!</td>
<td>We are able to sip victory drop by drop to quench.</td>
</tr>
<tr>
<td>مسيرة انتفاضة الجماهير في الشوارع.</td>
<td>Calls for rallies towards the Eastern borders along the Gaza Strip on May 15 within the Great March of Return rallies and breaking the siege.</td>
</tr>
<tr>
<td>ان حضرة جديرة بحق، أو هغ و علم يجرؤ على ضغط أبوه.</td>
<td>An artistic portrait painting at the Return Camp east of Jabalia in the northern Gaza Strip today.</td>
</tr>
<tr>
<td>ومجموعات جنود فلسطين في الشوارع.</td>
<td>Masses of the Gaza Strip continue to rally for the sixth Friday in</td>
</tr>
</tbody>
</table>

E. Data Preprocessing

Appropriate preprocessing steps help to improve the opinion mining process and get logical and satisfactory results (Maghari & Zendah, 2019). It can enhance the data quality and improve the classification accuracy (Alhaj & Maghari, 2017). The pre-processing steps used in our experiments are as follows:

Filtering. Repeated letters in phrases such as "اااااا" have also been used to illustrate the depth of speech. In the dictionary, however, these words are missing, so the extra letters in the word have been omitted. Figure 4 below shows an instance of such words.

Figure 4. Example of Filtering from Tweets

Question words. Words like "ماذا", "كيف" do not contribute to polarity and, thus, they were removed. Figure 5 shows an example of question words.

Figure 5. Example of Questions from Tweets

Removing special characters. Special characters like '[] {} 0/' were also removed. Figure 6 shows an example of tweet containing “/”.

Figure 6. Example of Special Characters from Tweets

Removing Stop words and emoticon. In order to continue with the SA system, stop words should be omitted. These include determiners and prepositions (في، إلى، من) and thus were filtered. Examples of Arabic stop words and tweets with emotions are shown in Figures 7 and 8 respectively.

Figure 7. Example of Stop Word from Tweets

Figure 8. Example of Emotion from Tweets
**Stemming.** Stemming tends to reduce a word to a popular base form in inflectional and related types, such as (أحب, حب, حبنا, أحبنا, تحب, تحبون).  

**Tokenization.** Tokenization refers to the division of the sentence into its desired component elements. In all NLP activities, it is an essential step.

**Feature extraction.** Bag Of Word (BOW) is used for text representation. It presents the word in fixed-length, but it ignores the order of words and the grammatical structure. We also considered the TF-IDF (Term Frequency - Inverse Document Frequency), which is a popular term weighting method for feature selection (Saad & Ashour, 2010).

**F. Classification**

In this phase, the algorithm (classifier) with the highest accuracy score was used to predict opinion mining of Arab people on the Great March of Return rallies in the Gaza strip. The classifier was applied on the preprocessed tweets to see the opinion.

**IV RESULTS & DISCUSSION**

We used four different algorithms to train three different datasets and to build a model. All the training data stored in the folders (AJGT, ASTD, Twitter) were gathered in a new folder. Then, the four algorithms were simultaneously applied on the three sentiment analysis datasets. Table 3 to Table 6 show the accuracy, recall, precision, and F1-Measure values for the four classifiers.

**A. Classifiers Evaluation Results**

Table 3 represents the results of applying machine learning classifiers on sentiment analysis Arabic datasets. It shows that the Neural Network classifier gave an F1-Measure values of 0.82% and 74% for negative and positive tweets respectively with an average value of 78.0%. The classification accuracy was 79.0% which is considered a good value.

<table>
<thead>
<tr>
<th>Precision</th>
<th>Recall</th>
<th>F1-Measure</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negative</td>
<td>0.77</td>
<td>0.89</td>
<td>0.82</td>
</tr>
<tr>
<td>Positive</td>
<td>0.84</td>
<td>0.66</td>
<td>0.74</td>
</tr>
<tr>
<td>Average</td>
<td>0.80</td>
<td>0.78</td>
<td>0.78</td>
</tr>
<tr>
<td>Accuracy</td>
<td>0.79</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 4 represents the results of applying Decision Tree classifier on the Arabic datasets. It shows that Decision Tree classifier gave accuracy value of (73.0%) and an average F1-Measure of (71.0%).

<table>
<thead>
<tr>
<th>Precision</th>
<th>Recall</th>
<th>F1-Measure</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negative</td>
<td>0.76</td>
<td>0.75</td>
<td>0.75</td>
</tr>
<tr>
<td>Positive</td>
<td>0.70</td>
<td>0.71</td>
<td>0.70</td>
</tr>
<tr>
<td>Average</td>
<td>0.71</td>
<td>0.71</td>
<td>0.71</td>
</tr>
<tr>
<td>Accuracy</td>
<td></td>
<td></td>
<td>0.73</td>
</tr>
</tbody>
</table>

Based on the previous results, Logistic Regression achieved the best score to the predefined data. Therefore, logistic regression was applied on the collected tweets of the hashtag (#The Great March of Return) for opinion mining on GMR rallies. Dreiseitl and Ohno-Machado urged that logistic regression has lower generalization error than decision tree classifier. It also easier to build than SVM (Dreiseitl & Ohno-Machado, 2002). Bolbol & Maghari (2020) also applied some ML classifiers on Arabic tweet datasets and found that LR outperformed other classifiers as DT.

**B. Opinion Mining Results on GMR**

Logistic Regression classifier was applied on the 500 tweets collected from twitter using the "#المسيرة_العودة_الكبرى" (#The Great March of Return) hashtag. A large difference was found in the results of sentiment analysis of twitter data. The classification results showed that only 71 tweets out of the 500 tweets were positive (with 14.2%), and 429 tweets were negative (with 85.8%). Overall, the number of the negative tweets was greater than that of the positive tweets.

**V CONCLUSION AND FUTURE WORK**

This paper aimed to introduce a simple approach for Sentiment Analysis through extracting opinions from Arabic tweets using machine learning. We used three sentiment analysis Arabic datasets to train and
evaluate four machine learning algorithms. The best accuracy achieved was 83% by using Logistic Regression. Application of logistic regression on the sample tweets revealed that 85.8% of the tweets opposed the Great March of Return, whereas 14.2% of the tweets supported it. In future, we will use CNN architecture in order to improve the results and enhance the classification performance. We can check the model over other datasets that are larger than ASTD, AJGT and Twitter, which were used primarily to equate our findings with the Arabic-language deep learning model.

REFERENCES


Predictive Analytics on University Student Dropouts from Online Learning due to MCO

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ABSTRACT

COVID-19 has and have been affecting the lives of millions of people all around the world. Some of which involves in adapting to the work-from-home culture. It is applicable to all individuals who had to perform their tasks from the comfort of their home whether if it is a 9-to-5 job, running a business or students who are continuing their studies. Observations made shown that students have been facing problems when it comes to attending virtual classes. Hence, this study will be focusing on university students comprising of undergraduate, post-graduate and doctorate students who will be dropping out due to internal or external factors. In order to predict the number of students whom will be dropping out during their online studies; using data mining techniques such as classification techniques and prediction algorithms inclusive of K-Nearest Neighbor (KNN), Logistic Regression, Random Forest, Decision Tree, Naive Bayes, Support Vector Machine and Genetic algorithms. Each of the algorithms will performed their unique features and percentage of accuracy when making predictions. Along with Association Rule mining such as the Apriori algorithm to identify the causes and effects between the identified factors. The testing data collection will be done manually via questionnaires distributed to students who are currently pursuing their online studies. Key factors involved in this study are age, financial, motivational factors and many more. The key beneficiary from this project will be educational institutions (major) concerned by their ratings, number of dropouts or even a significantly lesser number of student enrolling whether new or returning. The minor audience are the higher education students.

Keywords: Data Analytics, Predictive Analytics, Classification, Association Rule Mining, Data Mining, Algorithm, Higher Education, Student, Dropout.

1 INTRODUCTION

COVID-19 has and have been affecting the lives of billions of people all around the world since the dawn of the year 2020. This had made people to adapt the work from-home culture. It is applicable to all individuals who had to perform their tasks from the comfort of their homes and students who are continuing their studies. Business meetings and classes have been conducted online during the time of quarantine. This has led to affect various industries by this pandemic some of which includes education. Businesses and services have come to a halt when the World Health Organization had declared COVID-19 as a pandemic and education was being affected as well. According to UNESCO, schools as a collective had started to close towards the end of February. About 298 million of students were labelled as affected learners, approximately 20% of them were enrolled over 5 countries. As of the second of April, 195 country’s schools were closed, affecting about 1.6 billion of students (UNESCO, 2020).

Well known institutions such as Harvard University in the United States, admissions rates have shot up in the span of a year from 4.5% to 5.3% where they have been admitting more students as they were before (Delaney, 2019). An article from CNBC’s forum states that the acceptance rates have a potential to skyrocket after the pandemic is over (Dickler, 2020). Campuses are taking in students for the upcoming intakes and have been continuously admitting students in advance as a precautionary measure to avoid losses in business and credibility as well as to stay in parity with the target tuitions. Amidst the COVID-19 pandemic, colleges and universities all around the globe has shut down and opted to conduct virtual classes to prevent the spread of the virus. According to Hess (2020), a significant number of students agree that due to health concerns along with the following of the public health officials, approved that face-to-face classes must come to a halt. This includes of the readiness of the management and students to attend online classes with the same amount of energy, (The College Finance Team, 2020).

Due to this radical shift, students have not been involved or anticipated in any virtual classes before. Therefore, students have started requesting reduction of fees from their institutions because they have not been using the institutions’ facilities as they were before although the same amount of fees were being
charged. On the other hand, some students have opted to dropout straight away due to institutes demanding the same fees while students are not being to fully utilize their resources and experience. Small to medium-sized colleges and universities which rely fully on tuition to run the establishments are to face major difficulties according to Anderson, (2020). Colleges were warned that there would be less students attending because the worries of not receiving the same treatment as well as financial difficulties which will make students unable to bear the expenses according to the CEO of College Census, Jeremy Adler, as reported by Hess, (2020). However, institutes that have been operating online before the pandemic has been receiving more positive sentiments from students. Organizations such as Coursera, as a marketing strategy, had released a few of their courses free-of-charge for a certain period attracting more students to opt for that as an alternative.

Hence, this study will be focusing on university students comprising of undergraduate, post-graduate and doctorate students who will be dropping out due to internal or external factors. In order to predict the number of students which and whom exactly will be dropping out during their online studies by using data mining techniques such as classification techniques and prediction algorithms. Each of the algorithms having their unique features and percentage of accuracy when making predictions. Along with Association Rule mining algorithms, to identify the causes and effects between the identified factors. Key factors involved in this study are age, financial, motivational factors and many more. The key beneficiary from this project will be educational institutions concerned by their ratings, number of dropouts or even a significantly lesser number of student enrolling whether new or returning as well as higher education students as a minor audience.

II BACKGROUND OF STUDENT ATTRITION

Dropouts are referred to students who voluntary leave their course or programme that they were studying in an institution before completion. The act of abandoning involves various factors which lead students to leave their academic journey. Student attrition is a term used to describe number of students reducing over time. Dropouts emerge from multiple factors which leads them to do so. The primary factor being; students’ financial issues. It occurs when students are not able to continue paying the high course fees demanded from the particular institutions.

The other contributions to the dropout rate could be the student is facing issues in terms of their performance caused by various other factors such as health both mentally and/or physically. There have been various studies conducted to examine this phenomenon of studies either student leaving their academic voluntary or failing to uphold their academic performances in their respective educational institute. The studies that had been carried out by the authors, identified the factors that affected students to dropout as well as retaining the students; the ways to make the students stay and continue. Still, it has been an issue throughout the most institutions (Burke, 2019). This had been strongly affecting universities that fully rely on fees from students to run the establishment. The consequences resonate from that particular individuals' actions to affect the institution’s name and ranking as well as society.

One of the earliest studies conducted by Vincent Tinto, an author that has been mentioned by various researchers created the “Tinto’s Model”, on student retention and dropout published in 1975, (Tinto, 1975). It is one of the first successful studies, conducted to understand and to study on student retention and dropping out. This model had included student characteristics such as demographics, ethnic, communal, household, educational upbringing, socioeconomic status, psychological profile, and academic progress. The model suggested that social and academic incorporation into the educational institution acts as the foremost determinant of a student to reach graduation. Tinto’s model had also found a correlation between the family background, personal characteristics, former schooling, previous academic performance, and interactions amongst the respective faculty and student as mentioned in the journal of (Yaacob, et al., 2020) which uses data mining techniques to forecast student dropout at Universiti Teknologi Mara which the dataset was being obtained from the Department of Academic Affairs and Internationalization of the institution. Decades have passed and researchers had elaborated that (Tinto, 1975) model was flawed, tested by (Brunsden, et al., 2000) and concluded that the model was not proper for dropout and attrition research due to lack of significance between the factors which were correlated by the author.

Coming back to recent years, an identification of explanatory factors for students from an accounting program of bachelor’s level from a public university in Brazil. The number of participants participated in the research were almost 400 students involves in both qualitative and quantitative methodologies. The quantitative were logistic regression and qualitative were semi-structured interviews, (Durso & Cunha, 2018). Another study conducted in 2018, (Balraj & Maalini, 2018), demonstrates the use of Naïve Bayes algorithm for prediction and its significant accuracy of 83%, was conducted to find the factors causing students to dropout. The dataset collection was done.
from UCI Machine Learning Repositories which included various variables such as demographic, social, school, grades, etc. 2 datasets within the selection were on the subjects of Computer Science programme: Mathematics and Portuguese at the Residential University. A sample of 220 students were conducted and the results shown that universities could use this study in reducing dropouts and increasing their enrolment rates with the help of the findings. A prominent study on predicting virtual learning dropouts by (Yukselturk, et al., 2014), mentioned in the previous study by (Balraj & Maalini, 2018) and many others had involved data mining techniques as well. This study had used below a sample size of 200 students where application of data mining techniques such as k-Nearest Neighbour, Decision Tree, Neural Network and Naïve Bayes was demonstrated. 10-fold cross validation was applied to perform the training and testing process for prediction where k-Nearest Neighbour showed a significantly higher detection sensitivity than the rest.

The dataset consisted of not only the demographics from the previously mentioned studies but also data on self-efficacy, locus of control, readiness, and prior knowledge on the course.

Institutes that are highly dependent on tuition fees for maintenance and salaries to its staff are the ones strongly affected during this Covid-19. These are the institutions that do not received funding from the governmental organization and being in an organization where stakeholders have a chance of opting out from universities which do not yield much profits. Reduction in number of students leads universities to receive lesser amount of fees which leaves the institutes unable to continue being in the education industry. This would lead to retrenchment of staffs and management and it would lead to bankruptcy. According to OECD (Organization for Economic Co-operation and Development), about 40% of students pursuing their Undergraduate actually graduated within the duration of study while another 28% graduated outside their actual period as per their study plans (Guerra & Coates, 2019). As per an electronic publication by the World Bank, it had declared that this phenomenon brings a strong negative effects to countries with developing economies and also this has also failed to aid the poverty reduction (World Bank Group, 2015).

David Laude, a professor from the University of Texas undertook a study upon realizing that the professor himself was responsible for the dropouts of hundreds of students. In his study, he had looked into the profiles of students that had dropped out. The results came out to neither be their academic performance nor their determination (how hard they had studied), instead it was found to be correlated to their household income. He suggested that 30% of the students were prone to graduate in time who were in economic need. Students from a high-income household tend to graduate at double the rates in comparison to ones from a poor income regardless of their SAT/pre-university course (PBS NewsHour, 2015). From his observations, he states that student had a tendency of not feeling that they belong in the respective communities. In this situation, the student would feel the emotions of being left out of place due to not being able to cope with many other of their peer’s mannersisms and lifestyles. Students with qualifications are the future contributions to the nations’ economy. Therefore, the need to obtain an education qualification is important and the focus of retaining them in the institutions must be addressed by the management. According to the World Bank Group, 2016, the employee of a higher educational qualification will obtain a higher wage in any companies.

III METHODOLOGY

The institutions will be aided by applying a data-driven system from student’s enrolment, academic and personal (socioeconomic) data. This system will be used to predict students' unique ways in order to increase the retention rates and decrease the rates of dropouts. Big data has become a buzz word and has taken interest by various organizations all around the world. Nowadays, generating massive amounts of data every day, more than 1000 petabytes to be more precise (Lackey, 2019), and has become more valuable than oil (Silva, 2019). The gain in popularity was achieved due to its capabilities of obtaining hidden patterns and insights from data sources previously deemed as futile. The hidden knowledge includes identifying previously unknown business opportunities. It involves in a complex procedure of analyzing large amounts of data. The ability of generating reports which helps decision makers to make strategic, smart, and informed business decisions and performing analysis on various markets. It also helps in improving operational efficiency. The system allows managers to in developing strategies to gain competitive advantages against competitors. It also has the ability to improve business requirements and provide better customer service (Rouse, et al., 2019). Big data analytics supports in decision making, suggestions, and identifying useful information through various techniques from one organization to another.

A. Data Mining

The journey of data analysis begins by collecting data from various sources. These raw data will be combined by cleaning, manipulating, and pre-processing the data. After the processed being done, it is ready to be analyzed to obtain valuable information. The findings are then presented in the
form of visualizations i.e. graphs, charts, etc. It would be written in a report to be dedicated for the respective departments in an organization (Rouse, et al., 2019). Data mining acts as a part of big data analytic, which is the process applied to perform data analytics as mentioned earlier. It is used to search for valuable evidence and identify patterns hidden within a large raw dataset by applying algorithms that are then used to describe the dataset. After which, a machine learning or predictive model is created using various techniques and later deployed for ETL (Extract-Transform-Load) processes. This then automatically starts to execute the manually performed tasks by the analyst prior to deployment (Twin, 2019).

When it comes to machine learning, there are actually three techniques in total: (i) Supervised, (ii) Unsupervised, and (iii) Reinforced Learning. In this context, we will be only looking into the first two types. Supervised Learning applies to when data from a given dataset is labelled or classified and the output is not known. However, both the inputs and outputs are labelled, the learning takes place by the help of mapping. From the known input data, the output is derived. It is usually used for Classification and Regression problems. Where the output of the Classification problems are categorical and Regression problems involving real values are outputs. Classification problems may include Random Forest along with Support Vector Machines. Whereas Unsupervised Learning refers to the output or the results being unknown from known or labelled input data. In this technique, the algorithms used determines which possible labels are able to produce the known results and the learning takes place from trial and errors (Brownlee, 2019). In the learning process, data is split into training and test data in either an 80:20, 60:40, or 70:30 splitting ratio of training and testing data, respectively.

Therefore, this research will apply Knowledge Discovery in Databases methodology (KDD). KDD is referred to the complex yet illustratable process in finding valuable knowledge from large amounts of data. This process involves various disciplines and techniques including Computation and Statistics to depict hidden patterns (Fayyad, et al., 1996). Figure 1 shows the step of KDD. It starts off with obtaining data from various sources along with studying and understanding the domain of interest. After obtaining the appropriate datasets the suitable ones are selected to be cleaned. Cleaning involves removing and manipulating the data to make it standardized for databasing are known to be containing inconsistent, incomplete, complicated, and problematic records. This stage is known to be the most time-consuming step throughout the entire process. The cleaned data is then transformed by identifying the features based on the goal. It is transformed into the suitable form for analysis. After which data mining tasks take place. It involves in choosing the data mining algorithm such as classification and association for identifying the patterns then to decide which models to apply or whether to build a customized model. At the end, from the findings the analyst evaluates and represents the knowledge found in the forms of reports. It then becomes an automated process of knowledge gathering up until further tweaks are required.

**Figure 1. Steps in KDD (Fayyad, et al., 1996)**

### B. Strengths and Weaknesses

Data mining helps in identifying the hidden patterns and obtain knowledge from a given dataset by following the steps of KDD. This knowledge can then be used to understand the domain of interest, generate strategies, and make smart and informed decisions. It also helps in making predictions and identify suggestions to a given problem. Using data mining in educational domain will help institutions to understand the needs and requirements of their students as well as to understand what factors exactly inhibits to affect the dropout rates from their student demographics. It helps in finding the knowledge required for institutions to take precautionary measures and avoid the dropout issues as an entirety.

Data mining will be beneficial for institutions from various perspectives. The underlying issues with data mining are that during the process of knowledge extraction adds on operating costs as well as hardware and software resources along with manpower which can be bothersome. This process requires certified and skilled professionals which may not be affordable for many companies. The pre-processing stage requires most of the time for analysts to be spent on and having severely unclean data may cause analysts to spend the time unnecessarily.

Therefore, having an appropriate dataset is essential. The algorithms are required to be supervised by analysts due to at times, it may produce unreliable results. Same as before, there are violation concerns with privacy of the individuals’ data that is used for the analysis. For which, establishments must take it into account and enforce tight security to safeguard the data (personal information). This entire process makes the lives of businesses as well as consumers...
IV RESULT

In this section, the performance on a series of tests on the Student Dropout Prediction System is shown in order to evaluate and validate the outputs that it produces. The process of testing is performed to verify whether the system meets the previously determined requirements. Starting from the dataset to the models build itself had been tested along with the application which was built in order to serve the end users. The core purpose of testing was to validate the modules and components within the system whether it works as it was ought to. The series of tests included: Usability, Functionality, Reliability, Performance, and Security Testing.

Scikit-learn also known as Sklearn, is an open source Python library consisting of numerous tools for data analysis as well as predictive analysis and machine learning. It is built on the packages known as NumPy (numerical Python), SciPy (scientific Python), and matplotlib (Mat Lab plot). The Metrics module in the Sklearn package is used to perform assessments and also to check the quality of the predictive model by the help of various methods from it. The Accuracy Score, Confusion Matrix and Classification Report are imported as shown in Figure 2.

Figure 2. Python Library

The accuracy_score function calculates the accuracy of the model by comparing the number of correct predictions in accordance with the total elements which are the test subset/validation dataset in this case, y_test. Therefore, the formula 1 is as follows:

\[
\text{Accuracy Score} = \frac{\text{Number of elements correctly predicted}(y\_pred)}{\text{Elements}(y\_test)} \tag{1}
\]

Since this dataset contain in equal number of positive and negative labels, the author had implemented this validation technique. Yet another function which is similar to K fold cross validation however, it takes in a proper combination of the target labels. It performs selection of the defined number of splits to be done in integers and allocates the feature, target labels accordingly. Then after fitting the model, predictions are performed but, most importantly, different, and equal portions of class labels from the dataset are selected.

Here as shown in Figure 3, the cross-validation score function had been imported from the model selection module of Sklearn. What this function does is that it takes in the model as estimator the entire dataset split into the features and target respectively and lastly the number of times it will be repeated. This method takes in different train and test sets every time it repeats that is, if there are 10,000 records in a dataset, the function will take 1,000 sets at random then perform the predictions. These predictions and model accuracy scores are then kept into account and repeated for the n-number of times determined by the user.

Figure 3. Illustration of K Fold CV, (Li, 2019)

The comparing of the models using the aforementioned accuracy scores along with other parameters such as precision, recall, f1-score, support macro and weighted average based on each target i.e. the correctness and performance of each model for model selection in order to deploy are applied as shown in Figure 4.

![Figure 4. Demonstration of Stratified K Fold CV (Automatic Addison, 2019) (Automatic Addison, 2019)]](image)

It was found that the best performing models were Random Forest Classifier, followed by the Decision Tree Classifier. The performance from both these models were quite high compared to others being over 97% however, another model was to be selected as both of these are considered to be having similar characteristics.

Formerly, carefully compared the performance from the remaining 3 models, when comparing the accuracy scores, Logistics Regression algorithm had shown to be providing the highest accuracy of 88.57%, followed by Support Vector Machine (88.24%) and Naïve Bayes (86.84%) which was clear enough to be deduced with the lowest accuracy as shown in Table 5. The compared techniques is towards the sensitivities of the remaining two
models; LR\(^1\) and SVM\(^2\). Although both these models showcased a high accuracy, the precision score obtained in terms of predicting the dropout of a student were considerable amounts of 59% and 51% respectively. As for the Recall and F1-score, SVM had taken a lead though in a minor context however, the support counts of the LR model was higher than that of SVM. Assessing Figure 3, it was clear to select the LR model as it had a higher accuracy score, time taken to train, and support count.

<table>
<thead>
<tr>
<th>Model Name</th>
<th>Accuracy Score</th>
<th>Precision</th>
<th>Recall</th>
<th>F1-Score</th>
<th>Support</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Random Forest</td>
<td>Decision Tree</td>
<td>LR</td>
<td>SVM</td>
<td>Naïve Bayes</td>
</tr>
<tr>
<td>Accuracy Score</td>
<td>97.92 %</td>
<td>97.29 %</td>
<td>88.57 %</td>
<td>88.24 %</td>
<td>86.65 %</td>
</tr>
<tr>
<td>TP</td>
<td>829</td>
<td>870</td>
<td>229</td>
<td>380</td>
<td>634</td>
</tr>
<tr>
<td>TN</td>
<td>7375</td>
<td>7281</td>
<td>7122</td>
<td>7013</td>
<td>6642</td>
</tr>
<tr>
<td>FP</td>
<td>33</td>
<td>112</td>
<td>208</td>
<td>372</td>
<td>703</td>
</tr>
<tr>
<td>FN</td>
<td>141</td>
<td>115</td>
<td>749</td>
<td>613</td>
<td>399</td>
</tr>
</tbody>
</table>

### V CONCLUSION

In conclusion, the conducted tests on the predictive models along with the system using various techniques. The testing included checking the metrics of the selected models whether they were able to perform as tested using the training dataset as compared to a newly record as per the user’s requirement. All the test cases were met according to their expectations.

### ACKNOWLEDGMENT

This work is acknowledged by INTI International University (IIU), Malaysia for financial support.

### REFERENCES


\(^1\) Logistic Regression

\(^2\) Support Vector Machine


Assessing the Readiness of Higher Education Institution in Malaysia to Accept Generation Alpha using Predictive Analytics

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ABSTRACT
The impact of technology in education is getting more common. In the UK, most of the children start to learn coding skills from the age of 5. Generation Alpha will be very different from traditional college students. Technologies will be largely driven in education and educators need to learn how to adapt to it. The traditional method of teaching and learning might not be effective and efficient for Generation Alpha. Institutional culture needs to be changed to prepare the arrival of Generation Alpha students. In a technology-driven period, students need to learn problem solving skills to help themselves how to think not what to think, and collaboration skills to collaborate with peers around the world. What will the Generation Alpha students behave in higher education? How to define that an institution is ready to accept Generation Alpha? These questions can be answered by finding the unique pattern of generation z using predictive analytics. This research is focus on develop a dashboard system in assist decision making for the higher education institution. The dashboard system will allow Higher Education Institution (HEI) to capture and analyze useful insights and improve decision making from the student data. K-nearest Neighbours (KNN), Support Vector Machine (SVM), and XGBoost are data mining techniques are implemented in order to develop the prediction analytics model. The testing will be conduct for analysis and evaluation of the system.

Keywords: generation alpha, higher education institution, supervised learning, data mining, KNN, SVM, XGBoost.

I INTRODUCTION
The impact of technology in education is getting more common. Generation Alpha will be very different from traditional college students. Technologies will be largely driven in education and educators need to learn how to adapt to it. The traditional method of teaching and learning might not be effective and efficient for Generation Alpha. Institutional culture needs to be changed to prepare the arrival of Generation Alpha students. The current generation of the university or college students is called Generation Z who are born after the year 2000 (Pikhart and Klimová 2020). This group of children is born since 2010, which is the year that Apple unveils the first iPad (Apple 2017). They are the first generation that grows up in a digital world with exposure to electronic devices.

Education has been transformed from passive and reactive to interactive and aggressive (Raja and Nagasubramani 2018). Apple has been an aspiring kid coder who start as young as 6 years old (Apple 2018) which is unlikely to observe in previous generations (Romero Jr 2017). Generation Alpha is a generation that chooses technology over a human connection which loses human connection, but they will be the most educated generation (Romero Jr 2017).

The technology has been integrated into their lives seamlessly (Hughes 2020). Judy Raper who is an engineering school founder told Nature Index “We will expose students to problem-solving in industry, which is often way ahead of us,” (Dall et al. 2018). The Generation Alpha will be not the same as the traditional college students that we are seeing now (Romero Jr 2017). There are 41 out of 144 papers related to inappropriate curriculum and teaching strategy issue which indicates the importance of quality in learning (Quadir, Chen, and Isaias 2020).

Therefore, the scope of this research will focus on predictive data mining model for Generation Alpha students would be developed to analyze and extract previously unknown patterns. A dashboard system which is a web-based platform will be created for the Higher Education Institution (HEI) to analyze key metrics, visualize insights, and identify bottlenecks of the current solution.

The dashboard system is targeted for the Higher Education Institution (HEI) which includes most public and private institutions in Malaysia. The users should be able to open the website the obtain useful insights that will help the institutions to facilitate decision making.

II BACKGROUND STUDY
This reviews the existing body of literature in the context of behavioral characteristics of Generation Alpha and the future of Higher Education Institution (HEI). The various predictive techniques are assessed and explained in detail.

Knowledge Management International Conference (KMICe) 2021, 1 February 2021
http://www.kmice.cms.net.my/
A. Generation Alpha

Generation Alpha is the children who born years 2010 onwards (Velički and Velički 2015). Generation Alpha is far from being a household name to describe the new wave of world inhabitants, but it is one of the terms being used to describe those being born at the cross-over of Generation Z and new age.

B. Future of Higher Education Institution (HEI)

The future of Higher Education Institution (HEI) in Malaysia is uncertainty. 38% of 18-year-old applicants in the UK received at least one unconditional offer in the year 2019 (Johnson 2020). An unconditional offer is an offer that does not rely on the results of previous studies.

C. Supervised Learning

A subcategory of machine learning and artificial intelligence is supervised learning, also known as supervised machine learning (Education 2020). The other subcategories of machine learning are unsupervised learning and reinforcement learning. There are several types of classification models include Logistic Regression, K-nearest Neighbours (KNN), Support Vector Machine (SVM), Random Forest and Gradient Boosting. The author has selected K-nearest Neighbours (KNN), Support Vector Machine (SVM), and XGBoost to develop the prediction model.

For the first step of the KNN model is to select the number of K of neighbours. When K=1, then the algorithm is known as the nearest neighbour algorithm which is the simplest case (Datacamp 2018). Support Vector Machine (SVM) was initially constructed in the 1960s and then were refined again in 1990s. It is different compared with other machine learning algorithms. SVM is a model that trying to find the best decision boundary which helps to separate a space into two classes.

XGBoost is focused on execution speed and model performance. It is fast compared to other models. XGBoost is widely used in structured datasets on classification and regression problems.

III RESEARCH METHODOLOGY

Knowledge Discovery in Databases (KDDs) is the programmed extraction of implicit and useful insights from the huge amount of data collections (Klösgen and Zytkow 2002). The KDD process model is selected for the purpose system because it is complete and more precise compared with CRISP-DM and SEMMA which are mostly company-oriented (Shafique and Quiser 2014) as shown in Figure 2.

IV SYSTEM DESIGN

The purpose is to provide specifications of the system functions or features for the end-user. Requirements capture is important to understand the requirements of the client.

A. Fact-Finding Techniques

Three interviews have been conducted through a video-conferencing application from Microsoft Teams. The interviewees can answer the questions freely because of its open-ended questions. One lecturer and two students are selected for the interview session.

The world is preparing for Generation Alpha, Higher Education Institution (HEI) in Malaysia has to prepare for Generation Alpha. Generation Alpha is unlike the previous generation which has grown in various emerging technology. Higher Education Institution (HEI) in Malaysia has implemented blended learning for Generation Z students, they may have planned something for the Generation Alpha students. They may have a new module to teach the Generation Alpha.

It can be possible to happen that online class will be replaced by physical classes in the future because the difference between online classes and physical classes is the medium of learning, but the knowledge can be shared to the students in the same method.

It can be possible to happen because the difference between an online class and physical class is the medium of learning, but the knowledge can be shared to the students in the same method. Students do not want to open their camera and the educators could not observe the students.

V IMPLEMENTATION

A. Exploratory Data Analysis (EDA)

The following bar chart in figure 3 shows the number of exercises in each learning stage. The elementary learning stage has 784 exercises which own the highest quantity, junior learning stage has 543 exercises, and senior learning stage has 3 exercises which own the lowest quantity.
The number of exercises in various difficulties shown in figure 4. The easy difficulty has 784 exercises which own the highest quantity, junior learning stage has 543 exercises, and senior learning stage has 3 exercises which own the lowest quantity.

From the distribution plot in figure 6, it indicates that the highest number of problems attempts in the exercise is 5 or 6 problems. Because of the proficiency mechanism they might want to upgrade their level to become level 1 and continue with the next exercise.

B. Resampling

Resampling is a commonly used technique for interacting with extremely unbalanced datasets (Vidhya 2020). If the dataset is not balanced, the outcomes of the prediction model might not be accurate to deploy into a production model. The target variable which is the level attribute is visualized with the following plot. The plot figure 7 shows that there is a large gap among the datasets. The number of students who are having the level of 0 and 1 is more than other levels.

C. Feature Selection

The variable has to be reviewed and dropped if the variable has a very low variation because the model is not going to learn anything with it. If the variance is low or close to zero, then a feature is approximately constant and will not improve the performance of the model. In that case, the variable who results in zero variation should be removed.

\[
VAR(x) = \frac{1}{\eta} \sum_{i=1}^{\eta} (x_i - \mu)^2
\]  

(1)
D. Feature Importance

Feature importance applies to strategies that assign a score to the input function based on how beneficial a target variable can be expected (Brownlee 2020). This technique could provide insights into the dataset and model by selecting the most appropriate attributes for predictive modelling.

<table>
<thead>
<tr>
<th>Weight</th>
<th>Feature</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5884 ± 0.0041</td>
<td>is_upgrade</td>
</tr>
<tr>
<td>0.3745 ± 0.0031</td>
<td>problem_number</td>
</tr>
<tr>
<td>0.1002 ± 0.0014</td>
<td>total_attempt_cnt</td>
</tr>
<tr>
<td>0.0999 ± 0.0006</td>
<td>is_hint_used</td>
</tr>
<tr>
<td>0.0966 ± 0.0011</td>
<td>points</td>
</tr>
<tr>
<td>0.0896 ± 0.0018</td>
<td>used_hint_cnt</td>
</tr>
<tr>
<td>0.0752 ± 0.0007</td>
<td>total_sec_taken</td>
</tr>
<tr>
<td>0.0748 ± 0.0011</td>
<td>badges_cnt</td>
</tr>
</tbody>
</table>

The result of feature importance in table 1 shows that the 8 variables which are most important in the dataset. These variables would be stored for data modelling. After the unused attributes have been dropped, the author split the data to train and test set. 20% of the data is used to create the test data and 80% to create the train data.

E. Principal Component Analysis (PCA)

Principal Component Analysis, or PCA, is a dimensionality-reduction method that is often used to reduce the dimensionality of large data sets, by transforming a large set of variables into a smaller one that still contains most of the information in the large set.

After applying PCA, the training set has reduced the number of attributes to 7. An attribute which does not do any impact to the target variable has been removed from the data frame.

F. System Dashboard

The home page is a single page dashboard which consists of the highlights of assessing the readiness of HEI in Malaysia to Accept Generation Alpha and obtain the number of students is performing well in the courses at the top-right of the page.

The total number of students enrolled and problems which have been attempted in the system are listed. The dashboard also provides information about the increased number of students or problems to allow users to acquire information about the system performs compared with the previous month.

The line chart indicates the timeline of the problem attempted by the students. From figure 8, the author could determine that the number of problems attempted is increased by each month. Seasonality can be found in the chart.

The user city distribution shows the number of user account based on different cities in Taiwan. From the bar chart, there are 20 cities in Taiwan which can be differentiated by the colours.

The student statistics page consists of a detailed breakdown of the learning path of the course. It provides a drill-down view to have a more detailed insight from the dataset.

The scatter plot in figure 9 shows how the student performs courses. It uses two colours to differentiate the correctness of the exercises. From the x-axis, it is the time taken for each exercise, the higher the x value means that the user has taken more time at the exercise.

The users can select the users, courses, topics, and exercises that they wanted to in-depth analyse the student behaviour. The system also indicates the number of times that the students have attempted in the course.
features are identified in the feature selection phase. There is a total of 8 important features. The system also provides information that the student is ready to join HEI or not based on the student’s performance; figure 10.

![Student Level Prediction Page of the Dashboard](image)

**Figure 10. Student Level Prediction Page of the Dashboard**

**VI EVALUATION**

Evaluating a model is an important phase of building an effective machine learning model (Srivastava 2019). There are several types of evaluation metrics, but not every type is suitable for all kinds of machine learning models. Precision is defined among the examples which are projected to belong to a certain class as the fraction of relevant examples (Jordan 2017). This metric is used where the correct prediction is important.

\[
P = \frac{T_p}{T_p + F_p}
\]  

(2)

Recall is described as the fraction of the examples predicted to belong to a class in relation to all the cases that really belong to the class (Jordan 2017)

\[
R = \frac{T_p}{T_p + F_n}
\]  

(3)

These quantities are also related to the (F1) score, which is defined as the harmonic mean of precision and recall (scikit-learn 2020).

\[
F1 = \frac{2 \times P \times R}{P + R}
\]  

(4)

The precision and recall cannot be maximized in both ways because increasing the precision score would decrease the recall score, otherwise increasing the recall score would decrease the precision score.

It would be better to maximize the precision because the model is required to predict correctly when the student is detected as ready to join HEI. It is not ideal to have a model that predicted a proficient student as not ready to join HEI.

K-NN has a weighted average precision score of 0.785, recall score of 0.787 and f1-score of 0.786 are shown in Table 2.

<table>
<thead>
<tr>
<th>Precision</th>
<th>Recall</th>
<th>F1-Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>97.9%</td>
<td>99.7%</td>
<td>98.8%</td>
</tr>
<tr>
<td>85.1%</td>
<td>94.6%</td>
<td>89.6%</td>
</tr>
<tr>
<td>68.6%</td>
<td>76.7%</td>
<td>72.4%</td>
</tr>
<tr>
<td>62.5%</td>
<td>57.7%</td>
<td>60.0%</td>
</tr>
<tr>
<td>79.3%</td>
<td>65.9%</td>
<td>72.0%</td>
</tr>
</tbody>
</table>

SVM has a weighted average precision score of 0.779, recall score of 0.777 and f1-score of 0.761 are shown in Table 3.

<table>
<thead>
<tr>
<th>Precision</th>
<th>Recall</th>
<th>F1-Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>98.9%</td>
<td>100%</td>
<td>99.5%</td>
</tr>
<tr>
<td>76.2%</td>
<td>99.9%</td>
<td>86.5%</td>
</tr>
<tr>
<td>66.1%</td>
<td>83.7%</td>
<td>73.9%</td>
</tr>
<tr>
<td>73.7%</td>
<td>37.5%</td>
<td>49.7%</td>
</tr>
<tr>
<td>75.3%</td>
<td>68.1%</td>
<td>71.5%</td>
</tr>
</tbody>
</table>

XGBoost has a weighted average precision score of 0.796, recall score of 0.793 and f1-score of 0.791 are shown in Table 4. All the metrics for this model had performed very well. The precision score is the highest which means that the performance of the model is good compared with the previous models.

<table>
<thead>
<tr>
<th>Precision</th>
<th>Recall</th>
<th>F1-Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>98.3%</td>
<td>99.6%</td>
<td>98.9%</td>
</tr>
<tr>
<td>86.9%</td>
<td>94.5%</td>
<td>90.5%</td>
</tr>
<tr>
<td>68.7%</td>
<td>79.0%</td>
<td>73.5%</td>
</tr>
<tr>
<td>62.0%</td>
<td>61.6%</td>
<td>61.8%</td>
</tr>
<tr>
<td>82.9%</td>
<td>62.8%</td>
<td>71.5%</td>
</tr>
</tbody>
</table>

The analysis has been done on the student part. As there are different kinds of factors or features which might affect the level of proficiency of a student. The users could obtain information about the students’ performance in school. They can have taken some
actions to tackle the problems of the students which might affect their proficiency in the courses.

VII EVALUATION RESEARCH LIMITATION

Some potential limitations could be addressed in future research. Generation Alpha does not exist much data yet and makes it hard to do proper research which is related to Generation Alpha. The result concludes that there are not many research papers or journals that can be obtained. Defining the characteristics of Generation Alpha is difficult compared to previous generations. Due to the limited access of Generation Alpha data, the author would like to acquire the data from the current generation which is Generation Z. These data can be useful to analyze the insights and predict the patterns for Generation Alpha.

VIII CONCLUSION

The author has research on the supervised learning models which would be used to predict or classify the student’s performance. The author has also researched about the tools and techniques that would be applied in the implementation phase. A dashboard has been developed by using Streamlit. The classification metrics have been listed and compared among the machine learning models. The dashboard system is also being evaluated.

REFERENCES


A Comparison Study of Software Testing Activities in Agile Methods

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ABSTRACT
Nowadays the majority of companies in the world are adopting Agile methodology for developing their software products due to the methodology promises to deliver product faster with good quality. The most significant method for checking the quality of a product is software testing. However, in Agile development, software testing is very complex and still has challenges. This is largely happened because the Agile development does not concentrate much on software testing activities. It focuses on customer involvement, short iterations, and regular deliveries. This study is a comprehensive review of the current practices of software testing in the Agile methods. The comparison is made based on some criteria such as change during iteration, acceptance criteria, and quality assurance activities. The aim is to identify the similarities and differences between these methods specifically in creating test cases. The study focuses on three common Agile methods which are XP, Scrum and Kanban. The review shows no difference in the techniques for designing test cases between these three methods. This result can contribute to help the developers and testers who adopt Agile methodology to follow the same rule of creating test cases based on the suitable technique in different Agile methods.

Keywords: Agile methods, Scrum, Extreme programming, Kanban, Agile testing, test cases.

I INTRODUCTION
Trends for testing software development methodologies demonstrate that the practices of agility are adapted to the workplace context as organizations that adopts more practices of the agile-like software development (Atawneh, 2019). Software testing ensures that what you get in the end is what you wanted to build as stated in the system requirements. Also, it able to identify faults and errors in the system which can increase the quality of the software and it checks out if there is an error in the system which can make software unusable (Sawant et al., 2012). The Agile methods makes the testing becomes an essential component of other parts of the development phases and ensures the continuous product quality (Gil et al., 2016). The agile methods have some similar and difference features, where many studies make a comparison between these methods to show the similar and different aspects, such as Al-Zewairi et al. (2017), Anwer, et al. (2017), Black (2017), Kumar et al. (2019), Merzouk et al. (2017), and Saleh et al. (2019). Agile methods insist in sharing common values and principles, short iterations, continuous communication among Agile team members, and frequent fast delivery of system under test (Brhel et al., 2015; Tahir, 2019). However, some of these methods are different in some points such as period of iteration, acceptance of changing during iteration, and number of team members. Nevertheless, the previous studies did not show whether there is a difference in testing activities especially creating test cases among Agile methods. Therefore, there is a need to check whether they are different in the process of designing test cases or not. In order to help testers to be aware about creating test cases in each Agile method. Thus, this study aims to investigate whether there are any differences in designing test cases among the Agile methods, but this study uses the most Agile methods XP, Scrum, and Kanban (Black, 2017; Srivastava, 2017) adopt in the business environment (Anwer et al., 2017; Saleh et al., 2019) to achieve this comparison.

The next sections of this paper explain comparison between the Agile approaches extreme programming, Scrum, and Kanban, followed by testing in Agile and ending with the conclusion of this study.

II AGILE SOFTWARE DEVELOPMENT METHODS
Agile methodology is a collection of values, principles, and practices that incorporates iterative development, test, and feedback into a new style of application development (Agile 101, 2019; Lewis, 2009). Agile Software Development (ASD) methods are considered lightweight methods that could employ an incremental and iterative lifecycle accompanied with short requirements and iterations, which could be modified within the development with broad participation by the customer (Atawneh, 2019; Boehm & Turner, 2005; Usman et al., 2014). Agile methods are increasingly being adopted by companies worldwide to meet increased software complexity and evolving user demands (Matharu et al., 2015). There are many benefits for adopting ASD methods, such as frequent delivery, customer satisfaction, transparency, flexibility, improved
productivity, better software quality, and predictability (Matharu et al., 2015).

Agile methodology is implemented by several ways. The use of suitable way is depended on the type of project. The most commonly ASD methods used are XP, Scrum, and Kanban (Black, 2017; Srivastava, 2017).

A. Extreme Programming (XP)

XP has developed from long cycles of development in traditional methods (Beck, 1999). The XP aims at delivering useful concepts and ideas pertaining to the software engineering to “extreme” levels degrees (Beck, 1999). The XP method is “theorised” according to the key practices and principles that are being used (Beck, 1999). XP is described by some activities, values, principles, and practices. Activities such as listening (customer needs should be carefully listening by the developer), designing (class, responsibilities, and collaboration cards), coding (pair programmed and must be compliant with the development company’s coding standards), testing (unit, system wide integration, and acceptance testing), planning (iterations and user stories), and managing (stand-up meetings) (Black, 2017).

The development in XP is guided by five values, which are communications between the projects team members, simplicity of activities, feedback from customer, system, and the team, courage the team members, and finally, for delivering a good software product, the respect between the team members is compulsory. Additional XP guidance are described as a set of principles: humanity, economics, mutual benefits, self-similarity, improvement, diversity (open-minded to suggestions), reflection, a continuous flow, opportunity (i.e., impediments as opportunities), redundancy (different approaches for problem solution), failure are normal (multiple versions), quality (should not be compromised), baby steps (short space of time), and accepted responsibility by team members (Black, 2017).

The team members in XP should follow 13 practices: 1) sit together, 2) skills and competences, 3) informative workspace, 4) energized work, 5) pair programming, 6) simple and clear user stories, 7) weekly cycle, 8) quarterly cycle, 9) slack the small non-serious stories, 10) ten-minute build, 11) continuous integration, 12) Test Driven Development (TDD), and 13) incremental design (increment in XP is smaller in size than increment in Scrum) (Anwer, Aftab, Shah, et al., 2017; Black, 2017; Matharu et al., 2015). XP values and principles influenced on most of ASD methods to follow it (Abrahamsson et al., 2017; Black, 2017). The XP lifecycle is described in Figure 1. Regarding testing, it is considered one of the major activities to ensure high quality product and high customer satisfaction (Al-Zewairi et al., 2017). XP using TDD, which is a type of unit testing in which test cases are written before coding development to pass these test cases (Beck, 1999).

B. Scrum

Scrum is ASD method aimed to improve team efficiency and dedicated for managing products (Black, 2017). Scrum puts forward iterations, roles, meetings, rules, and artefacts. There is no obligation to use specific practices, it is optional to team to decide their way to do things. Three things as a minimum should be available to implement Scrum; a wall for placing sticky notes, representing user stories, tasks and impediments; pens and blank sticky notes; and a set of cards to estimate the effort of implementation (Black, 2017). The main roles in Scrum are Product owner, Scrum master, and Scrum team (Anwer et al., 2017; Black, 2017). Figure 2 illustrates Scrum framework process.
**Product Owner.** Product owner is the person who directs the Scrum team toward “what to do next”, includes and prioritizes the user stories in the product backlog, which should be accessible, clear, and transparent to all other members (Kayes et al., 2016). He has a responsibility for deciding feature criticality, quality characteristics and product validity (Black, 2017).

**Scrum Master.** The scrum is facilitated by a scrum master, who also helps to build high-value products with a development team. Scrum master ensures that practices and rules are implemented. He helps in managing and prioritizing the product backlog items. In addition, scrum master deletes all the impediments and outside distracting influences that come along in the process of sprint goals achievement (Black, 2017; Kayes et al., 2016).

**Scrum Team.** They are self-organized, cross-functional, ranged from 3 to 9 members, and they are responsible of converting the user requirements into active software through developing the code. Testing is also a team responsibility. The scrum team includes different skills members such as, testers, developers, architects and so forth and other specialists (e.g., a performance testing specialist) may join the team when needed and when their tasks are done, they are leave. The following Table 1 displays certain keywords in Scrum which have special meaning (Black, 2017).

<table>
<thead>
<tr>
<th>Scrum Keyword</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sprint</td>
<td>A fixed period of time (iteration) which usually ranged from 2 to 4 weeks as well as each sprint produces a new version of the product.</td>
</tr>
<tr>
<td>Velocity</td>
<td>A measure of the amount of work in a sprint a team can do. It can refer to the number of completed story points.</td>
</tr>
<tr>
<td>Product increment</td>
<td>A releasable product that resulted at the end of each sprint.</td>
</tr>
<tr>
<td>Product backlog</td>
<td>The source of the sprint content. The requirements are stored in product backlog in the form of user stories (product backlog items (PBIs)) that are not implemented yet. These user stories are ordered, where the more important become the first for implementation. During sprints, the product backlog not allowed to change, but the changes can be allowed during the release planning.</td>
</tr>
<tr>
<td>Sprint backlog</td>
<td>A set of high priority items from the product backlog which selected by the team during the sprint meeting. The items of sprint backlog also divided into tasks for execution.</td>
</tr>
<tr>
<td>Definition of done (DoD)</td>
<td>A product increment become a 'done' state when an agreed list of activities including testing is achieved at the end of a sprint.</td>
</tr>
</tbody>
</table>

Regarding testing, a high-level test planning is performed before write test cases to set the environment, budget, place, and team members. So before delivering the product, unit, integration, regression and all non-functional testing are performed (Harichandan et al., 2014). All types of testing performed through test quadrant to get high product quality (Collins et al., 2012).

**C. Kanban**

The word Kanban comes from Japanese which means 'signboard' (Merzouk et al., 2017). It is like Scrum used for managing the products with an emphasis on continuous delivery on just-in-time. Kanban process is designed to assist teams by working together in efficient way (Black, 2017; Merzouk et al., 2017). In Kanban, three instruments are used, Kanban board, work-in-progress limit, and lead time.

**Kanban board.** On a board, several columns list items in different states. Each column represents a set of activities called a station, which represented as analyze, development, and tests, as illustrated in Figure 3. This Agile method also used sticky notes for symbolizing items, steps, and tasks. These sticky notes move from left to right when all activities of a station are done and there is a free slot in the next column. Thus, Kanban board helps in tracking the activities of testing.

**Limit Work-in-progress (WIP).** There is a limited number of tasks that can handle in each station. Therefore, in a time there is a limited number of user stories. This number of user stories is decided by the team with the contribution of testers depending on the test effort.

**Lead time.** Kanban is utilized to improve the cycle time and tasks continuous flow via reduce the (average) lead time for the complete value stream. Thus, when complete a task, immediately the ticket...
is transferred to the next station if there is any a free slot.

The test cases are designing earlier for development and the maintenance of it during development progresses can help in remove defects during the iteration. Kanban has a concept is Done-Done (Like Serum has DoD) which point to that a user story cannot reach a completion state until complete the testing.

Figure 3. Kanban Lifecycle

III AGILE TESTING

Software testing is a quality assurance activity. It is an important part of any project which improve the quality and productivity of Agile projects (Gil et al., 2016; Nawaz & Malik, 2008). It is a series of processes that begin with requirements step in the early phases of product life cycle (Nawaz & Malik, 2008; Tekin & Cetin, 2012), hence lack of testing resources leads to poor quality (Chomal & Saini, 2014; Rajkumar & Alagarsamy, 2013). In Agile, a testing practice follows Agile principles and it prepared properly so as to cater for continuous changes of the requirements (Jammalamadaka, 2016; Yu, 2018b). It does not just mean testing on Agile projects but testing an application with a plan to learn about it as well as it is integrated into Agile development process unlike a traditional testing which is a phase (Anwer et al., 2017; Harichandan, Panda, & Acharya, 2014). However, it is similar aims with traditional testing, but it is different in the team structure. All team members are involved in Agile testing but with special contribution from professional testers (Kayes et al., 2016).

Agile testing process is based on the iterative methodologies and overcome the disadvantages of sequential models (Khan et al., 2016). All errors are corrected in each iteration after constant testing, obtaining clean code permanently (Gil et al., 2016). The test cases in Agile must be developed as the requirements evolve (Lewis, 2009). The continuous change of requirements and projects long duration calls for changing as well as increasing the test cases (Beer & Felderer, 2018; Do, 2016). Testing in Agile can address these drawbacks that found in traditional testing, via adaption of frequent change of requirements and short iterations and releases (Yu, 2018a, 2018b). As well as via continuous feedback that redirect all the development process (Gil et al., 2016). The testers utilize essential information and they discard the irrelevant details (Gil et al., 2016).

As mentioned before, testing activities are achieved during each iteration. Starting from creating test plan, prioritizing user stories into product backlog, then creating acceptance criteria that for the testable user stories. Following by writing test cases based on the acceptance criteria, as illustrated in Figure 4. The created test cases should be easy, understandable, and reusable for all team members (Gil et al., 2016).

Figure 4. Testing Activities During Iteration Adapted from (Rajasekhar & Shafi, 2014)

ASD methods needs Agile testing practices for its implementation. Agile testing has been widely used in various test practice. The common strategies in testing practice are Test Driven Development (TDD), Acceptance Test Driven Development (ATDD), and Behavior Driven Development (BDD) (Rajasekhar & Shafi, 2014; Yu, 2018b). TDD is based on writing test cases followed by coding. Therefore, the actual tests start before the programming (Black, 2017). ATDD is depended on the collaboration of business customers, developers and testers in producing testable product requirements and to build high quality software in a more rapid way. The key point of ATDD is that it is driven by pre-defined acceptance criteria and acceptance test cases where each part of the program must pass an acceptance test before being merged into the master branch (Atawneh, 2019). Whereas, BDD is depended on the expected behavior of the software being developed. The BDD is often considered to be an extension to TDD and it provides a way to achieve modularity in the software development process (Atawneh, 2019).

Test cases are designing by one of the testing techniques black box or white box, where, each one of has some techniques of designing test cases (Black, 2017). These techniques are used in traditional methodologies and in Agile methods as
well, but in Agile the documentation way is different (Black, 2017). In black box, test cases are designed only from the test item specifications without looking at the code (IEEE, 2008). In contrast, the white-box testing shows what happen inside the system, the tester has an insight about the details of the structure and source code inside the application which he uses it to design test cases (Honest, 2019; Irawan et al., 2018). The design techniques of test cases in black box like boundary value analysis, equivalence class partitioning, and decision tables (Black, 2017). Examples of white box techniques of designing test cases are control flow, basis path testing, loop testing, and data flow testing (Nidhra & Dondeti, 2012). In this paper we give the steps of designing test cases using equivalence class partition technique as example of black box testing (Nidhra & Dondeti, 2012).

1. Define the equivalence classes.
2. Write the initial test case that cover as many as valid equivalence classes as possible.
3. Continue writing test cases until all of the valid equivalence classes have been included.
4. Finally, write one test case for each invalid class.

As example of designing test cases in white box techniques is basic path testing steps (Nidhra & Dondeti, 2012).

1) The code is using for drawing the corresponding control flow graphs, 2) determine the cyclomatic complexity of resultant flow graph, 3) find the linearly independent paths, 4) prepare the test cases for each path one test case and for each test case it should define the input condition and expected output. These designing techniques are using in all Agile methods (Black, 2017).

XP, Scrum, and Kanban are commonly used with some differences and similarities. Since these methods are belonging to Agile so they have iterative and incremental nature but with different durations, continuous planning, clear definition of roles, and a workflow discipline. XP focus on engineering aspects of software project whereas Scrum and Kanban focus on management aspects. Table 2 shows the comparison between them. Some points of this comparison is extracted from a number of studies which include (Al-Zewairi et al., 2017; Anwer, Aftab, Shah, et al., 2017; Black, 2017; Kumar et al., 2019; Merzouk et al., 2017; Mohammad Almseidin et al., 2015; Nawaz & Malik, 2008; Saleh et al., 2019; Sophocleous & Kapitsaki, 2020). However, these studies have not highlighted testing activities and how designing test cases in different Agile methods.

Table 2: Comparison between XP, Scrum, and Kanban

<table>
<thead>
<tr>
<th>Criteria</th>
<th>XP</th>
<th>Scrum</th>
<th>Kanban</th>
</tr>
</thead>
<tbody>
<tr>
<td>Focus</td>
<td>Engineering aspects</td>
<td>Management aspects</td>
<td>Management aspects</td>
</tr>
<tr>
<td>Stages inside iteration</td>
<td>Analysis, design, planning for testing, testing</td>
<td>Analysis, design, evolution, testing delivery</td>
<td>Analyse, development, testing</td>
</tr>
<tr>
<td>Team size</td>
<td>2 - 20 members</td>
<td>5 – 9 members with Scrum Master and Product Owner</td>
<td>Undefined</td>
</tr>
<tr>
<td>Iteration/ Sprint duration</td>
<td>From 1 to 3 weeks</td>
<td>From 2 to 4 weeks</td>
<td>No specific period. It is measured based on the cycle time</td>
</tr>
<tr>
<td>Daily meeting</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Requirements plan</td>
<td>The listing of prerequisites is done always</td>
<td>The requisites require listing based on the length of the run, each two, three or a month</td>
<td>The basics are done always every day/ hour</td>
</tr>
<tr>
<td>Change during iteration</td>
<td>Allowed without constraints</td>
<td>Changing not allowed if Sprint begins</td>
<td>Allowed without constraints</td>
</tr>
<tr>
<td>Acceptance criteria</td>
<td>Defined from user stories</td>
<td>Defined from user stories</td>
<td>Defined from user stories</td>
</tr>
<tr>
<td>Test cases</td>
<td>Designing based on acceptance criteria</td>
<td>Designing based on acceptance criteria</td>
<td>Designing based on acceptance criteria</td>
</tr>
<tr>
<td>Feedback</td>
<td>Span from minutes to months</td>
<td>Span over a month</td>
<td>Undefined</td>
</tr>
<tr>
<td>Testing</td>
<td>Performed in each iteration</td>
<td>Performed in each iteration</td>
<td>Performed in each iteration</td>
</tr>
<tr>
<td>Quality assurance activities</td>
<td>TDD, pair programming, continuous integration, unit testing, system testing, acceptance testing, coding standards, refactoring, collective code ownership, simple design, on-site customer, face to face communication, regular daily meeting, focusses and concentrates on leveraging</td>
<td>Unit testing, continuous integration, acceptance testing, exploratory testing, automation testing, regular sprint and daily meetings, coding and design standards, test cases are design based on acceptance criteria</td>
<td>A single user story is handled in an iteration, each user story is split into tasks, tasks split into sub-tasks, test is performed in each station, testing activities are traced by helping Kanban board, continuous flow, upfront test cases design, test cases are design based on acceptance criteria</td>
</tr>
</tbody>
</table>

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http://www.kmice.cms.net.my/
The XP, Scrum, and Kanban have iterative and incremental nature but with different durations. These ASD methods with several features and aspects to support projects that need short or long period of time to be finished.

It is noticed in Table 2 that testing activities are integrated with other parts (i.e., analysis, design, develop) of the ASD methods process (e.g., XP, Scrum, and Kanban). Testing is a very important part and implement good practices and follow the whole-team approach (Gil et al., 2016; Srivastava, 2017). It is achieved effectively in each iteration of the ASD process. Testing activities such clarifying requirements, preparing test data, and writing test cases in all software development methods have the similar aims, which is detection, prevention, demonstration, improving quality, verification, and validation (Chauhan, 2010; Kaplesh & Pang, 2020; Kayes et al., 2016; Rajasekhar & Shafi, 2014).

However, in ASD it should take into consideration the volatility of requirements, the whole team sharing in testing process, and iterative and incremental life cycle. The testing activities support several principles, practices and values of different ASD methods (i.e., XP, Scrum, Kanban), such as continuous integration, incremental, acceptance criteria, and accepting changes during the development. The increments in these methods requires test cases to validate its functionality and to validate the whole system operations. Test cases which is the main part of testing activities constitute based on the acceptance criteria, which are extracted from testable user stories in all these methods (Black, 2017; Kayes et al., 2016). XP, Scrum, and Kanban methods use the same strategy to write test cases, which written before coding. Therefore, designing test cases from user stories is similar in ASD methods. However, the big issue is that many companies do not create test cases based on the requirements (i.e., user stories) (Sophocleous & Kapitsaki, 2020; Uikey & Suman, 2012) and this causes several problems of testing quality, other issues is displayed in Table 2.

IV CONCLUSION

The main result of this comparison between Agile methods are observed that these methods (XP, Scrum, and Kanban) are different in some roles and practices but in testing activities they are similar, where designing test cases depends on the user requirements, which described in Agile as user stories. As well as they are using the same designing techniques of test cases. The role of software testing is very imperative in the development process of Agile projects for ensuring the quality of products. The nature of Agile that accept requirement changes, incremental, and iterative emphasize that the testing should be achieved in each iteration. An additional research is needed to achieve to support our work on the test cases in Agile methods to show its importance for gain high quality software. This study contributed to show that the testing activities (i.e., designing test cases) are not different in Agile methods.

REFERENCES


Analysis of Space Management Following the Successful Transformation of the Malaysia Agriculture Expo Park Serdang (MAEPS) into a Low Risk COVID-19 Quarantine and Treatment Centre

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ABSTRACT
The conversion of the Malaysia Agriculture Expo Park Serdang (MAEPS) is the fastest built Low Risk COVID-19 Quarantine and Treatment Centre catering for the predicted overflow of COVID-19 patients in Malaysia. This study examined the reasons for the successful transformation, as well as identified the building characteristics that allowed spaces to be selected as sites for a Low Risk COVID-19 quarantine and treatment centre. The methodology employed was a qualitative analysis of secondary resources, a site observation at MAEPS, and a focus group interview. The findings indicated that the architecture of MAEPS, especially Hall A, contributed to the successful transformation through the design of a columnless interior and positive cooperation and the sharing of expertise between the parties involved. The results enhance our understanding of architectural influences on social needs and space conversion. The management of the team and compliance with the guidelines and procedures of pandemic management led to a successful transformation within a short period of time.

Keywords: Covid-19, MAEPS, space transformation, quarantine.

I  INTRODUCTION
This study examined the factors facilitating the magnificent transformation of a conventional hall in Malaysia Agriculture Expo Park Serdang (MAEPS) into Malaysia’s first Low Risk COVID-19 Quarantine and Treatment Centre (PKRC) with 600 beds. MAEPS was also honoured as the “Fastest to Complete Interim Treatment Centre” by the Malaysia Book of Record (MBR) on 15 July 2020, during the closing ceremony of the PKRC (Ramayah, 2020; Saipul, Mahaizura and Rosyahaida, 2020). It was the brainchild of the prime minister and entailed a multi-agency collaboration between the Ministry of Health (MOH), National Disaster Management Agency (NADMA), Angkatan Tentera Malaysia (ATM), Polis Diraja Malaysia (PDRM), Jabatan Bomba & Penyelamat Malaysia (JBPM), Angkatan Pertahanan Awam Malaysia (APM), Jabatan Imigresen Malaysia, Jabatan Penjara Malaysia, Jabatan Sukarelawan Malaysia (RELA), Malaysia Genome Institute (MGI), Jabatan Kebajikan Masyarakat (JKM), MAEPS and various private entities and non-government organisations (NGOs) (Abd Samad, 2020). This PKRC officially opened on 16 April 2020 and the first treatment was administered on 21 April 2020. A total of 1362 patients received the treatment, of whom 94% were males and 69% were illegal foreigners. The total workforce comprised 1157 personnel from various agencies (665 medical and 492 security personnel) (Abd Samad, 2020). The successful recognition of MAEPS as a PKRC was therefore examined with a focus on space management and how the work was completed to fulfil the vision of the prime minister. This was to transform the convention hall into a PKRC with completed facilities and services similar to that of a hospital such as clinical services, a ward for COVID-19 patients, a pharmacy, X-ray room, resuscitation rooms to stabilise patients in emergency situations, and pathology laboratory services (interview with Encik Zaidi b Shahrim, CEO Mardi Corp., 2020).

II  METHODOLOGY
A qualitative methodology was employed to achieve the objectives of this study. Secondary sources were examined to study the guidelines for the transformation process and the design characteristics of the MAEPS, especially the design of Hall A. A focus group interview was conducted with the Chief Executive Officer of Mardi Corp and staff to determine the exact operational works undertaken during the transformation by the Mardi Corporation, which was responsible for the venue owner and facilities. The sharing of experiences illuminated the
management and monitoring of all teams and the spaces needed. The data were analysed and the findings utilised to determine the factors underpinning the successful transformation of MAEPS in a short period of time into the first massive interim quarantine centre for Malaysia.

III RESULTS AND FINDINGS

Several guidelines were provided by the Ministry of Health (MOH) and the National Disaster Management Agency (NADMA) that focused on developing and operating the quarantine centre. The facilities provided in MAEPS were the first in Malaysia to form part of a quarantine and Low Risk COVID-19 Treatment Centre comprising two main halls covering 14200 m² and 604 beds for PUS. The transformation was led by NADMA to the Work Department (JKR) overseen by Arkitek Hasnah Yun and had to face the challenge of complying with requirements regarding spatial organisation and human movements to control the infectious disease. The design also had to fulfil the active and passive fire protection requirements of the Fire Fighter Department. This included a requirement for pathways and an emergency assembly point, the location of fire extinguishers, and appropriate signages. Figure 1 presents a Summary on the Management of Cases in the Quarantine Centre by the Ministry of Health (MOH, 2020).

Figure 1. The Flow of Operation in a Quarantine Centre by MOH (MOH, 2020)

MOH also announced the Guideline of Quarantine Station (Guidelines COVID-19 Management No.5/2020 updated on 24 March 2020) whereby the establishment of a quarantine station is a requirement under Section 14 of the Prevention and Control of Infectious Disease Act 1988 (Act 342) (MOH, 2020). According to the Act, “The quarantine station is to be used for isolation or observation of any person who is infected or whom the Authorized Officer has reason to believe is infected to be removed to a quarantine station until the person can be discharged without posing any danger to the public” (2020). This involves the cooperation of multiple agencies such as the District Health Office, District Welfare Department, Malaysian Royal Police, Army, Local Council and, PGA, and others. MAEPS as a PKRC at national level therefore complied with the guidelines as stated in Annex 32 Quarantine centre (http://covid-19.moh.gov.my/garis-panduan/, 2020). According to En Zaidi (2020), the management in this PKRC of MAEPS was strictly accomplished with 100% compliance among local companies to the guidelines stated in Annex 32. In terms of the details, the objectives of establishing a quarantine centre were to separate infected and potentially infected persons from healthy people. In addition, it aimed to control the movement of those infected to prevent the disease from spreading. MAEPS also fulfilled the pre-requisites for a gazette centre for quarantine as follows:

i. Space layout:
The distance between each bed must be at least 1 metre apart if shared space is inevitable. This cohorting procedure applies only to positive situations (MOH, 2020). MAEPS also complied with other prerequisites such as providing a room for PPE and clinical examinations. The beds provided were made by a local company that assembled and painted them at MAEPS within four days of the establishment of the PKRC. They had to ensure that the beds followed the MOH requirements with no edgy surfaces and no fabric used as material for the mattress and pillow covers. In terms of amenities and facilities, the MAEPS convention hall was already provided with toilets, some of which had to be renovated to become bathrooms with specifications that considered safety and health.

ii. Security and safety:
In addition, MAEPS was monitored under the National Security Council to ensure requirements for quarantine premises were met. Safety was overseen by Polis Diraja Malaysia (PDRM), the Army, and RELA. There were two sharpshooters or snipers located at the tower near to Hall A, MAEPS, to cover the boundary of the premises which were also protected by barbed wire fences. Additionally, the security and safety aspects were emphasised and assisted by Angkatan Tentera Malaysia (ATM) and PDRM, such as the spatial organisation focusing on the openings and the building perimeter, including the coordination of keys and
tagging. Selection of the material for the PKRC also had to conform to health and safety factors.

iii. Cleanliness
There were two types of cleanliness that needed to be provided: clinical waste for which the District Health Office was responsible and general cleanliness and general waste for which the Local Council was responsible.

iv. Food:
The food supply had to pass tests for nutrition and potential poison three times before being distributed to the patients and those on the frontline under the supervision of the District Health Office. The District Welfare Department was responsible for the food supply.

v. Staff duty:
The Incidence Commander coordinated the staff on duty throughout the MAEPS as it became a PKRC.

vi. Linen:
The concession extended from the hospital services managed the linen and clinical waste at MAEPS.

vii. Water supply:
The Work Department was responsible for supplying water to the quarantine centre.

The National Disaster Management Agency (NADMA) provided the Guidelines Entry and Quarantine Process Person under Surveillance (PUS) Arriving from Abroad (24 July 2020). This was due to the spread of COVID-19 by foreigners entering Malaysia and was stated under Act 1988 (Act 342) Section 15 (1), beginning on 24 July 2020. Figure 2 presents the quarantine procedure that started on 24 July 2020 upon arrival in Malaysia. The quarantine period could be as long as 14 days or any other period stipulated by the MOH.

This follows the requirement stated in UBBL 133 Final Exit, UBBL 166 Alternative exits, UBBL 171 Horizontal exit and UBBL 133, UBBL 169 Exit route. As elaborated in UBBL 165, the travel distance in the designated area should be reachable, as shown in Figure 3. The width of the openings to Hall A and Hall C fulfilled the requirements of all stated emergency exits and travel distance, albeit with strict security reinforcements. MAEPS also had to comply with access to fire devices such as fire trucks, pumping appliances for extended ladders, turntables, and hydraulic platforms as required by the Fire Fighter Department.

The security system was also assisted by CCTV, a public announcement system, and wireless intercom. The MAEPS, as a PKRC, was provided with free high speed Wi-Fi access contributed by Telecom Malaysia (TM) to ease the health recording and registration system in this PKRC (Rafidah, 2020).
The involvement and contributions of multiple agencies following the transformation of MAEPS to a PKRC is summarised in Figure 4. All agencies stated in Figure 4 were provided with expertise in significant areas, resulting in the tremendous solution and successful spatial organisation and circulation of Hall A and Hall C in MAEPS as a PKRC. Although this was the first time some of the agencies had worked together, they managed to cooperate.

Figure 4. Work Flow showing the Contributions and Execution of Agencies involved in the Transformation of MAEPS to PKRC (Mardi Corp., 2020)

The local companies that contributed to establishing MAEPS as the first Malaysian PKRC within four days are listed in Table 1:

Table 1. List of Local Vendors for PKRC MAEPS (Mardi Corp., 2020)

<table>
<thead>
<tr>
<th>No.</th>
<th>Vendor</th>
<th>Services/Supplies</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Qube Integrated Malaysia Sdn Bhd</td>
<td>Shell scheme (Hall A)</td>
</tr>
<tr>
<td>2.</td>
<td>Q Caterers</td>
<td>Catering services</td>
</tr>
<tr>
<td>3.</td>
<td>Vantage Five Sdn Bhd A</td>
<td>Ward, shell scheme - Hall A</td>
</tr>
<tr>
<td>5.</td>
<td>JMP Production Sdn Bhd</td>
<td>AV system</td>
</tr>
<tr>
<td>6.</td>
<td>Binsabi Sdn Bhd</td>
<td>Tentages</td>
</tr>
<tr>
<td>7.</td>
<td>Ahar Global Solution</td>
<td>Mechanical support</td>
</tr>
<tr>
<td>8.</td>
<td>Advanced Profiniti Sdn Bhd</td>
<td>Bed, mattress, pillow, cabinet - Hall C</td>
</tr>
<tr>
<td>9.</td>
<td>Hartamas Ceria Sdn Bhd</td>
<td>Tentages</td>
</tr>
<tr>
<td>10.</td>
<td>NeutraHightech</td>
<td>IT services</td>
</tr>
<tr>
<td>11.</td>
<td>View Green Enterprise</td>
<td>Cleaning services</td>
</tr>
<tr>
<td>12.</td>
<td>Kejuruteraan RI</td>
<td>Electrical support</td>
</tr>
<tr>
<td>13.</td>
<td>Cemong Computer</td>
<td>Supply IT hardware</td>
</tr>
<tr>
<td>14.</td>
<td>Eqool Enviro Sdn Bhd</td>
<td>Supply Air Cooler</td>
</tr>
<tr>
<td>15.</td>
<td>Senheng Electric (KI) Sdn Bhd</td>
<td>Electrical appliances</td>
</tr>
<tr>
<td>16.</td>
<td>TOI Services Sdn Bhd</td>
<td>Portable toilets</td>
</tr>
<tr>
<td>17.</td>
<td>AJAY Tailoring</td>
<td>Uniform (for frontliners)</td>
</tr>
<tr>
<td>19.</td>
<td>Flora Pest Control</td>
<td>Vector control</td>
</tr>
<tr>
<td>20.</td>
<td>RadiFems Sdn Bhd</td>
<td>Biological/clinical waste</td>
</tr>
</tbody>
</table>

IV DISCUSSION

As shown in Figure 5, the spacious Hall A of MAEPS indicates the multi-purpose area that can be convert into any desired spaces. MAEPS was built by a well-known builder, UEM Builders Berhad, with a columnless interior supported with cables from the exterior for roofing. Figure 6 depicts the architecture of Hall A of MAEPS and Figure 7 displays the interior of Hall A.

Figure 5. Hall A, MAEPS from the Exterior (Mardi Corp., 2020)

The columnless spacious area in Hall A contributed to the fast transformation of this space into PKRC.
Figure 6 depicts the plan layout of Hall A before the transformation.

Ensuring the hall was columnless meant numerous compartments could be assigned in this hall during the transformation. NADMA and all agencies faced minimal challenges in organising the spatial zoning and circulation. Figure 5 depicts the plan layout of Hall A, MAEPS, after the transformation to PKRC. Hall A is a fully air-conditioned space with a height clearance of up to 9 metres, with 3 sectional wings converted to a gym and a rest area for PUS.

According to Encik Zaidi, the other halls in MAEPS that were also converted to PKRC were Hall C, which was dedicated to those on the frontline with a capacity of 200 beds, and Hall DG with a capacity of 300 beds. Figure 6 displays the plan layout of Hall C before the transformation while Figure 7 depicts the plan layout of Hall C after the transformation. However, following the opening of MAEPS as a PKRC, Hall DG was not used as both Hall A and Hall C managed to accommodate the numbers of PUS in this centre. Both Hall A and Hall C were segregated with a specific zone, namely a Green Zone, for treatment and services, a Yellow Zone for the offices of those on the frontline and a surveillance area, and a Red Zone allocated for beds for the PUS and patients. Figure 8 depicts Hall DG during the planning of the conversion to PKRC (Mardi Corp., 2020).
Compliance with the guidelines, laws and regulations regarding the special implementation of material spaces along with the facilities achieved the planned objectives. Figure 12 demonstrates that the measurements complied with the MOH guidelines as the compartment panels are 10 feet in height and the distance between the beds exceeded 1 metre.

The activities inside Hall A were under the surveillance of those on the frontline with a high consideration for safety from any potential infection diseases. The circulation and spatial organisation of the Red Zone allocated for the Person Under Surveillance (PUS) complied with infection protection standards by ensuring the correct distance and height of all compartments. COVID-19 is believed to spread by water-droplets and is not an airborne spreader. Figure 13 depicts the work of fitting the compartments by the contractors during the transformation of Hall A to PKRC within four days. The compartment allows the PUS to not only be monitored but also to have the privacy required for them to rest and sleep. Figure 14 depicts the example proportion in the cubicles of Hall A.

In this Red Zone, PKRC also accommodated a lounge area for the PUS. Figure 15 depicts example activities in the lounge area.

The Yellow Zone was dedicated to a registration counter and also a surveillance area for those on the frontline. Figure 16 depicts the compartment for the surveillance counter that complied with standard measurements to avoid direct contact with PUS.
Hall C was specifically dedicated to those on the frontline. It comprised a meeting area, resting area, lounge, a counselling area, and more as most staff were unable to return home. Figure 17 displays the resting area.

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**A Review on Usability Requirements of Visually Impaired Users for Accessible E-book Applications**

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**ABSTRACT**

An e-book is basically a book in electronic or digital format that is significant and beneficial for readers who cannot access print books, such as the visually impaired. An accessible e-book is one that allows the visually impaired to use it and achieve the same intended benefits as those who are normal. However, current e-book applications are not practical for users with vision disabilities. With the increased demand for e-books, it becomes even more important to design usable and accessible e-book interfaces for users with vision impairments. This paper hence aims to conduct a review on the usability requirements of accessible e-book applications for the visually impaired. For this purpose, the authors applied an intensive review of current works from 2010 to 2020 that focus on the development and evaluation of e-book usability and accessibility. This study also reviewed general accessibility requirements and guidelines for mobile applications. In total, 24 usability requirements were identified. As the main purpose of the usability evaluation is to determine whether the users’ needs are met, and to identify the needs of the visually impaired that can guarantee that those needs are introduced into their e-book applications.

**Keywords:** Accessibility, visually impaired, e-book applications, usability requirements.

**I \ INTRODUCTION**

With the increased demand for digital information, e-books and e-readers, the importance of designing usable and accessible application interfaces for users with different abilities intensifies (Ballantyne et al., 2018). E-books are progressively used on mobile gadgets. This is mainly significant and beneficial for readers who cannot access print books, such as the visually impaired (Patel & Morreale, 2014). Concerns about easy access to digital resources for the visually impaired must be acknowledged and designers and evaluators must understand that accessibility does not routinely involve usability and vice versa (Khan & Khusro, 2020; Kleyhans & Fourie, 2014). However, countless users with vision disabilities found mobile applications as inaccessible (Khan & Khusro, 2020; Mi et al., 2014). Moreover, the National Federation of the Blind (NFB) claimed that many e-books do not meet the requirements of visually impaired users. As a result, equitable access to digital resources for the visually impaired is still limited (Bartalesi & Leporini, 2015; Khowaja & Fatima, 2019; Kleyhans & Fourie, 2014).

Requirements are features or behaviours of a system as perceived by one or more stakeholders (Zachariah & Nonyelum, 2020). Identifying the requirements for the visually impaired to make an application more accessible and usable is essential and must begin at an initial stage of application development to guarantee benefits of the developed application and its continuous usage (Nathan et al., 2016). An evaluation plays a critical role in addressing usability problems and user needs. However, current usability evaluation models for e-books do not address accessibility issues for the visually impaired (Baker-Eveleth & Stone, 2015; Haslinda et al., 2014; Wang & Huang, 2015) and only suggested limited measurements on accessibility such as alternative text for non-text elements, change text size, and screen readers compatibility (Axtell et al., 2018; Bartalesi & Leporini, 2015; Minatani, 2017; Rogers & Draffan, 2016). However, these measurements are still not sufficient in offering a satisfying experience of an accessible application for the visually impaired (Siebra et al., 2018).

The goal of this article is to review the usability requirements of visually impaired users for accessible e-book applications by conducting a literature review (LR). Literature that focuses on examining and developing e-books that reflects the perspective of visually disabled people are carefully reviewed to define the requirements. Besides that, the study also reviewed the current guidelines and requirements for general mobile applications to address the requirements more deeply. This paper consists of several sections. The first section presents a brief introduction. The second section covers the review of previous works, and the third section presents the methodology. The final section covers the discussion and conclusion.

**II \ LITERATURE REVIEW**

According to Henry (2018), “accessibility means that people with disabilities can perceive, understand, navigate, and interact with the Web and that they can..."
contribute to the Web. Web accessibility also benefits others, including older people with changing abilities due to aging”. Guidelines on accessibility for people with disabilities and the elderly are available for several types of electronic systems. For instance, the IBM Human Ability and Accessibility Centre provides guidelines to help create accessible web, mobile, and desktop applications for people of all abilities (IBM, 2019). The accessibility checklist is based on the revised Section 508 standards, the EN 301 549 standard in Europe, the Worldwide Web Consortium (W3C) recommendations, and IBM Research best practices. In addition, a set of 75 guidelines for web accessibility were proposed by Pernice et al. (2001). Many of these guidelines would make the designs accessible to everyone. However, the most important accessibility guidelines are related to the design (Pernice et al., 2001). A good design usually helps sighted users to increase their efficiency and complete tasks faster; but for visually impaired users, a good design is essential to make task accomplishment possible (Pernice et al., 2001). The following sub-sections will discuss the usability requirements.

A. Usability Requirements and Guidelines for Accessible Mobile Applications

With the growing adoption of mobile devices by the visually impaired, it is important to develop solutions and applications for this audience (Ghidini et al., 2016). Most of the solutions found in literature enable accessible interactions by accepting gestures as inputs and providing speeches, audios, and regular tactical feedbacks as outputs (Piccolo et al., 2011; Power & Jürgensen, 2010). In terms of gestures for touch screens, the study by McGookin et al. (2008) proposed general design guidelines to improve the accessibility of the interfaces for the visually impaired. Based on participatory interviews, the study by Kane et al. (2011) proposed a set of accessibility guidelines for touchscreen-based applications for both blind and sighted users. However, it focused only on a common situation associated with selecting gesturing design for visually disabled people (Siebra et al., 2016). Another study by Arroba et al. (2011) introduced a novel methodology and a set of guidelines for developing accessible touch screen platforms for visually impaired users.

In a research performed by Piccolo et al. (2011), a focus group session was conducted with the visually impaired (blind and partially sighted) to identify a set of guidelines for developing an accessible software solution. Buzzi et al. (2012) studied the accessibility problems faced by blind users mainly when they are interacting with mobile learning applications using touch screen mobile devices. The study discussed aspects that must be considered such as using standard user interface elements and providing alternative interaction modalities. Mi et al. (2014) designed a general heuristic checklist for accessible smartphone devices; however, this study did not classify type of disabilities to better frame their requirements (Siebra et al., 2016). To address these limitations of the previous study, Siebra et al. (2017) identified requirements that are associated with various category of disabilities. In addition, Siebra et al. (2015) identified 13 requirements based on semi-structured interviews and a systematic literature review for accessible mobile applications for visually-impaired users. These requirements are classified into three: six requirements for blind users, six requirements for low/limited vision users, and one requirement for the visually impaired. In Siebra et al. (2016), these 13 requirements were classified into essential (9), desired (2), and not observed (2) based on observation analysis.

Based on the findings of Kim et al. (2016) who examined the interactions of camera-based mobile applications, creation of accessible applications for the visually impaired can be achieved by providing a simplified structure, maintaining consistent user interface layouts, and increasing configurable settings. Ghidini et al. (2016) studied approaches of interaction that could be used easily by visually impaired users. The outcomes indicated that mobile devices, particularly smartphones, must deliver proper feedbacks, a simple design for simple interaction, and the capability to find the options and features of the application.

B. Usability Requirements of the Visually Impaired for Accessible E-Book Applications

An accessible e-book for a visually impaired user is one that allows them to use the e-book and achieve equal benefits as an individual with normal vision with approximately the same amount of effort (Texas School for the Blind and Visually Impaired, n.d.). Therefore, e-book application interfaces should be designed carefully to allow the screen reader software to read each element a user may interact with, such as menu and icons (Ghidini et al., 2016). Each interface element must include a brief description (accessible name) to be read aloud by screen readers (Ghidini et al., 2016; W3C, 2017).

Another important requirement is an accessible format. Screen readers will not function and read e-contents correctly if the format is not accessible (Axtell et al., 2018; Bonnici et al., 2015; Maatta & Bonnici, 2014). There are dual basic formats for e-
books: fixed layout such as PDF files, and fluid format as in ePub, MOBI, and IBA (Walton & Hailey, 2015). Nevertheless, fluid format is best suited for handheld devices (Zeng et al., 2016) and even more accessible for visually impaired users (Axtell et al., 2018; Bartalesi & Leporini, 2015). Still, there are concerns related to the accessibility of contents such as pictures devoid of descriptive text, and inaccessible PDFs (Axtell et al., 2018; Southwell & Slater, 2012). Also, if the content is not correctly marked up, the e-book remains unavailable (Lazar et al., 2015).

Numerous applications provide Text-to-Speech (TTS) which addresses the accessibility limitations of written books (Attarwala et al., 2012; Munteanu, 2013). TTS improves comprehension especially for struggling readers such as the visually impaired (Balajthy, 2005). However, TTS is a computer-based speech and at times difficult to understand (Axtell et al., 2018). Therefore, many settings associated with TTS have been introduced to increase its benefits. One of them is the synchronization of the highlighting of words being read which helps in improving focus and comprehension (Balajthy, 2005; Biancarosa & Griffiths, 2012). Other features such as TTS voice speed and volume adjustments are also important because different users have different levels of listening ability that affects their comprehension (Curts, 2016; Power & Jürgensen, 2010). In addition, these TTS settings are frequently used by the visually impaired specifically voice pitch (45%), speed (75%), and volume (70%) (Shin et al., 2017). Furthermore, the customization of TTS voice (such as male or female voice) must be available to suit preferences of the visually impaired users (Power & Jürgensen, 2010).

Likewise, many accessibility features are required in order to produce accessible e-book applications for the visually impaired. Examples of such functions are text enlargement, user selection of various attributes such as text and background, colour contrast, and support for different input techniques such as voice commands (Axtell et al., 2018; Minatani, 2017). Besides the ability to access electronic contents, a user should also be able to use the interfaces which provide information with minimum effort (Southwell & Slater, 2012). Therefore, a good design is represented by a user-friendly navigation design which makes the application easier to use by the visually impaired particularly for learning (Minatani, 2017; Shin et al., 2017; Southwell & Slater, 2012). Though e-books exist in more accessible formats, this alone does not ensure that it is easy to use in supporting learning. Learners must be able to read in a sequential manner and to move instantly over the content, along with the ability to make annotations (Buzzi et al., 2012). Fortunately, e-books provide interactive features such as search, navigation, and editing tools. They also support hyperlinks, bookmarking, and annotations which are advantages over printed books (ChanLin, 2013).

From the above two subsections, it is revealed that several studies had proposed usability requirements for accessible mobile applications and declared them in terms of checklists, classifications, and guidelines. Unfortunately, e-book studies did not thoroughly identify the usability requirements for accessible mobile e-book applications.

### III METHODOLOGY

Identifying user requirements is very important as they are critical in ascertaining user interface usability satisfaction for any application. This study aims to review the usability requirements of accessible e-book applications designed for the visually impaired. For this purpose, the authors applied a literature review approach on current works from 2010 to 2020 in the domain of development and evaluation of the usability and accessibility of e-books. The study also reviewed general accessibility requirements and guidelines for mobile applications. The authors searched the Association for Computing Machinery (ACM) Digital Library, Scopus, Science Direct, and Google Research Databases to find the relevant papers. The authors also used the snowball method to identify additional papers from existing articles reference list (Wohlin, 2014).

This intention was accomplished by compiling a list of mobile usability guidelines and requirements for mobile application and e-book application user interface. The study excludes any requirements of mobile as a device and any requirements related to operating systems as the scope of this study is only on application interfaces. Besides that, there are many assistive technology hardware solutions available for visually impaired users such as Braille Keypads and Braille Displays. However, their usage is not common mostly because of their costs (Siebra et al., 2017). Therefore, this study excludes any requirements that depend on such external devices.

### IV RESULTS AND DISCUSSION

Applications that are not available or only partially accessible are an obstacle to users (Ballantyne et al., 2018). Visually impaired users depend on the power of information, communication, and technology (ICT) software to interact with digital interfaces (Southwell & Slater, 2012). E-books as ICT software offer a new chance for learning for the visually impaired. Addressing the requirements of the visually impaired for a usable and accessible e-book application is essential. Based on the reviewed literature, this study identified 24 usability requirements. Table 1 summarizes these requirements.
Table 1: The Usability Requirements of Visually Impaired Users for Accessible E-Book Applications

<table>
<thead>
<tr>
<th>Description</th>
<th>Source</th>
<th>Presented are standard, reasonable, and suitable for the small screen on mobile devices</th>
</tr>
</thead>
<tbody>
<tr>
<td>R1   Interface elements can be read aloud by screen readers when touched</td>
<td>(Mi et al., 2014; Power &amp; Jürgensen, 2010; Siebra et al., 2016, 2017, 2015; Woodward, 2014)</td>
<td>(Lanyi, 2017; Power &amp; Jürgensen, 2010; Siebra et al., 2015, 2017, 2016)</td>
</tr>
<tr>
<td>R3   Provision of a clear spoken, haptic, or even sound feedback for all actions/interactions</td>
<td>(Arroba et al., 2011; Mi et al., 2014; Power &amp; Jürgensen, 2010; Siebra et al., 2016, 2017, 2015)</td>
<td>(Arroba et al., 2011; Buzzi et al., 2012; Kane et al., 2011; Mi et al., 2014; Piccolo et al., 2011)</td>
</tr>
<tr>
<td>R4   The application reads aloud the name of a character that is being tabbed</td>
<td>(Mi et al., 2014; Siebra et al., 2016, 2015, 2017)</td>
<td></td>
</tr>
<tr>
<td>R5   Users can select various attributes of text and background (i.e. size, colour, font type, line spacing, etc)</td>
<td>(Axtell et al., 2018; Crossland et al., 2014; de Oliveira et al., 2018; Minatani, 2017; Mune &amp; Agee, 2015; Shin et al., 2017; Siebra et al., 2016, 2017, 2015)</td>
<td></td>
</tr>
<tr>
<td>R6   The applications must support customizations and prevent adjustments in user-defined settings</td>
<td>(Buzzi et al., 2012; Siebra et al., 2016, 2017, 2015)</td>
<td></td>
</tr>
<tr>
<td>R7   Text enlargement/Zooming</td>
<td>(Crossland et al., 2014; Kleyhans &amp; Fourie, 2014; Mune &amp; Agee, 2015; Rogers &amp; Drafnan, 2016; Siebra et al., 2017, 2015; Woodward, 2014)</td>
<td></td>
</tr>
<tr>
<td>R8   Provide meaningful alternative description to interface elements and images</td>
<td>(Buzzi et al., 2012; Lenzi et al., 2013; Power &amp; Jürgensen, 2010; Siebra et al., 2016, 2017, 2015)</td>
<td></td>
</tr>
<tr>
<td>R9   Adjustable brightness/contrast/colour controls</td>
<td>(McLaughlin &amp; Kamei-Hannan, 2018; Ribeiro et al., 2019; Rogers &amp; Drafnan, 2016; Siebra et al., 2016, 2017, 2015; Woodward, 2014)</td>
<td></td>
</tr>
<tr>
<td>R10  Support TTS</td>
<td>(Attarwala et al., 2012; McNaught et al., 2010; Munteanu, 2013)</td>
<td></td>
</tr>
<tr>
<td>R11  Users can adjust the setting of TTS to his preferences (voice, volume, speed)</td>
<td>(Curts, 2016; Power &amp; Jürgensen, 2010; Shin et al., 2017)</td>
<td></td>
</tr>
<tr>
<td>R12  Synchronization of the highlighting of the words being read</td>
<td>(Axtell et al., 2018; Biancarosa &amp; Griffiths, 2012; Epp et al., 2017; Munteanu, 2013)</td>
<td></td>
</tr>
<tr>
<td>R13  The application supports various input methods such as voice commands</td>
<td>(Ghidini et al., 2016; McNaught et al., 2010; Shin et al., 2017)</td>
<td></td>
</tr>
<tr>
<td>R14  The interface layout is perceivable and out of clutter (i.e., the interface elements)</td>
<td>(Buzzi et al., 2012)</td>
<td></td>
</tr>
</tbody>
</table>

It is clear from Table 1 that the usability requirements for the e-book interface for visually impaired users are mainly related to the need to access both the application interface and book content. Accessibility features such as text enlargement, compatibility with a screen reader, and high contrast are among the most important features. Besides that, visually impaired users as any normal book readers need to use functions that facilitate the reading process such as navigation, annotations, and search. Therefore, designers should take these requirements into account and provide clear spoken feedbacks for all interactions as certain mobile applications might be inaccessible at the usage level due to poor design (Ballantyne et al., 2018).
V. CONCLUSION
This paper aims to reassess the requirements for usable and accessible mobile e-book applications for visually impaired users that are frequently overlooked by developers. This paper contributes by providing a list of usability requirements in designing accessible mobile e-books for visually impaired readers. However, the proposed list of requirements still needs to be validated i.e. a task that can be undertaken in future studies involving visually impaired users or expert reviews.

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technology to make accessible content more user-friendly.


Knowledge Management in Pandemics: Design and Implementation of Social Distancing Mobile Application

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ABSTRACT

Pandemics naturally are difficult to eradicate completely because of its long span but can easily be managed. The COVID-19 pandemic has forced individuals/decision-makers globally to have knowledge in its management. Despite measures taken to curtail the spread of the virus in Nigeria particularly in Kaduna state, there is no social distancing app developed as one of the strategies to curtail the spread of the virus in the state. Hence, this paper describes one of the management measures that can be enforced by the Kaduna state government (KDSG) to reduce the spread of the coronavirus in the state by designing and implementing a Social Distancing Mobile App called Kaduna trace (KDTTRACE) for the state citizens. To achieved this, a flutter written in DART programming language is used for the frontend design while firebase is used for the backend design. The result will be the designed app for the iOS, and android based devices that will be pushed into Github repository for private use, will be uploaded to google play store for public consumption on completion. The extension of the app to handle contact tracing of the citizens with the virus in the state will be future work of this study.

Keywords: Knowledge management, Pandemic, COVID-19, Social Distancing, Mobile App.

I INTRODUCTION

Pandemic is said to be defined as epidemic occurring globally or over a long period of time by crossing international boundaries and usually affecting a huge number of people that may occurs annually in each of the temperate southern and northern hemispheres, given that seasonal epidemics are not considered pandemics.

Covid-19 pandemic management is a difficult situation because of its long span, health and socio-economic effects. However, compare with other natural disasters, the covid-19 pandemics’ overwhelming effects can actively be taking care of and reduced by managers, via right and timely decisions. Decision making to manage the wide spread of the covid-19 pandemic can be critical, and it effectiveness depends on the measures taking in creating effective and efficient knowledge management awareness in pandemics (Ammirato, Linzalone, & Felicetti, 2020; Viner et al., 2020).

COVID-19 is spread globally by and large as a result of movement of people. With its emergence, researchers, entrepreneurs, governments and industries around the world have been involved in discovering or adapting existing technologies to support healthcare, government and industries in tackling the new crisis. Therefore, based on the classification of the COVID-19 Apps, social distancing apps is classified under contact tracing apps based on these related study (Behar et al., 2020). A lot of studies proffer solution to curtail the wide spread of COVID-19 pandemic globally. For example, the contact tracing apps in China such as WeChat and AliPay (Behar et al., 2020; Sookman, 2020); Singapore, TraceTogether (Cho, Ippolito, & Yu, 2020); BlueTrace (Bay et al., 2020); India “Aarogya Setu” (Bridge to Health in English) app (Behar et al., 2020; Tiwari, Kashyap, Rai, Tiwari, & Pandey, 2020). South Korea and Taiwan (Behar et al., 2020).

Millions of persons have been infected, nearly 200,000 death have been realised globally since its discovery based on this study (Alanagreh, Alzoughool, & Atoum, 2020). Similarly, in Nigeria according to the Nigeria Centre for Disease Control and Prevention (NCDC) daily updates the number of infected persons is 67,220 and the number of deaths is 1,171 nation-wide. Just as any other state in Nigeria, Kaduna state recorded 3,044 cases of infected persons and only 47 cases of death recorded so far. Nigeria as a nation is finding a possible way out to fight the epidemic. They rely on classical public health measures in collaboration with its health agencies such as NCDC to curb the epidemic. The main goal of the public health measures is to prevent person-to-person spread of the disease by separating people to interrupt transmission using all the necessary tools obtainable. According to Tiwari (Tiwari et al., 2020), there are many negative consequences of a pandemic. Pandemic may engender psychological stress (Brooks et al., 2020), physical health problems (Zhang, Wu, Zhao, & Zhang, 2020) and decreased social support (Tiwari et al., 2020).
The NCDC has redefined social distancing as “remaining out of congregate settings, avoiding mass gatherings, and maintaining distance (approximately six feet or two meters) from others when possible” during the COVID-19 pandemic period. Hence, the term connotes physical distancing that aims to curtail the wide spread of the virus by contact. According to World Health Organization (WHO) when “an infected person coughs or sneezes, droplets containing the virus are deposited on objects and surfaces where people may likely touch”. Hence, anyone in close proximity of about 1-2 meters may be at risk and the possibility to contract and spread the virus is negligible when appropriate physical distance is upheld (Agusi et al., 2020).

More so, the knowledge of the environment in the society particularly the societal interactions of human in public places such as workplaces, markets, religious places of worship, schools, hospitals, motor parks, airports are highly required. Having the adequate knowledge of the societal interactions of citizens in such places will provide cue on the appropriate technological tools to utilize in fighting against pandemic like COVID-19 in the society. However, so far, the conventional preventive measures adopted to fight against the pandemic as suggested by the WHO have been adopted by Kaduna state to curtail viral spread. These measures by themselves are inadequate without technological supplementation with tools like robots, apps etc. Apps such as the social distancing app are being utilized globally in bridging gaps in the fight against coronavirus spread. Thus, having the knowledge of the environment and the right tools (social distancing apps) to utilize during pandemics is one of effective and efficient strategies of management of the pandemics in our societies.

Based on the analysis of the previous work done on the COVID 19 pandemic Apps, there is paucity of research on the development of social distancing mobile app to mitigate the spread of COVID 19 in Nigeria, particularly Kaduna State. The apps have become popular in almost all part of the world for their success in curtailing the virus. As such, this paper will bridge the gap by designing and implementing a social distancing mobile app (KDTRACE) for the state citizens as one of the management strategies to curtail the spread and effects on health and socio-economic crises in the state particularly during this crucial period when schools, social and economic activities have resume normalcy after almost a year of lockdown. The app will cement the mitigation efforts as it will allow people to maintain adequate distance while they are out and about. Having the advantage of giving the society the opportunity to return to normalcy unlike other measures that involve confinement of large segments of the population.

II COVID-19 PANDEMIC IN KADUNA STATE

The Kaduna state government (KDSG) is at the forefront of all activities where Industries, Universities and all other governmental bodies are supporting the government. Unlike the other states in the country, in which a lot of solutions to problems are gained from companies or institutions alone and then adopted by the government to solve and prevent the COVID-19 from its wide spread. Kaduna State being situated in the northwest zone of Nigeria, is one biggest educational center in the country and the 18th state of the Federation. Education is one of the key objectives of the government of Kaduna State. It was formerly Liberal State. It has now become Centre of Learning because of the presence of many tertiary institution in the state. The State consists of 23 local government areas. Population of over six million people.

According to NCDC report as of 30th November,2020, in Kaduna state the number of confirmed cases is 3,064 and 191 confirmed death cases.

III KNOWLEDGE MANAGEMEN IN PANDEMICS

Pandemic generally cannot easily be predicted because it is not time-bounded, single, or discrete event (Ammirato et al., 2020). It is rather a continuous process, that functions for a certain period that lasts until its cure has been introduced and pandemics knowledge management is vital to curtail mass contaminations and loss of lives.

Knowledge management generally refers to set of processes designed to create, store and apply knowledge. Knowledge management in pandemics has a higher strategic objective, aim at saving lives. Knowledge is a strategic means to drive decision-makers in the management of a pandemic. Pandemics can extensively be spread worldwide and its economic loss circulate over time and across nations. As such, it infers a feature of Pandemics knowledge management has to cross diverse knowledge domains such as political sector, governmental, health, economic, political and government sectors. However, knowledge management can improve the process of pandemic management, by ensuring the accessibility of precise and reliable vaccines when available.

In terms of literature review on KM in pandemics according to (Ammirato et al., 2020), “To the best of our knowledge no literature review on knowledge management in pandemics exist”. However, as shown
in figure 1, the study gave some knowledge-related reviews that uses pandemic as an important test to formulate theories highlighting the state of the art.

IV KDTRACE OVERVIEW
KDTRACE is a social distancing app where KD is representing Kaduna and TRACE is a monitoring process of the app. The app is mainly design for Kaduna state citizens of Nigeria. The app uses procedures to register Bluetooth encounters among participating devices to manage and curtail the spread of the virus in the state. The app is design using Bluetooth with beacon technology. Beacon is a tiny wireless transmitter which utilize low-energy Bluetooth to send signals to other nearby smart devices. They are able to connect and transmit information to those smart devices by making position-based searching and interaction much easier and very accurate.

When two or more participating devices come into close proximity of 2 meters of radius to each other, they exchange identifiable messages that are non-personal containing temporary identifiers. The identifier is a unique ID number that smartphones identifies as unique to the beacon. The uniqueness of the beacon technology is that after searching for devices within the proximity, it connects to smartphones that has similar app installed on them and ignore the rest unlike using only Bluetooth that can connect to any device that broadcasted signal within the proximity range. When it searches and connect to devices having the app installed on them, the app beep a number of times and triggers a simple voice message “Kindly Maintain the 2 Meters Distance Apart as stipulated by the KDSG” as warning.

For the frontend design of the App, a flutter as a framework for building cross platform apps writing using DART programming language. One of the advantages of using DART is that it has cross platform features in the sense that one can write a single software that can run on multiple platforms such as on iOS, and Android devices. While for the frontend a firebase is use for user authentication. It has advantage of being serverless software, one need not to develop backend from the scratch and it save cost of infrastructure on the cloud. The results obtained will have significant impact on practice, policy and implementation of Sustainable Development Goals (SDGs) that will support public health authorities of Kaduna state and the Nigeria Centre for Disease Control (NCDC) Kaduna unit in curtiling the spread of the pandemic in the state. There are procedures involve for the workability of the app including the collection of personally-identifiable information like phone number to authenticate user devices.

V HOW KDTRACE WORK
The flowchart in figure 2 represent the flow on how the KDTRACE supposed to work. In that figure three main stages were involve; first, is the initialization/information stage, second, is the authentication and the third, is the activation stage. Thus, the detail explanation of the stages is giving as follows. At the initialization/information stage, the App launches with a welcome /information screen where general messages, KDSG guidelines/rules and user agreement regarding the Covid-19 are displayed, KDSG guidelines/rules on Covid-19 and user agreement are also provided on that stage. Then, the user will click on get started. Next is the authentication stage where the app at that stage will prompt the user to enter his/her phone number. When the user enters his phone number, that is at the back-end by generating unique randomized User-ID and associates it with the user’s phone number called one-time password (OTP) containing six numeric digits that is done using firebase. It will be sent to the user’s phone, if the user receives the OTP, he will enter the send OTP to verify. These as shown in
Figure 3 Otherwise it will resent the OTP again. After verifying the OTP, the app requests for Bluetooth access, and when the access is permitted, the app enters the third stage that is the activation stage. At that stage, the app opens up the connectivity page whereby the app searches for devices within 2 meters range and gets connected to those devices that have similar app installed on them. The app will beep for certain number of times and trigger a voice message as indicated in the flowchart.

![Figure 2. KDTRACE Working Procedures](image)

Figure 2. KDTRACE Working Procedures

Otherwise it will start searching for devices within that range to connect and if the app is deactivated the procedure is also shown in the flow diagram in Figure 2.

![Figure 3. User Verification](image)

Figure 3. User Verification

In this study, phone contacts are the only personal identifiable details needed from the user.

When the OTP verification is successful, then it will move to the next stage that is the contact tracing. At that stage, the app will request for Bluetooth access/activation. Once the Bluetooth is activated, the app opens the connectivity page/home screen. Under the home screen there two menus thus; search and connection. The search, searches for the users’ devices that has the app installed by discovering them – using beacon technology and connect to them. In this case, the KDTRACE devices exchange signals over the Bluetooth Low Energy (BLE) protocol. In the BLE jargons, devices can either be on Peripheral or Central function or may alternate between the functions. This can be illustrated in figure 4.

![Figure 4. BLE Handshake Flow](image)

Figure 4. BLE Handshake Flow

When 2 devices are linked, the Central reads the Peripheral’s Encounter Message, and then writes back its own Messages that it comes across; each of the linking permits a two-way communication between the Central and Peripheral. Allowing two-way communications encourages symmetry and handles the constraint where other devices are only able to work as Peripherals.

Moreover, KDTRACE devices scan and broadcast on configurable cycles. Scanning occurs always during which devices scan for other KDTRACE devices as Central. A shorter duty cycle for scanning to preserve resources is recommended. It is also recommended both scanning and broadcasting duty cycles should be > 1, to guarantee that devices have the chance to see themselves.

VI DESIGN PROCEDURE CONSIDERATIONS

A. Bluetooth vs GPS

This paper considered only Bluetooth with beacon technology solution for now no GPS. Because our devices are not saving any data for security and legal considerations, until terms and conditions for storing public data have been reviewed approved by the authority. In the context of this paper Bluetooth was chosen mainly because it classifies nearby contacts with a “lower false positive rate than GPS.”

B. Bluetooth Limitations

Today, a lot of smartphone users use Bluetooth to link their phones with peripherals like smart watches, headphones, etc. Limitations are occasionally realized in the use of the Bluetooth technology. The weaknesses have to be updated at the operating system-level, and hence users are to be encouraged to certify that their operating systems are regularly updated. The apps may be alerting users if an obsolete operating system is detected, to notify...
users to consider updating them. However, these are beyond the scope of this paper.

VII KDTRACE IMPLEMENTATION CHALLENGES

A. iOS background Bluetooth Challenges

Whereas Android category of the KDTRACE reference execution functions fully for Central and Peripheral whereas the app is in foreground and contextual execution modes, the iOS category of KDTRACE has restriction on contextual Bluetooth workability.

When in the contextual, the iOS app broadcasts in a proprietary broadcasting format which is not part of the Bluetooth standard and hence not readable by non-iOS devices. It may also unable to scan for other KDTRACE devices around it. As such, this is done to encourage iOS users to keep their app open, especially when in dangerous environments. The app also alerts the user if access is not granted/Bluetooth is not on, this may cause the app not to function well.

B. Transmission Power Differences

There are transmission power differences across devices. KDTRACE utilise RSSI readings to estimate distance. Though, through tests of devices in local environments, it has been confirmed that the alteration in transmission power across popular mobile devices can be as large as 30 dB (1000x). At the course of testing, also it was discovered that transmission power varies little between different devices of similar model and is slightly affected by mobile phone covers. To account for the differences, reference signal strength readings has been taken in greater than API 18. this have been used to standardize RSSI readings when categorizing encounters by proximity.

VIII CONCLUSION

The development and implementation of the social distancing app is one of the management strategies to curtail the pandemic in Nigeria, particularly KDSG. Once the App has been adopted by the government, in an attempt to save both its citizens and the economy of the state, can launch a public awareness campaign to inform the general public about the existence of the App generally and the measures that will be taken if individuals do not adhere to the practice of social distancing as informed by the App. Such measures include but are not limited to implementing pecuniary taxing regulations of levying fines etc.

Conversely, non-adhering citizens could even be subjected to the wrath of the law. Thus, the KDSG using the KDTRACE app in tandem with other appropriate measures could successfully monitor and reduce the spread of the virus in the state. These measures consequently can afford the state the opportunity to resume normal economic and social activities without fear that the state will go back facing massive poverty which reverse the economic and social downturn. The relevance of the study to SDGs is that, the economic impact of COVID-19 has increased the poverty toll globally and locally and if left unchecked, it will plunge large swaths of humanity into severe poverty and destitution. Thus, precluding poverty both at local and global level is one of the objectives of the SDGs.

However, if the App is fully implemented in Kaduna state and widely accepted, it will be extended to handle contact tracing of the citizens with the virus in the state using locations such as Geographical Positioning Systems (GPS) and this will serve as the future work of this paper.

REFERENCES


Data Visualization for Multimedia Super Corridor Malaysia using Dot Distribution Maps

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ABSTRACT
Multimedia Super Corridor (MSC) is a Malaysian government designated zone developed as a catalyst for the advancement of the information and communication technology (ICT). Currently, the locations of each MSC Malaysia status companies are represented in a list. Thus, it is time-consuming and inconvenient for users to go through a list of 3213 of MSC Malaysia companies. This study proposed to develop a webpage application to visualize the locations of MSC Malaysia companies in Klang Valley using dot distribution maps technique. Google Maps Javascript API is used to display the map in the webpage application. The data of the companies are collected and reorganized with additional information. The webpage application also utilizes markers as symbols to display the exact location of the MSC Malaysia companies. Besides, the tooltips feature is also included. Pan and zoom control features are provided by Google Maps Javascript API. From the result of system testing, it shows that the webpage application functions, work properly and the locations of MSC Malaysia companies are presented in a more understandable way in which ease for users to search for the exact location. By applying dot distribution maps technique, the users can easily view and identify the locations of MSC Malaysia companies in Klang Valley.

Keywords: Data Visualization, JavaScript, Multimedia Super Corridor, Dot Distribution Maps, Google Maps, API

1 INTRODUCTION
A structured and unstructured of large and complex data are referred as big data in which the traditional processing techniques are unable to operate on these data (Husin & Abdullah, 2019; Taylor-Sakyi, 2016). The characteristics of big data are 5V’s which consist of volume, velocity, variety, veracity and value (Hilka, Srimathi, & Bonthu, 2016). According to International Data Corporation (IDC), the collection of data is growing at an exponential rate (Olshannikova, Ometov, Koucheryavy, & Olsson, 2015). A massive volume of data is complex to be analyzed, therefore the data visualization techniques will be used to solve this issue. Data visualization is vital in visualizing the big data efficiently (Razak, Fauzi, Gining, & Jamaluddin, 2019; Sulaiman, Mohamad, Hanafi, & Wahab, 2018). The visualized data using the data visualization techniques are more understandable as they are presented in graphical or pictorial form (Sadiku, Shadare, Musa, & Akjuobi, 2014).

In this study, MSC status companies are chosen as the dataset domain. MSC is a Malaysian government designated zone developed as an accelerator for the progression of the information and communication technology (ICT). MSC Malaysia companies are initiative projects by the fourth Malaysian Prime Minister, Tun Dr. Mahathir Mohamad. MSC Malaysia companies are classified into four different clusters of ICT focus area which are Creative Content Technologies (CCT), Global Business Services (GBS), Institutes of Higher Learning (IHLs) and Information Technology (InfoTech). The advancement of ICT is important to the society to transform Malaysia into a knowledge-rich economy by the year 2020 to achieve the Vision 2020 (Injau, 2011). MSC Malaysia is committed to nurture and guide the talent groups from primary and secondary students, undergraduates, fresh graduates and working professionals, digital maker, and premier IHL. This study is proposed to focus on fresh graduates from local universities. It is a job opportunity for the fresh graduates because MSC Malaysia is a great platform for the fresh graduates to pursue their career in digital technology to enhance their knowledge in ICT area.

Based on our study, we found that the user faces difficulties to identify the location and search the MSC Malaysia company on the current web site. It is due that the user can only search for the name of the MSC Malaysia company. Alternatively, the user can search for each company by scrolling up and down through the list. However, it is very time-consuming for the user to identify the location of the company because the user can only view the address once clicked on the company's name to view more details information of the company. Currently, the MSC Malaysia company has 2,954 active companies. The data stored for each company includes the company name, core activities, address and contact and these data are still presented as a text list. This presentation of data is inefficient to be analyzed.

Data visualization can be categorizing to five types which are temporal, multidimensional, hierarchical,
network and geospatial (Ward, Grinstein, & Keim, 2015) (Wilke, 2019). In this study, the geospatial or spatial data visualizations type is chosen because it is suitable category in order to display the real-life physical locations of the MSC Malaysia companies in Klang valley.

In geospatial category, there are several techniques that can be used to visualize the data such as cartogram, choropleth map, proportional symbol map, dot distribution map and dasymetric map. Cartogram is map that represents a mixture of statistical and geographical data in the geographical sections are adjusted in which the statistics of the population and income are presented (Nusrat, Alam, & Kobourov, 2018). Cartogram can be categorized into four different types which are contiguous cartograms, non-contiguous cartograms, dorling cartograms and rectangular cartograms. Choropleth map is used to visualize the weather condition or vulnerability data of region. Choropleth also is the most common technique used to depict the quantitative thematic geodata. The spatial units such as countries, states and cities are frequently used in choropleth map to emphasize the differences of the geographically distributed data by color or patterns (Skowronnek, 2015). Proportional symbol map is a map that visualize the location data such as countries, states or regions which varies by the variable attributes and the locations data are presented using circle, square, bar or a pictographic symbol. The advantage of using proportional symbol map technique is the attribute values of the measured location data and conceptual location data are represented together (Kunigami, Rezende, & Souza, 2014). Dot distribution map also known as density map uses dots in visualizing the location data. It is a technique used in representing the point-based data in which each point displayed on the map represents data with a known geo-location or a value aggregation (Polisciuc, Alves, & Machado, 2015). Dasymetric map is used in assigning population data to display the spatial data and its auxiliary data. The outcomes of dasymetric mapping can be validated by evaluating the relationship between the density of population and the auxiliary data using the statistical linear regression (Liu, Peng, Wu, Jiao, & Yu, 2018).

Different techniques of geospatial can be applied on the particular scenario and case study. Therefore, the dot distribution map is chosen since it is suitable with the objective of this study to visualize the MSC Malaysia companies in Klang valley.

II RESEARCH METHOD

This section will focus on the process of developing the data visualization for MSC Malaysia status companies. The waterfall model (Sulaiman & Ghani, 2011) was chosen as the software process model to represent the comprehensive study process as depicted in Figure 1. This model is used because it works well for smaller projects where the requirements are well understood.

![Waterfall model](image1)

In requirements definition phase, the system’s services, constraints and goal is established by consultation with target user and literature review from selected website, books and articles from journal and conference proceeding. The data of active MSC Malaysia companies were collected from Malaysia’s Open Data Portal (Jamil, n.d.). The data extracted from Malaysia’s Open Data Portal is in .xlsx format as shown in Table 1. The extracted data consists of 3213 active MSC Malaysia companies. It consists of 370 CCT cluster, 605 GBS cluster, 2119 InfoTech cluster and 119 IHLs and Incubators cluster.

<table>
<thead>
<tr>
<th>Cluster</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>CCT</td>
<td>370</td>
</tr>
<tr>
<td>GBS</td>
<td>605</td>
</tr>
<tr>
<td>InfoTech</td>
<td>2119</td>
</tr>
<tr>
<td>IHLs and Incubators</td>
<td>119</td>
</tr>
</tbody>
</table>

![Sample of extracted data](image2)

Figure 2 shows the use case diagram (Sulaiman, 2003) representing the functional requirement of data visualization for MSC Malaysia companies (Sulaiman, Rosli, & Ghazali, 2009). The target user can be an internship student, fresh graduates or any qualified local or international people.

![Use Case Diagram](image3)
In system and software design phase, an overall system architecture model is proposed as depicted in Figure 3. The architecture partitions the requirements to either hardware or software systems (Gani & Sulaiman, 2005; Sulaiman, Tamizi, Shamsudin, & Azmi, 2020). All the data are stored inside the web server. The user need to use any browser in order to access the data visualization for MSC Malaysia companies. In implementation and unit testing phase, it is realized by using related software and hardware such as notepad++ as programming editor for Hypertext Markup Language (HTML), Cascading Style Sheets (CSS) and JavaScript, Google Chrome as web browser, XAMPP as a web server and laptop with Windows 10 operating system.

The array list is utilized to store the data companies which include the company’s name, cluster, contact, website, address, latitude, longitude and main activities. All the data will be sorted according to its cluster and city. Figure 6 shows a sample code excerpt using initCyberjaya() function.

The marker is used as a symbol to indicate the exact location of MSC Malaysia companies. The coordinates for the marker to be placed will be retrieved from an array list named locations. Once the coordinates have been retrieved, the marker for each company will be generated. Figure 7 shows the excerpt code of the marker.

The discrete piece of information of the company which includes company name, address, contact, core activities and URL website is generated using tooltips. The tooltips will display when the user hover their mouse to the particular marker. Figure 8 shows the tooltips coding excerpt. As shown in Figure 8, the name of company is stored at loc[0], address stored at loc[5], contact that consists of telephone number is stored at loc[3] while email is stored at loc[4] in the array list. Core activities is stored at loc[6] and website is stored at loc[7] in the array list.
The drop-down menu features on the dot distribution map enable the users to display different datasets on the map. Figure 9 shows the drop-down menu for cluster which consists of CCL, GBS, InfoTech and IHLs and Incubators. This drop-down menu enables user to display the MSC Malaysia companies according to selected cluster. For example, if a user clicked on CCT, the application will only display the MSC Malaysia companies that belong to that cluster. This similar approach will be applied for cities in Klang Valley such as Petaling Jaya, Shah Alam, Cyberjaya, Subang Jaya, Bangsar and Kuala Lumpur. All the functions, variables and reserved words are tested in unit testing phase to confirm that the code is doing things right (Azmi & Ibrahim, 2011a).

In integration and system testing phase, the functional testing is done to ensure all the functional requirements as stated in the requirements definition phase were verified (Azmi & Ibrahim, 2011b). The last phase, operation and maintenance is ignored since it is beyond of our study scope due to the main objective is to develop the data visualization using dot distribution map (Sommerville, 2015).

### III RESULTS AND DISCUSSION

The data visualization for selected 80 MSC Malaysia companies are presented in the graphical user interface as illustrated in Figure 10. By a single click on map button, the web page will display all the selected companies from all clusters. It will ease the target user to identify the location and distribution of the companies.

#### A. Map based on cluster

Figure 11 illustrates the location of MSC Malaysia companies based on CCT cluster. The user can select an appropriate cluster by using the drop-down menu. The user can select another cluster such as GBS, InfoTech and IHLs & Incubator as well.

#### B. Map based on city

Figure 12 shows the drop-down menu for selected companies in particular city in Klang Valley such as Petaling Jaya, Shah Alam, Cyberjaya, Subang Jaya, Bangsar and Kuala Lumpur.

#### C. Tooltips

Figure 13 shows the tooltips that will display the information such as company name, cluster name, contact, address, core activities and website URL when the user mouseover to the particular marker.
The list of MSC Malaysia companies previously were shown in MSC Malaysia directory on the Malaysia Digital Economy Corporation Sdn Bhd (MDeC)’s official website (Malaysia Digital Economy Corporation, n.d.). However, the current official website no longer displays the list of active MSC companies. It only shows the number of active companies which are 3295 as of May 2019. The data collected from the Malaysia’s Open Data Portal listed an active MSC companies as of year 2017 consists of 3212 companies. Thus, it is difficult to determine whether the MSC companies in 2017 are still active in 2019. In addition, the current data do not provide the complete company profile such as contact number, email, address and coordinate of the company’s location. Therefore, the data need to be updated when the new current active MSC Malaysia companies are obtained.

Figure 13. Tooltips for Each Companies

IV CONCLUSION
This paper presents the development of data visualization for MSC Malaysia status companies using dot distribution maps technique. The target users for this study is for fresh graduates that are looking for job or any qualified local or international people that would like to pursue a career whether for full time, part time or an internship with MSC Malaysia companies located especially in Klang Valley. This study covers all clusters of the MSC companies which are Creative Content Technologies (CCT), Global Business Services (GBS), Information Technology (InfoTech) and Institutes of Higher Learning (IHLs) and Incubators. This study can be further improved by adding searching feature that will enable the users to search the nearest location of MSC Malaysia companies based on city or state.

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O'Reilly Media.
“Do you trust me?” - The Outlook of Belief, Desire and Intention in the Fourth Industrial Revolution

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ABSTRACT
Trust has been a barrier towards technology implementation, despite the benefits that technology promises to provide humanity since the emergence of the Internet. Nevertheless, the technology facilitates the current situation when there is a need to work from home (WFH). WFH has become a new norm across borders due to the COVID-19 pandemic in 2020. Many organisations have opted to shift their operations to virtual environment instead of physically being at offices formally, temporarily or permanently in future. Business owners, managers and supervisors feel the needs to keep track of each subordinate’s work progress and have used many tools available in the market for reporting and record keeping processes. It is believed that intelligent software agents with the belief-desire-intention (BDI) model could assist both parties – employers and employees – and at the same time reduce stress and the feeling of insecurity among employees by improving trust between both parties. This research looks into the possibility of embedding intelligent software agents into the work progress reporting system that is scattered within an organisation. Five organisations were investigated from the perspective of respondents at operational level, and a proposed Detect-Determine-Direct (3D) Framework for work progress reporting automation is presented. This framework is based on the BDI Model found implementable in intelligent software agents, hence bringing out the significance of automation in work progress reporting without relying on specific systems. The reporting automation at operational level that could reduce trust issues is deemed significant towards a positive impact on the overall supply chain in IR4.0, especially during the pandemic crisis.

Keywords: Intelligent software agent, BDI model, 3D framework, work progress reporting, humanity.

I INTRODUCTION
The Fourth Industrial Revolution (4IR) is expected to change the way we live, work and communicate, changing the things we value and the way we value them. We can see the changes in business models and employment trends, as well as in working and living environment. With the recent outbreak of COVID-19, it is observed that our life is digitally transformed to a new normal, coincidently aligning to the 4IR initiatives. When the situation forces organisations to let go some of their employees due to the economic crisis, it seems that they have to rely on the digital capacity they have to survive and sustain the business.

In the Fourth Industrial Revolution (4IR), it is a surprise that trust is still an issue, especially at operational level, where middle management chooses to play a role in micro-managing the subordinates. Observing across organisations from few industries, the trend of reporting work progress to the management seems to differ, yet it is highly dependent on the trust given to the employees. In organisations where humanity is highly expected to be embedded in the system, the trust issue still exists.

Focusing on one aspect of 4IR is the human side of getting things done within the process from farm to fork, i.e. the whole supply chain. Human interaction is still significant in today's supply chain management. However, with the recent pandemic, a high reliance on the automation and Internet connection has brought the human interaction to be on a challenging side. The trust that we have in interacting with each other by personally facing each other during a completion of an important task has reduced to a rate less than the common trust we have, via emails and social applications.

The question in hand is: Can we still trust what is being communicated via online messages (e.g. emails, social applications)? In some domains, the new normal of working from home (WFH) has caused a question of trust among the managers and employers towards their employees. As a result, a more rigid reporting process is required at all levels in an organisation, in which employees have to declare the tasks they do every day, how many hours they have worked for each task, and the percentage of each task completion. In some organisations, the employees are required to send snapshots or some proof that the tasks have been done as declared to the supervising manager, as soon as the tasks are completed on the same day. This has brought to a
hike in distrust within an organisation despite the idea of having more trust-enabled environment when online platform is used.

Technology, on the other hand, has reached an advanced level that software bots could imitate human’s communication when interacting with customers or even employees, depending on the system purpose it is programmed for. The advancement of artificial intelligence has proposed the concept that imitate real human when intelligent software agents are programmed with learning ability as well as having belief, desire and intention (BDI). It is observed that the concept of BDI can be used to oversee and monitor human integrity at work, as the software agents can be programmed to communicate with humans like humans. More important than that, software agents can take up some mundane tasks commonly performed by humans (Mohammed et al., 2019), to ease humans’ work while reducing their stress in overwork due to critical situations like a pandemic and working from home. These two could significantly help build trust among humans, especially between employees and their managing supervisors.

This paper aims to conceptualise the adoption of software agents in an environment that could enable trust among its stakeholders, namely employees and their managing supervisors, for the realization of the Fourth Industrial Revolution (4IR). In achieving this aim, the objectives of this study are: to investigate the current situation of reporting task progress and completion at operational level; and to conceptualise a software agent BDI framework that takes in the aspect of humanity in its architecture.

II BDI MODEL AND 3D FRAMEWORK

Belief, Desire and Intention, or BDI, are the three capabilities of an intelligent software agent. Burr, Cristianini and Ladyman (2018) defined an intelligent software agent as “any program that can be described as having a model of its environment, which it uses to take actions that enable it to achieve its goals, while also acquiring further information that it can use to update the parameters of its model”. In such cases, the environment mentioned here includes the behaviour of a human counterpart or user, and the agent’s goals would depend on the actions performed by the interacting user. In this environment, the agent would obtain rewards based on its ability to influence the behaviour of the human user (Burr, Cristianini & Ladyman, 2018) and mediate the user’s tasks efficiently according to the actual goal (Ismail & Ahmad, 2014). In one of the tasks assigned for agents to perform in previous research include “mediating the processes required for monitoring and reporting actions” (Mzahm, Ahmad & Tang, 2013), which supports the work of this paper.

The three mental attitudes or concepts that are part of the BDI model assignable to intelligent software agent for its functioning are as follows (Perez, 2019):

- **Beliefs** represent the environment characteristics of the agent’s model as what is believed to be true. It is seen as informative component and it is updated accordingly as perceived from each action. Since it is perceived from agent’s environment, the beliefs may be false.

- **Desires** represent the ideal state of the agent’s environment, as they store the information of the goals to be achieved, with properties and costs associated with each goal. Desires motivate agents to reach their goals, just like in the human mind as they represent things to be accomplished in the future. Desires might not be realistic nor achievable, but can be mutually inclusive or exclusive.

- **Intentions** represent part of the desires that an agent takes as goals to be accomplished soon. In other words, intentions are considered the current action plan chosen to be performed. Nevertheless, intentions cannot go against the beliefs.

Based on the BDI concept, a model was designed according to the tasks mediated by software agents. Ismail and Ahmad (2014) found an emergence of a pattern of Detect-Determine-Direct (3D) when goals were defined for the agents in previous research. The main goal for an agent to “detect” is to identify a situation that meets the required criteria. The “determine” task of an agent is basically to decide on what to do based on the detected situation, and the purpose for an agent with “direct” task is to perform an action based on the decision made on what should be done. Since this concept of 3D was derived from deep analysis on BDI and personal knowledge management concept learnt from real human situations, it is deemed to be the most suitable as a potential technique to be adopted in this research.

There was an evolution on the 3D Framework for the past recent years. It started with the Prediction-Detection-Action (PDA) Framework that was adopted in smart classroom environment (Ismail & Ahmad, 2013). It was then evolved into a multi-agent Precaution-Detection-Action (PDA) Framework, in which the concept was adopted in fall detection at geriatric centers (Tang et al., 2017). In both situations of PDA Framework in 2013 and 2017, the detection is performed at sensor devices and the action is performed either in the form of reporting, alert, or physical action by a machine. Unlike them, the 3D Framework adopted in this study is reflected...
on the detection performed on work processes within computer systems, whereas the “direct” is an action of reporting within the computer systems as well.

BDI architecture, on the other hand, was adopted in indoor social robots for the purpose to make it proactive in communicating with humans (Ujjwal & Chodorowski, 2019). This proves that the BDI architecture can be used to integrate or even embed humanity into a system environment.

## III RESEARCH SETTINGS: INTERVIEW SURVEY

Apart from the literature analysis, this research takes up short interviews to gather the process of tasks implementation and reporting at operational level from various sources. The focus is not only on the work process but also on the humanity part relating to them.

An example of the interview excerpt is as shown in Figure 1. The case differs from one organisation to another, in which some would enforce full 8 hours working in office as soon as the Movement Control Order (MCO) is lifted up on 1 June 2020, whereas some provide flexibility in working hours in office. In most cases, it depends on the nature of the job or tasks performed by the employees, whether they need to be in office or not.

In Case K (education sector), the MCO started from 18 March 2020, and mid-term break was pushed earlier to that date for 2 weeks (instead of the usual one week). Classes started in April, with daily reporting via WhatsApp to supervisors. Daily data entry on tasks completion in spreadsheet started on 1 June 2020 until 31 August 2020, because employees started to check in to office phase by phase. Non-academics started to work fully 8 hours a day in office starting 15 June 2020. Option of working from home is given to academicians but limited to 2 days per week starting 1 July 2020. After 31 August 2020, all employees are expected to be fully working 8 hours a day in office, especially the academicians.

![Figure 1](image_url)

**Figure 1. Sample excerpt of an interview.**

Five respondents from five case organisations were interviewed with questions related to their daily reporting methods to their supervisors and management board, especially during the Movement Control Order (MCO). Due to critical situation during MCO, the reporting procedure became quite strict in some organisations especially at operational level. Some organisations enforced daily reporting on top of monthly reporting processes, whereas some adopted weekly formal reporting on top of informal daily reporting processes. In addition to that, the use of technology differs among the organisations, with most of them rely on more than one tool, e.g. case organisation Z (as shown in Table 1) uses Zoom, Skype and Slack for the same purpose of communication but for different group of people and type of communication, i.e. formal and informal. The results summary of interview data analysis is as shown in Table 1.

### Table 1. Work Processes during MCO in Five Organisations.

<table>
<thead>
<tr>
<th>Case</th>
<th>WFH Status</th>
<th>Reporting Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>K</td>
<td>WFH reduced by phases until 31 Aug 2020</td>
<td>Daily check in [Mobile App with GPS]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Key in task or activity performed, number of hours, completion rate [MS Excel Spreadsheet]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Optional, take snapshot as proof of task recorded [Social Media]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Daily report in the first month of MCO [WhatsApp]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Daily check out [Mobile App]</td>
</tr>
<tr>
<td>M</td>
<td>WFH ended 31 May 2020</td>
<td>Daily check in [Google form]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Key in task or activity performed, platform used, content scope, from what time to what time, location [Google Sheet]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Screenshot online task done as proof</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Submit daily report [Google Form, Email]</td>
</tr>
</tbody>
</table>
Table 1 shows that most organisations do not require weekly reporting since they already have daily and monthly reporting processes. It is believed that this requirement is dependent on the initiative of the supervising managers, whether there is a need to have weekly reporting or not. Since employees are reachable daily via WhatsApp Group, the weekly reporting may not be necessary.

Case organisation Z requires weekly reporting partly because the organisation is very structured hierarchically, and their work processes are well focused at all level, hence there is a need to have weekly reporting to ensure sustainability of the business processes.

On another hand, case organisations K and M experience heavy daily reporting processes over multiple mediums and tools, which cause mental stress to the employees, especially when proof of tasks performed is highly required, i.e. observed in Case M. Even though Case T is from the same industry as Case K and M, it is observed that the organisation is highly flexible, proving that the level of trust is higher in that organisation.

### IV FINDINGS

Based on the interview data analysis, the concept of Detect-Determine-Direct (3D) Framework by Ismail and Ahmad (2014) is adopted to design the BDI automation on the work process reporting outlined in Table 1. An outline of how the 3D is implemented is as shown in Table 2.

<table>
<thead>
<tr>
<th>Task</th>
<th>Detect</th>
<th>Determine</th>
<th>Direct</th>
</tr>
</thead>
<tbody>
<tr>
<td>Check in</td>
<td>Data on time, location and health (green, yellow or red)</td>
<td>Required tasks based on health status, whether to proceed to next, or skip all until next day</td>
<td></td>
</tr>
<tr>
<td>Submit previous day report</td>
<td>Submission of the save information or file to the supervising manager, trigger employee for confirmation first</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perform task</td>
<td>Log data on various tools, e.g. Outlook, Teams, portal, etc.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Task completion</td>
<td>Based on log data, trigger employee to confirm % of completion, should be more than previous record (if related) if not yet 100%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Task duration</td>
<td>Based on log data, trigger employee to confirm number of hours task is performed, rounded to 30 minutes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pictures captured</td>
<td>New picture data</td>
<td>The link to current task progress (i.e. after time start or before time end of current task), trigger employee for confirmation on this link</td>
<td></td>
</tr>
<tr>
<td>Save daily report after each task</td>
<td>The data to repository, trigger employee to confirm the tasks identified throughout the working hours</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Check out</td>
<td>Data on time and location</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Submit previous week report</td>
<td>Total number of hours spent to tasks for the week</td>
<td>The saved information (daily files) on Monday morning to the supervising manager, trigger employee to confirm before submitting</td>
<td></td>
</tr>
</tbody>
</table>

Table 1. BDI Automation on Work Processes using the 3D Framework.
The summary of automated work progress reporting in Table 2 defines the tasks to be assigned to the intelligent software agents, which carry the belief, intention and desire to perform based on Detect, Determine and Drive domains. This is translated into a comprehensive illustration, as shown in Figure 2.

Based on the illustration in Figure 2, there are three main agents performing the tasks in the agent environment, namely Detect agent, Determine agent, and Direct agent. These agents perform the tasks as how the names are given to them, and based on the summary of tasks in Table 2. The life of these agents is based on the daily routine of their human counterparts’ activities. It is assumed that the agents are mobile and reside mostly in the computer system and network system of the organisation, and are able to move (if required) and perform tasks on the employees’ computers, mobile devices and the servers possessed by the organisation.

The reason behind this architecture is to support the need of trust on the managing supervisors’ side, as well as to reduce the feeling of intrusion and stress among the employees, which are triggered due to the strict reporting process. Nevertheless, the employees would not feel the rush or urgency to do the reporting tasks because the agents would do the compilation of their activities for them. The employees will only be triggered to confirm and verify whether the reports consolidated by the agents are correct or not, before being submitted to the managing supervisor.

V DISCUSSION

Figure 2 proves that the intelligent software agents can be designed to perform the consolidation and submission of reports, as part of their goals to mediate the tasks of their human counterparts. This supports the identification of mundane housekeeping functions that software agents could be deployed to perform (Ismail & Ahmad, 2011), and the need to adopt the BDI model to enable the agents to perform the tasks as illustrated in Figure 2. With the belief, desire and intention characteristics of the software agents, the system environment would be more comprehensive and doable.

From the illustration in Figure 2, it is found that there is a need to have some checkpoints in automating the reporting details. For example, after the detection of a person’s check-in status (i.e. whether he/she applied for a leave), this system will decide whether to trigger the person to submit the progress report(s) or not. If the report(s) is not submitted at this point of time, the system needs to recall when the person checks in next. Not illustrated here is the checking of reports submission under Detect agent.

The complexity of agents’ movement and tasks performance on systems outside of the human counterpart’s computer (i.e. email server, portal server, video conferencing server, other applications servers) is not explained in detail here. It is assumed that the work performed by the humans will be initiated or triggered from their own computer or mobile devices. Hence, all processes related and extended from this point will be followed through by the software agents for detection.

With the belief, desire and intention functions embedded in the agents, they could identify what to be reported and what should not be reported. In this matter, there is a possibility of deploying another Control agent, to ensure that the humans’ rights on privacy and confidentiality can be protected. It will also ensure security on the humans’ and company’s sides. Having said this, the Control agent should have its own BDI architecture and 3D framework. It is recommended that the future work will cover on this aspect.

VI CONCLUSION

COVID-19 pandemic has turned the table around with changes in organisational work process generally and how people do and deliver their tasks specifically. Business owners’ intention on keeping track of their employees while working from home on daily basis reporting query via mobile application and communication software tools, like virtual conferencing software and such, has caused an increase of stress as additional workloads are added on employees’ shoulders. Implementing intelligent
A software agent within an internal organisational network could reduce employees’ burden on daily and monthly reporting, as well as enhancing trust among employers and employees.

This research started off with the issue of trust between the middle management and the operational level in various organisations. Taking the opportunity of humanity-enabled capabilities deemed possible in intelligent software agents called BDI Model, this research proposes the Detect-Determine-Direct (3D) Framework for work progress reporting automation, with a humble purpose to reduce trust issues (which was observed to deteriorate during the COVID-19 pandemic). Future work will look into the development of this multi-agent system with embedded BDI concept, which will benefit not only the operational level but will also give an impact to the whole supply chain in the Fourth Industrial Revolution (4IR). In other words, the overall outcome will be a bottom-up approach (Ismail & Ahmad, 2011) of work progress reporting automation.

In addition to that, there is an opportunity to look into the adjustable autonomy and its application (Mostafa, Ahmad & Mustapha, 2019) in this proposed multi-agent system to improve the automation of reporting process, as this could mitigate some of the challenges that come with developing autonomous system in dynamic environments. This is seen as an opportunity since adjustable autonomy management has been integrated within a BDI agent’s architecture (Mostafa et al., 2017) in recent research.

REFERENCES


Usability Evaluation Factors in Acquiring Knowledge through Mobile E-Book Applications by Visually Impaired Users

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²Hadhramout University, Yemen, {munyabamatraf@gmail.com}

ABSTRACT

People read for various purposes, for example, to find data, interpret text, and acquire new knowledge. Electronic book (e-book) provides new opportunities to the visually impaired (VI) to read and learn and acquire knowledge at the same time as sighted people do. The e-book is an alternative to the traditional reading methods for the VI because it provides features like text enlargement and read aloud. However, the current mobile e-book applications are still not reaching their satisfactory level. Besides, usability evaluation studies for these applications are not clear in terms of factors used in the evaluation. Therefore, this study aims to identify the factors involved in a usability evaluation to evaluate e-book applications for the VI. Hence, the study applied a literature review to identify the usability factors that may use in the evaluation of e-book applications designed especially for VI. In total, 36 factors were identified but the study proposed six factors namely Efficiency, Effectiveness, Satisfaction, Learnability, Accessibility, and Navigation for the usability evaluation of accessible mobile e-book applications for VI to ensure that these applications are usable and accessible by them and will guarantee effectively acquiring knowledge.

Keywords: Acquiring Knowledge, e-book application, usability factors, visually impaired.

1 INTRODUCTION

Currently, people are more dependent on their mobile phones which subsequently leads to an increase in the number of mobile applications (Hussain & Ferneley, 2008). Therefore, developers need to build high-quality applications with the intention of competition (Shitkova et al., 2015). The quality of an application for mobile devices comprises of several aspects; the important one is usability (Harrison et al., 2013). Another important factor of the application quality is accessibility whereby user interface (UI) and content may have limited access by users with different types of impairments or aged persons (Vieritz et al., 2013). Accessibility is the ability to access and control all information for all user categories (Billi et al., 2010).

As a result, accessible technology will provide equal ways of accessing the same transactions and content presented through any website or application (Lazar et al., 2015). Usability and accessibility are two rising factors in the design and evaluation of any product. Nevertheless, accessibility and usability cannot substitute each other but they can complement each other (Khowaja et al., 2019).

E-book is a book in digital support displayed on a desktop, notebook, mobile devices, or dedicated devices, but this puts out its most noticeable feature which is interactivity (Possatti et al., 2018). Whereas e-books, typically have in-use features such as search, annotations, and interactive tools which are of importance and users will continue to improve (Vassiliou & Rowley, 2008). The use of e-books has increased in recent years and they are fast becoming popular and their market share in e-publishing is growing (Gupta & Dhawan, 2019; Xin, 2018). The e-book has many advantages compared to traditional books and users find e-book useful and it influences their preferences over print books (Mune & Agee, 2015). E-book is quick to read, easy to manage formats, available anywhere anytime, with user-friendliness (Kumbhar, 2018). People read, for example, to find data, interpret text, and acquire new knowledge (Liesaputra & Witten, 2012). For disabled users such as VI people, e-book plays an important role to overcome their barriers to read paper books (Holanda et al., 2018; Schlitz et al., 2017). Consequently, it is considered as a chance for visually impaired to improve their knowledge.

There are different terms to describe visual disabilities: visually disabled, blind, partially sighted, and non-sighted (Kleynhans & Fourie, 2014), where the vision function is classified into four broad categories: normal vision, moderate vision impairment, severe vision impairment, and blindness (Vision Impairment and Blindness, 2017). Moderate vision impairment combined with severe vision impairment are grouped under the term “low vision”: low vision taken together with blindness represents all vision impairment (Kleynhans & Fourie, 2014). Statistics show that about 253 million people live with vision impairment: 56 million are blind and 217 million have moderate to severe vision impairment, and 81% of them are aged 50 years and above.

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(Bourne et al., 2017). E-book offers new opportunities for people with vision impairments (Lenzi et al., 2013). However, e-book should implement accessibility principles, to be useful for the VI, which may be a built-in technology or compatibility with adaptive technologies (Dix, 2009).

Evaluation plays a critical role to address the usability problems of mobile applications. On one hand, general evaluation models and standards such as Nielson (1994), GQM (1994), and ISO 9241-11 seem to be ineligible to address the issues of a specific application type as they are generic and unable to clearly define the measurements for the usability evaluation (Abubakar et al., 2016; Khowaja et al., 2019). On the other hand, limited evaluation models for e-book consider the accessibility of e-book applications as the main factor (Sulaiman & Mustafa, 2019; Zhang et al., 2017). Moreover, evaluation models for e-book have either been developed for desktop software and websites or they do not consider accessibility. As a result, studies that evaluate mobile e-book applications usually depend on general usability measurements as in (Al-Qatawneh et al., 2019; Jardina & Chaparro, 2013, 2015; Mune & Agee, 2015) which are unable to address specific usability issues of a mobile e-book (Baharuddin et al., 2013; Dubey et al., 2012).

Therefore, this research seeks to address this gap by proposing factors that are involved in a usability evaluation model of accessible mobile e-book applications for VI users whereby an evaluation model of e-book can increase the usage of e-book and overcome technical barriers (Xin, 2018). The remainder of the article progresses as follows. The second section delivers the background and the related work on the topic addressed i.e., previous usability evaluation models in general and for e-book. The third section illustrates the research methods while the conclusion is further discussed in the last section, along with the potential research paths.

II BACKGROUND

This section will cover the previous work on usability in terms of models and standards. It will cover general evaluation models for desktops, mobile applications, and e-book. Usability evaluation is a significant pillar in the design of the UI (Greenberg & Buxton, 2008). Usability is defined by ISO 9241-11 (1998) as: “The extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use”. Evaluation of usability is commonly done subjectively (Nayebi et al., 2012). The software systems have different candidate audiences. Therefore, the definition of usability may have a different point of view for each of these audiences (i.e. end-users, software developers, and managers) (Abran et al., 2003). For the end-users, a usable application will allow them to perform the expected task faster and more efficiently (Abran et al., 2003). Yet, without a certain understanding of the end-user of the systems, considering and achieving the usability and learnability of the system becomes a significant quality obstacle for the designer (Abran et al., 2003). A variety of usability models and standards has been developed by the Human Computer Interaction (HCI) society, for example, Nielson (1993) model and the GQM model by Basili (1994). These models and standards proposed different usability factors as summarised in Table 1.

Table 1. Comparison of Different Usability Standards, Models for Software Systems

<table>
<thead>
<tr>
<th>Model/Standard</th>
<th>Usability Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Nielson, 1993)</td>
<td>Satisfaction, Learnability, Errors, Efficiency, Memorability</td>
</tr>
<tr>
<td>(Van Solingen &amp; Berghout, 1999)</td>
<td>Simplicity, Accuracy, Time taken, Features, Safety, Attractiveness</td>
</tr>
<tr>
<td>(ISO 9241-11, 1998)</td>
<td>Effectiveness, Efficiency, And Satisfaction</td>
</tr>
<tr>
<td>(Seffah et al., 2006)</td>
<td>Effectiveness, Efficiency, Satisfaction, Productivity, Safety, Internationableness, Accessibility, Learnability, Trustfulness, and Usefulness</td>
</tr>
<tr>
<td>(Dubey et al., 2012)</td>
<td>Effectiveness, Efficiency, Satisfaction, Safety, and Comprehensibility</td>
</tr>
</tbody>
</table>

Table 1 shows general usability models and standards for the evaluation of software systems or applications. Besides being general models, these models provide inadequate guidelines and consistency in applying these models for usability evaluation especially for mobile applications (Flood et al., 2013; Hussain et al., 2013). Additionally, metrics are also inadequately provided in supporting the derived factors except ISO 9241-11 (1998) and QUIM (2006) (Flood et al., 2013). While some models, for example, the model by Dubey et al. (2012) was not even tested and were ambiguous. Using these models may produce incomprehensive results especially when the model does not provide metrics. Such models, therefore, are difficult to be used by researchers and usability practitioners especially for applications that focus on VI or other special needs applications apart from QUIM, which is reliable for usability evaluation or design of independent model (Nathan et al., 2016, 2017).
The usability of mobile devices and their applications vary from other computer systems, as they have different characteristics. Users are looking for applications that are easily learned, take inconsiderable time to accomplish a particular task, and easy to use (Nayebi et al., 2012). Real user testing of mobile devices is equivalent to standard desktop studies. However, special care is required for recording equipment, room configuration, and even test participants. There are many usability evaluation studies introduced for mobile applications, these studies are presented in Table 2.

Table 2 indicates models for mobile usability evaluation. Some of these models do not come with metrics to measure the exact factor (Baharuddin et al., 2013). Besides the studies lack in providing appropriate descriptions of implementing the measures identified (Nathan et al., 2016). Moreover, the previous models do not consider any mobile usability factors for disable users except MAEHI which makes the models difficult to accommodate the usability of mobile e-book applications VI.

A. Usability Evaluation Models and Studies for E-book

The needs of the consumers are paramount for the look and feel of the book (Wilson, 2002). It is important to discuss the usability of e-books as interactive applications must take into account the needs of the consumer. Several studies in the literature addressed the usability issues of e-book, some of these studies proposed evaluation models. This study analyzed the previous studies to summarise their finding in terms of measurement used for the evaluation See Table 3.

Table 3. Usability Evaluations Models and Studies of E-book in General and for VI

<table>
<thead>
<tr>
<th>Study</th>
<th>Factors</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Lim et al., 2012)</td>
<td>Efficiency, Effectiveness, Satisfaction, Learnability</td>
<td>Accessibility not considered; the model also lacks evaluation metrics</td>
</tr>
<tr>
<td>(Haslinda et al., 2014)</td>
<td>Understandability, Learnability, Operability, Attractiveness</td>
<td>Accessibility not considered and only subjective metrics provided</td>
</tr>
<tr>
<td>(Baker-Eveleth &amp; Stone, 2015)</td>
<td>Efficiency, Effectiveness, engagement, Ease of learning</td>
<td>Accessibility not considered and only subjective metrics provided</td>
</tr>
<tr>
<td>(Wang &amp; Huang, 2015)</td>
<td>Visibility, Ease, Efficiency, And Enjoyment</td>
<td>Accessibility not considered</td>
</tr>
<tr>
<td>(Goel et al., 2018)</td>
<td>Efficiency, Aesthetics, Interactive GUI, and efficient</td>
<td>Accessibility not considered and lack of metrics</td>
</tr>
<tr>
<td>(Sulaiman &amp; Mustafa, 2019)</td>
<td>Efficient, Effective, Satisfaction, Accessibility, Learnability</td>
<td>Not provided evaluation metrics</td>
</tr>
<tr>
<td>(Siegenthaler et al., 2010)</td>
<td>Effectiveness, Navigation, Design, Orientation, Functionality, Handiness</td>
<td>Accessibility not considered</td>
</tr>
<tr>
<td>(Jardina &amp; Chaparro, 2012)</td>
<td>Efficiency, Effectiveness, Satisfaction, Cognitive workload, Navigation</td>
<td>Simple accessibility metrics for normal vision users provided</td>
</tr>
<tr>
<td>(El-Glaly et al., 2012)</td>
<td>Efficiency, Effectiveness, Error, Cognitive workload</td>
<td>Introduced a novel tactile way of reading for the visually impaired</td>
</tr>
<tr>
<td>(Jardina &amp; Chaparro, 2013)</td>
<td>Efficiency, Effectiveness, Satisfaction, Features, Accessibility, Engagement, Comprehensive, Cognitive workload, Navigation</td>
<td>Simple accessibility metrics for normal vision users provided</td>
</tr>
<tr>
<td>(Lenzi et al., 2013)</td>
<td>Navigation, Accessibility</td>
<td>Enhanced ePub format evaluation study by blind users</td>
</tr>
</tbody>
</table>

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The above table shows that the most proposed factors are efficiency, effectiveness, learnability, and satisfaction. Other factors only appear once in each model even though they are very important such as accessibility. In addition, studies that focus on the usability of e-book for VI are more into evaluating the accessibility and the ability to navigate the e-book. Moreover, the learnability of e-book application from VI user’s perspective had not been examined thoroughly.

### III METHODOLOGY

This study used Literature Review (LR) to discover the factors that are typically used to evaluate mobile e-book applications in general and especially for those having vision disabilities. A comprehensive analysis of usability models in general and mobile applications from 1990 to 2019 has been done. Besides, current work on e-book evaluation for both sighted and VI users from 2010 to 2019 has been reviewed. Based on the reviewed papers (See Table 1,2, and 3), a total of 36 factors were identified however, based on the frequency referred to and used in the literature, only 16 factors were selected. In this review, the factors are identified based on the number of counts that exist in the usability evaluation literature in general as well as for mobile e-book usability evaluation, and evaluation of e-book usability from VI concerned. A count that is more or equal to three is taken into the factors list, the same method of identification used by Baharuddin et al., (2013) and Nathan et al. (2017).

Table 4 presents the usability factors that were identified.

<table>
<thead>
<tr>
<th>Factor</th>
<th>Freq.</th>
<th>Factor</th>
<th>Freq.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Efficiency</td>
<td>19</td>
<td>Simplicity</td>
<td>5</td>
</tr>
<tr>
<td>Effectiveness</td>
<td>17</td>
<td>Cognitive Load</td>
<td>5</td>
</tr>
<tr>
<td>Satisfaction</td>
<td>15</td>
<td>Attractiveness</td>
<td>5</td>
</tr>
<tr>
<td>Learnability</td>
<td>13</td>
<td>Safety</td>
<td>4</td>
</tr>
<tr>
<td>Accessibility</td>
<td>10</td>
<td>Understandability</td>
<td>3</td>
</tr>
<tr>
<td>Navigation</td>
<td>7</td>
<td>Memorability</td>
<td>3</td>
</tr>
<tr>
<td>Error</td>
<td>6</td>
<td>UI aesthetic</td>
<td>3</td>
</tr>
<tr>
<td>Features</td>
<td>6</td>
<td>Operability</td>
<td>3</td>
</tr>
</tbody>
</table>

Table 4 shows that Efficiency, Effectiveness, Satisfaction, Learnability, and Accessibility are the most frequent factors used to evaluate usability (cited by 19, 17, 15, 13, and 10 studies respectively). These results are similar to the findings of previous studies (Coursaris & Kim, 2006, 2011; Weichbroth, 2020, 2018). A total of 16 factors to be used in the evaluation of the application for VI are thought extremely much for any model development and therefore summarization is mandatory (Harrison et al., 2013). Thus, the most appropriate factors will be carefully chosen by considering the more relevant used factors and the requirements, while some are omitted because they are not relevant to e-book applications for VI. The study followed the summarization method used by Coursaris & Kim (2011) to ensure only the essential elements are included in the study (Baharuddin et al., 2013). This assures reliable evaluation of mobile e-book applications for VI. Consequently, the study proposed the initial evaluation factors for evaluating the accessible mobile e-book applications to ensure that VI can access the application. Figure 1 shows the factors proposed for the evaluation.

**Figure 1. Usability Evaluation Factors for Evaluation Accessible Mobile E-book Applications for the VI**

### IV CONCLUSION

The word usability is constructed of two nouns ‘use’ and ‘ability’ which indicated the ability to use the application easily. That means the ability to operate, navigate, and learn the application interface with no errors (Weichbroth, 2020). The usability of the e-book for VI indicates the ability to read, access,
and navigate the application interface as well as the content. In parallel with the findings found from similar studies as (Coursaris & Kim, 2006, 2011; Weichbroth, 2020, 2018), the findings are consistent in the extent of the top three main factors for any application, which concern Efficiency, Satisfaction, and Effectiveness (See Table 4). Moreover, an increased interest in learnability and accessibility can also be noticed. On one hand, learnability is about how easy can new users learn the application. This factor is more challenged when the user has any kind of disability and needs to give more attention to evaluators. On the other hand, the accessibility factor is the core factor for designing an application for the disabled whereby if the application is not accessible it is simply not usable. As a result, this study proposed Effectiveness, Efficiency, Satisfaction, Learnability, Accessibility, and Navigation as usability evaluation factors for accessible mobile e-book applications for VI users. In future work, metrics for each of these factors will be generated followed by expert review for verifying the proposed factors and metrics. Likewise, the proposed factors and metrics will be validated through a usability study.

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Kleyhans, S. A., & Foure, I. (2014). Ensuring accessibility of electronic information resources for visually impaired people: The need to clarify concepts such as visually impaired. Library Hi Tech, 32(2), 368–379.


Exploring the Significance of IoT-Enabled Health Monitoring and Assistive Systems for Elderly NCD Patients in Malaysia

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ABSTRACT

Apparently, it might show that for elderly people staying at their own house can be the main secured center for them in order to reduce health hazards. In this regard, the improvement of connected devices has had a remarkable effect upon the entire healthcare sector and has been noticeably appreciated in remote clinical monitoring, chronic disease management, preventive care, and assisted living. This study intends to explore the significance of IoT particularly wearable technology and digital healthcare for senior patients of non-communicable diseases (NCD). The study also discusses several benefits of IoT like reducing cost, raising quality for the healthcare service providers in Malaysia including a higher level of success, productivity, and precision of health monitoring and treatment systems. Based on effective knowledge management as the key strategy in this regard, the insights of this study will help the elderly community and healthcare providers to recognise the use of IoT Enabled Health Monitoring and Assistive Systems and their significant contribution to improving healthcare for the country in the long run.

Keywords: IoT, Healthcare, NCD, Elderly patients, Malaysia

I INTRODUCTION

According to an estimate of the World Health Organisation (WHO), non-communicable diseases (NCDs) were accountable for 41 million deaths. This is equivalent to 71% of global deaths in the year 2016. Moreover, the WHO report in 2018 depicted that, from every four reported deaths in Malaysia, three were due to NCDs (WHO, 2018). Hence, the Ministry of Health Malaysia has designated the prevention and control of NCDs as a high priority, which is evidenced in the country’s National Strategic Plan for NCD 2016–2025 and its complementary national strategies to control risk factors associated with NCDs.

The number of people aged 60 years and above has tripled in the past 50 years worldwide. It is estimated that this number will be more than triple in the coming 50 years (Nations, 2015). Malaysia’s total population reached 28.3 million based on the Malaysian Census 2010. Among them, the proportion of people aged 60 years or above was 7.9%, compared to only 3.9% in 2000. This accession shows a large-scale “transition of Malaysia towards an ageing population worth particular attention” (Department of Statistics Malaysia, 2010). The number of elderly Malaysian patients who require unique care and support by the year 2020 and beyond has a clear discrepancy with the number of healthcare staff and physicians with suitable training to give such care presage. Therefore, “developments in public health and nutrition, along with advancements in medicine have subsidised longer life-expectancy in this country” (Poi et al, 2004).

It may be viewed that for elders to remain at their own house is the secure location for them to reduce health risks. However, as people age, it yields a couple of physiological changes. It does not only have an impact on our ‘physical outlook’ but also creates some worsening conditions for their health as well. The more people grow old the more delicate the body becomes. This leads the body to, “experience health disorders such as eyesight problems, hearing problems, body joint problems, memory losses, and so on” (Balamurugan et al., 2012, p.274). People can help the affected by alleviating the symptoms and avoid getting more worsening of the ongoing conditions. Hence the proper way is to continuously check their health condition and take rapid action if an urgent illness draws the attention.

The main idea of this study is to explore the significance to monitor the ‘elderly health condition’ through the advancement of the Internet-of-Things (IoT) applications for NCD patients. The use of IoT systems will help to create a bridge between community medical practitioners and their NCD patients in Malaysia, who can transfer their real-time health data more recurrently and effectively this way.

The term Health Information Technology (HIT) particularly in the healthcare industries is getting popular among the people and community. HIT associates with the current main information technology that facilitates health information
exchanges, thus ensuring the safety of information among the patients, healthcare staff, and healthcare service givers across the ‘computerised system’. According to a report of MarketResearch.com (2015), it is estimated that “by 2020, the amount of USD 117 billion will be contributed by the IoT enabled development in the healthcare sector” (n.p.).

II LITERATURE REVIEW

By 2030, Malaysia is estimated to appear as an ageing nation with elderly people covering more than 15% of the population (Hu, Fahmi, Yuhao, Kiong & Harun, 2018). The medical issues of elderly NCD patients are usually seen as not exciting and not reversible. Hence, this issue requires to be campaigned as exciting, challenging and curable for developing better health of the society and community. NCD comprises mainly cardiovascular disease (CVD), cancer and diabetes. In Malaysia, the largest proportion of the burden of CVD occurs between the ages of 50 and 80 years. This age group accounts for 67.4% of the CVD burden for the country (Ministry of Health Malaysia, 2018). Moreover, a remarkable proportion of the burden also from diabetes happens between the ages of 50 and 69 years, which accounts for 42.8% of the attributable costs (Table 1).

As NCD is considered under preventable conditions, it is crucial for countries to establish the risks and predictors of these types of diseases. Risks associated with NCDs can be eradicated efficiently by developing several habits. For example, reducing unhealthy diet, increasing physical activity, reducing tobacco or alcohol abuse.

If these risks are eradicated to nearly 75% of global heart disease, stroke and type 2 diabetes along with 40% of cancer could be prevented (WHO, 2019). To complement this agenda, further research on health trends of older people is advisable to evaluate different indicators of health, such as demands for care, chronic diseases and disability (Parker & Thorslund, 2007).

Technology Supports the Delivery of Integrated Care:
The improvement of ‘connected devices’ has had a remarkable effect on the whole healthcare sector. Moreover, it has been remarkably appreciated in, for instance, “remote clinical monitoring, chronic disease management, preventive care, and assisted living for elderly people” (Dimitrov, 2016). Therefore, reports show that “the total value of the IoT health care devices such as wearables like smartwatches market is expected to reach $40 billion in 2018”.

Table 1. Malaysia’s Disability Adjusted Life Year (DALY) and their Cost Burden by Age and Gender (Ministry of Health Malaysia, 2018)

<table>
<thead>
<tr>
<th>Age group(years)</th>
<th>Males</th>
<th>Females</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>50-59</td>
<td>26 843</td>
<td>26 985</td>
<td>22.58</td>
</tr>
<tr>
<td>60-69</td>
<td>23 032</td>
<td>25 241</td>
<td>20.25</td>
</tr>
<tr>
<td>70-79</td>
<td>12 480</td>
<td>14 595</td>
<td>11.36</td>
</tr>
<tr>
<td>&gt;=80</td>
<td>4 657</td>
<td>6 230</td>
<td>4.57</td>
</tr>
</tbody>
</table>

*DALYs cost burden (RM)

<table>
<thead>
<tr>
<th>Age group(years)</th>
<th>Males</th>
<th>Females</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>50-59</td>
<td>1 149 780 038</td>
<td>1 155 886 323</td>
<td>22.58</td>
</tr>
<tr>
<td>60-69</td>
<td>986 536 875</td>
<td>1 081 174 224</td>
<td>20.25</td>
</tr>
<tr>
<td>70-79</td>
<td>534 564 233</td>
<td>625 159 215</td>
<td>11.36</td>
</tr>
<tr>
<td>&gt;=80</td>
<td>199 466 436</td>
<td>266 863 051</td>
<td>4.57</td>
</tr>
</tbody>
</table>

*RM - Malaysian ringgit

Between 1990 and 2017, the risk of NCDs became progressively common in Malaysia (Figure 1). The chart on the right depicts the sum of years of healthy life lost while the other is the death rate for every 100,000 people.
It is also crucial to dedicate more efforts to utilise advanced technologies like IoT in elderly care. A wide range of solutions is available to fulfill the needs of the elderly and to mitigate health hazards. Figure 2 illustrates some of these current solutions and services to align with this intention in the form of small, medium, and large projects that have also been launched to effectively handle the elderly people’s needs including that of NCDs.

![Figure 2 Various Applications and Services suggested for Remote Elderly Monitoring (Azimi, Rahmani, Liljeberg & Tenhunen, 2017).](image_url)

Smart Continuous Glucose Monitors (CGMs) like EVERSENSE (Figure 3) and FREESTYLE LIBRE send data on blood glucose levels to a corresponding app on Android devices or iPhone and Apple watches, and allow for remote monitoring by caregivers such as the relatives of elderly patients.

![Figure 3: Eversense Diabetes (Econsultancy, 2020)](image_url)

A similar example can be in the smart insulin pen that helps diabetes patients by interacting with a smartphone app, storing long-term data, and calculating their insulin dose. The variety of the sensors can be associated with the nature of the stimuli that they respond to. For example, there are few big physiological symptoms like a heartbeat, blood pressure, or body movements that are associated with elderly healthcare as well. Moreover, this sensor can be also placed on the body, for instance, as “clothing, subcutaneous implant, wearable devices such as smartwatch and glasses” (Deloitte, 2018a).

**Knowledge Management in IoT Enabled Healthcare:**

It is obvious that IoT is a connected system that depends on an autonomous communication of multiple and diverse physical objects, “representing an Internet-based information architecture and facilitating the exchange of knowledge, services and goods” (Dijkman, Sprenkels, Peeters & Janssen, 2015). It necessitates a clear understanding of the significance of knowledge management for the healthcare providers in Malaysia as well.

Knowledge management (KM) is generally defined as, “the process of capturing, developing, sharing, and effectively using knowledge. Knowledge management efforts typically focus on strategic objectives such as improved performance, competitive advantage, innovation, the sharing of lessons learned, integration, and continuous improvement.” (Girard & Girard, 2015). The growing emphasis on the significance of knowledge as a competitive advantage has led to the adoption of KM in healthcare organisations (Omotayo, 2015) for treating the elderly NCD patients as well. KM has been considered as an innovative management tool to facilitate healthcare organisations to efficiently handle their internal and external knowledge (Omotayo, 2015) which is essential to fruitfully utilise the IoT for elderly NCD patients care. KM helps healthcare organisations to transform large amounts of medical data (Dwivedi, Bali, James & Naguib, 2001) extracted from IoT devices related to elderly NCD patients and to promote sharing of knowledge among healthcare professionals. The concept of KM permits healthcare experts in hospitals to use global methodologies that include intellectual capital and IT software to meet medical needs (Itsquiz, 2016).

Usually, well-organised knowledge helps to make more informed decisions and alleviate the flow of data extracted based on IoT devices that doctors have every day regarding the elderly NCD patients. The implications of IoT and KM efforts simultaneously can enhance the real-time medical data that ultimately promote collaboration between different healthcare institutions and facilitate better decision making to treat elderly NCD patients with high-quality record management. Nowadays, “electronic medical record systems help to improve the
knowledge by codifying and delivering medical practices and experience into healthcare decision support systems” and making strategic decisions through data mining techniques (Itsquiz, 2016).

Nevertheless, healthcare providers are heavily dependent on access to knowledge in order to solve problems along with making optimal decisions regarding elderly NCD patients as well. It is becoming crucial for healthcare providers in the current rising complex environment to efficiently handle knowledge for giving the best possible innovative healthcare services (Haughom, 2014). An effective strategy for knowledge management in healthcare can help to maximise the benefits of the implementation of IoT to mitigate the risks associated with elderly NCD patients in a timely manner. In today’s world, “the healthcare industry is poised to be driven by the high innovative connected health technologies which consist of IoT, applications, services and solutions” (PR Newswire (2016).

The main purpose of digital health is to mainly lessen the expenditures and remarkably develop the medical services, and eventually to make the ‘IoT enabled healthcare applications’ more “realistic and viable” (Wood, 2016). The IoT empowered care related to health is being delineated with the help of mainly two improvements: firstly, the ‘wearable technology’ and secondly, ‘digital healthcare’. Wood (2016) highlighted that, “by leveraging the wearable devices in IoT, it delivers a range of health products and services from telemedicine to self-diagnosis and monitoring which results in reducing cost and becomes a major influence of driving the insurance company for IoT adoption”. Ma et al (2015) emphasized that, “the IoT enabled healthcare should deliver the core values that not only to benefit patients but also drive the entire healthcare industry to form an organism of health services”.

Figure 4 shows the conceptual IoT enabled healthcare. Based on this figure, the connected objects (“Things”) apply logic to sense the information, then gather the health data (“Data”) of elderly NCD patients (“People”), and afterwards, transmit it to private/public cloud. Lastly, the data gathered are synthesised (“Process”) to generate meaningful health information (“Data”). Meaningful information related to the health is then presented (“Process”) to medical staff (“People”) in either report format or checking GUI.

![Figure 4: The Idea related to IoT Enabled Healthcare (Hossain & Muhammad, 2016)](image)

### III SIGNIFICANCE OF IOT IMPLICATIONS FOR ELDERLY HEALTHCARE

Healthcare/Medical sector make use of evolving IoT. As these have the prospect for getting close to most people especially to the elderly NCD patients group. The crucial effect is on health checking when the symptoms are mainly silent. In such circumstances, quick diagnosis may help prevention procedures and also reduce the chances of chronic illnesses or mortality. In short, bigger IoT integration seems “desirable, particularly because the global health system is clearly moving toward health care at home” (Islam et al., 2014). Table 2 depicts the significance of various use of IoT particularly for various groups associated with healthcare.

<table>
<thead>
<tr>
<th>Stakeholders</th>
<th>IoT Devices</th>
<th>Healthcare Benefits of IoT</th>
</tr>
</thead>
</table>
| IoT for elderly NCD Patients | Fitness bands and other connected wireless devices like BP and heart rate monitoring cuffs, glucometer, etc. | - Personalised attention.  
- Constant tracking of health conditions.  
- Alert mechanism sends signals to family members and concerned health providers. |
| IoT for Physicians | Wearables and other home monitoring equipment embedded with IoT | - Keeping track of patients’ health, plan treatment, to facilitate medical attention.  
- The IoT data help to identify the best treatment process for elderly NCD patients. |
| IoT for Hospitals | IoT-enabled sensors, hygiene | - Tracking real-time location of medical |

Table 2: IoT for various Users (Extracted from Karjagi & Jindal, 2020)
monitoring devices | equipment like nebulisers, oxygen pumps, etc.
-Deployment of the medical staff at different locations.
-Preventing patients from getting infected.

Dimitrov (2016) reports that by 2020, “20% of the IoT market will be on the Internet of medical things (IoMT) and that another 20% will be directly or indirectly related to health, well-being, and Ambient Assisted Living (AAL). Thus, the health sector would have 40% of the market”. The new IoMT sector is growing at a rapid pace and is estimated to reach US$158 billion by 2022 from US$41 billion in 2017 (Deloitte, 2018b). The recent COVID-19 crisis will further intensify the process of a hyper growth of this sector.

The progress of IoT enabled medical devices and equipment, and treatments in the medical sector will ultimately help to reduce cost and bring large profits for health service providers. Moreover, “IoT will also help to develop effectiveness, efficiency, and accuracy of health monitoring and treatment systems” (Islam et al., 2014). Hence, IoT can benefit the patients particularly “the elderly NCD patients to experience the affordable high quality of health care, monitoring and treatment services” (Islam et al., 2015).

IoT has created a prospect for generating fully ‘computerised systems’ that are likely to lessen human intervention into the physical world and practical life. This is especially required to drastically develop the quality, productivity, precision and cost in the industries and ultimately create merits to people particularly the elderly NCD patient community.

IV CONCLUSION

No matter it is health, manufacture, or business, a well-organised knowledge system can help to make well-thought-out and more informed decisions in all sectors and alleviate the transmission of data for regular needs. Undoubtedly, the application of IoT along with KM efforts possess immense prospects for treating elderly NCD patients and Malaysia is also no exception to this. The insights of this study will help the elderly community and healthcare providers to recognise the significance of IoT Enabled Health Monitoring and Assistive Systems due to their significant contribution to improving healthcare for the country in the long run.

Like any other country, Malaysia too encounters a growing number of elderly NCD people. Hence, there is a necessity to understand the benefits and applications of IoT based healthcare system while recognising sociocultural and other factors that will navigate future health management and social care in NCD cases like the high occurrence of hypertension and diabetes and decreasing birth rates. Data-driven healthcare by integrating the use of IoT and advanced knowledge management system to access just-in-time solutions for elderly NCD patients is considered a timely endeavour. It can help healthcare professionals with an inter-departmental exchange of clinical information and suggestions to figure out diagnosis on time and set appropriate treatment for the elderly patients in Malaysia.

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Towards Central Repository Design for Domain of Interlocking Institutional Worlds: Successful Collaboration Starts with a Sharing Platform

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³University of Dubai, {kbinhashim@ud.ac.ae}

ABSTRACT
Creating and organizing disaster knowledge into a common platform from various agencies and sources is vital to the enhancement of disaster management efforts. Prominent leading disaster relief organizations including the European Union, Federal Emergency Management Agency, United Nation, World Health Organization (WHO), National Disaster Management Agency, and National Disaster Management Agency (NADMA) have acknowledged integrated effort as a fundamental element to address disaster. However, despite the increasing data availability, challenges in terms of data interoperability and incompatible data still persist. This paper highlights the importance of a Central Repository (CR) design that supports knowledge and best practices in sharing in disaster management strategies, and discusses key lessons learned from 22 countries in their effort to improve data collection, interoperability, and sharing capabilities. Therefore, through this paper, we hope to fill the gap by aiming at increasing the effectiveness of interlocking inter-agency’s institutional worlds which lead to information and knowledge sharing.

Keywords: Central repository design, Interlocking Institutional Worlds, Knowledge sharing, Flood management.

1 INTRODUCTION
Interlocking Institutional Worlds (IW) are collections of interlocked organizations interacting together in a domain. These organizations interact and exchange information to achieve a common objective. Often these organizations are made up of many players from different backgrounds. Hence the need of standard and common terminology must be established to avoid misunderstandings. Some of the IWs domains include the Olympics, the semantic web, Postal codes (Colomb R. M., 2013; Colomb & Ahmad, 2007) and flood management (Khantong, 2018; Khantong & Ahmad, 2020). Disaster management falls into IWs domain (Khantong & Ahmad, 2020). The importance of an integrated knowledge sharing effort in the disaster management domain is vital, and is addressed by prominent leading disaster relief organizations including the European Union (EU), Federal Emergency Management Agency (FEMA), United Nation (UN) and National Disaster Management Agency (NADMA), who have acknowledged integrated effort as one of the fundamental elements to address disaster.

Studies in disaster management have emphasized the need for an efficient knowledge sharing platform, as brought up in the Tsunami event. World Health Organization (WHO) has determined the need for new strategies and approaches to leverage on the magnitude of data resources available, which have the potential to improve disaster management. But it also has complexities and challenges. Data interoperability is a big challenge that arises from incompatible data standards and nomenclatures used in different disciplines. The European Union reported that various methodologies exist for disaster loss data collection in Europe. The available loss databases vary between states in their level of completeness and detail. Systems created vary in their purpose. This introduce heterogeneities leading to another main challenge to ensure the availability and accessibility of accurate and reliable disaster risk information when required.

To date, there are no proper standards or guidelines on how this shared knowledge should be captured, organized and shared. In Malaysia, the country has NADMA to lead the new disaster management structure. NADMA has identified overcoming information challenges as an important joint task force mission, and carries the belief that sharing of information is critical in disaster management as no single entity (Government agencies, NGO, international organization) can be the source of all required information.

This paper highlights that, despite increasing data availability from a wide range of sources that unlocks unprecedented potentials for disaster risk reduction,
data sharing remains a challenge. Although the problem has been addressed by several initiatives, the following challenge still remains: to make online data integration a routine and making data sharing a practice. This has moot for the idea for an alternative central repository (CR) design to address IWs domain knowledge sharing requirements.

II CR FOR ENABLING KNOWLEDGE SHARING IN THE DOMAIN OF IWS

Knowledge sharing is crucial in disaster management efforts. The disaster domain is made up of many players from different backgrounds. IT has been relied upon by these players in modern society as a digital technology to capture, create, organize and distribute knowledge. The systems belonging to the players combined, allow for new discovery of unsuspected patterns and hidden relations allowing holistic understanding through interdisciplinary integration from data across relevant disciplines. But, data interoperability is a big challenge that arises from incompatible data standards and nomenclatures used in different disciplines. There are no proper standards on how this knowledge sharing should be captured, organized and shared in which a new design for CR to support IWs domain can fill the gap.

III CONFRONTING THE CHALLENGES OF DISASTER MANAGEMENT

Natural disasters are a worldwide issue. They cause catastrophic losses. Many countries produce their disaster management programs to reduce disaster impact with the objective to potentially manage disaster throughout the disaster lifecycle phase of mitigation, preparedness, response and recovery. Managing risk is often referred to the reducing of impact, such as reducing loss of life, loss of assets and property damage. Managing vulnerability involves various social and economic issues regarding the capability of a human community to cope with the disaster event. Many countries have relied upon technologies including informatics to manage disasters. Learning from previous events and having a common platform for knowledge sharing is considered crucial for the domain to capture, organize and share knowledge as part of disaster management efforts.

A. Availability of Reliable data

The availability of reliable data has been a major constraint in the disaster domain. Not that data is unavailable, but the nature of the domain requires inter agency collaboration. Where each agency holds their own data, data scarcity happens. A systematic storage of data associated to disaster events has been a sketchy effort at best in developed countries, and at infant stages in developing countries. Data management has the potential to contribute towards the betterment of the disaster domain. It eliminates confusion and unfamiliarity during disasters. For instance, technology such as big data analytics allows for early prediction, while geospatial technology allows for better understanding at site. One can imagine the chaos if the front lines were entirely unfamiliar with the disaster site. However, no amount of technology sophistication can be optimized effectively without human intervention. It involves issues of training, coordination and understanding between players, willingness to share data, resource sharing and support from the top. These can be agreed as critical factors that need to be embedded for technologies to be effective to support the disaster domain (National Research Council, 2007; Berg & Phillips, 2017). Hence it is important to understand the requirements in data sharing for this kind of domain.

B. The Information Sharing Concept and Interoperability

Disasters vary widely from small to catastrophic. Understanding this fact allows us to accept that, while experts can identify roles of first responders, these roles are not always fulfilled on each incident that occurs. Solving the interoperability problem is not just a technical issue. In many cases, spending on technical solutions fails to meet the needs of end users. It needs understanding of the domain, navigating human relationships and trust, as it is made of people from different jurisdictions, agencies and disciplines (Contestabile, 2011). There is also a general consensus that the impact of disasters is also determined by the victims’ unequal exposure to risks reported by United Nations Office for Disaster Risk Reduction (UNISDR). To address complex interactions between natural hazards and human vulnerabilities, requires adaptive strategy (Mizutori & Guha-Sapir, 2018). The UNISDR also reported gaps in economic data losses, where only 37% data was captured throughout the 1998-2017 period. Moreover, 63% of the direct costs of majority of the disasters were unknown or not well captured. Overcoming information challenges is vital, as sharing of information is critical in disaster management, as no single entity (Government agencies, NGO, international organization) can be the source of all required information. As mentioned above, solving the interoperability problem is not just a technical issue. Too often organizations come to realize that the solution invested on does not meet the needs of end users. Solving the interoperability challenge involves navigating human relationships and issues of trust, and this is something that must be approached at first, especially in a domain like IWS.
as the lack of this will impede information sharing. Recognizing these challenges, a new central repository design must be approached sequentially from a people, process and technology standpoint and work through a process whereby they can understand each other’s need for information, and trust can be developed between the parties.

C. Country Efforts to Improve Data Collection and Sharing Capabilities

Disaster risk is increasing in line with population growth in exposed areas. This has also contributed towards the increased value of losses. Yet many countries have difficulties in managing disasters and estimating future losses, as the domain is not well understood, and is hampered by low quality of historical data. Here, we have conducted a study on the efforts taken by 22 countries to improve data quality and encourage sharing capabilities. We limit the study based on the country loss database (DB), repository and integrated risk management platform, as it is related to our study of designing a CR for interlocking domain related to disasters.

Table 1. Country Efforts to Improve Data Collection, Interoperability and Sharing Capabilities

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>Yes</td>
<td>Maintained and kept updating its disaster CR. Collaboration between Federal agency for torrent and avalanche control.</td>
<td>European Commission Joint Research Centre (ECJRC)</td>
</tr>
<tr>
<td>Belgium</td>
<td>Yes</td>
<td>Has databases with partial loss recordings.</td>
<td>ECJRC</td>
</tr>
<tr>
<td>Bulgaria</td>
<td>Establishing</td>
<td>In the process of establishing its loss database.</td>
<td>ECJRC</td>
</tr>
<tr>
<td>Croatia</td>
<td>No</td>
<td>Regularly updates its disaster databases.</td>
<td>ECJRC</td>
</tr>
<tr>
<td>France</td>
<td>Yes</td>
<td>Public has partial access.</td>
<td>ECJRC</td>
</tr>
<tr>
<td>Germany</td>
<td>Yes</td>
<td>Public has partial access.</td>
<td>ECJRC</td>
</tr>
<tr>
<td>Greece</td>
<td>Yes</td>
<td>Publicly accessible national disaster databases.</td>
<td>ECJRC</td>
</tr>
<tr>
<td>Italy</td>
<td>Yes</td>
<td>Publicly accessible national disaster databases.</td>
<td>ECJRC</td>
</tr>
<tr>
<td>Netherlands</td>
<td>No</td>
<td>Nil</td>
<td>ECJRC</td>
</tr>
<tr>
<td>Portugal</td>
<td>Yes</td>
<td>Regularly updates its disaster databases.</td>
<td>ECJRC</td>
</tr>
<tr>
<td>Romania</td>
<td>Yes</td>
<td>Regularly updates its disaster databases.</td>
<td>ECJRC</td>
</tr>
<tr>
<td>Slovenia</td>
<td>Yes</td>
<td>Regularly updates its disaster databases.</td>
<td>ECJRC</td>
</tr>
<tr>
<td>Spain</td>
<td>Yes</td>
<td>Regularly updates its disaster databases.</td>
<td>ECJRC</td>
</tr>
<tr>
<td>Sweden</td>
<td>Yes</td>
<td>Publicly accessible national disaster databases.</td>
<td>ECJRC</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>No</td>
<td>Nil</td>
<td>ECJRC</td>
</tr>
<tr>
<td>Bahamas</td>
<td>Yes</td>
<td>Only on GIS based data.</td>
<td>United Nations Economic Commission for Latin</td>
</tr>
</tbody>
</table>

Table 1 above presents and analyses how countries cope with the demand and challenges of inter-organizational collaboration, information integration and sharing needs in the disaster domain. We realize that the methods and their execution varies between countries, even though the objective may be similar in terms of their level of completeness and detail. The IT systems used to support the activities also vary in purpose and complexity. Even though recording disaster events is important, there is still no internationally agreed method derived. Most countries may refer to the framework by United Nations but will alter it to their flavor. This is the reason some countries may reflect not having a central platform for loss database. For instance, the European Commission Joint Research Centre (Rios Díaz & Marín Ferrer, 2018) reported that 3 of 15 participating member states do not have a loss database. We can also learn; disaster is an event involving many agencies needing to collaborate and share data. However, it is a complex domain. Most countries may opt to begin the initiatives for data sharing between a few groups or selected agencies with common relations and interest. Austria for example started its central collaboration and data sharing between Federal agency for torrent and avalanches control; Austrian Federal Ministry of Agriculture, Forestry, Environment and Water Management. In Belgium, Germany, Italy and Spain, they started with partial loss recordings based on specific disasters limited to floods. Italy started rolling out with only two regions, Sicily and Umbria. While in Bahamas, only GIS related data was captured as a start.
IV DISCUSSION

The purpose of this paper is to discuss the fact that, despite increasing data availability from a wide range of sources, promising to unlock unprecedented opportunities for disaster risk reduction, data interoperability and a central platform for knowledge sharing remains a challenge due to a number of barriers. For one, interdisciplinary integration is obtained with the integration of data across relevant disciplines. This introduces incompatibility in data standards and nomenclatures used in different disciplines. Although the problem has been addressed by several initiatives, the following challenge still remains: to make online data integration a routine. This paper presents the need to look at an alternative approach towards a central repository design, to support domain needs where many players are expected to interoperate by sharing information. We bring the discussions as below:

A. Lack of guidelines and standards for inter-agency coordination

The disaster domain demands for interagency coordination. Coordination is difficult but vital in disasters. Based on Table 1, it can be seen that establishing a disaster repository has been a priority in many countries. However, the process of data collection, data storage and sharing data has no standards, and it lacks guidelines. IT systems supporting disaster data vary significantly not only between countries, but also among government agencies. Some use simple tables, federated databases and integrated systems linked to other databases such as cadastre or hazard database. This has prevented data from being shared and being aggregated for collaborative decision and action (Mozersky, et al., 2020). A good CR design supporting many players should consider standards. Below are some initiatives addressing this: (a) In US, the Federal Emergency Management Agency (FEMA) developed a data loss collection toolkit at the community level including detailed terminologies and uniform disaster situation reports (Manafi, Saraei, & Mostofi, 2018). (b) In Slovenia, the country established a methodology to assess and document data collection to ensure high quality data that is verified at local, regional and state levels. (c) Italy has developed standard forms for collecting flood loss data, which is done at the regional level, such as in Umbria.

B. The call for new strategies and new approaches by World Health Organization (WHO) and the US Department of Homeland Security (DHS)

There is a growing consensus on turning on information for wider view on disaster situations. "Getting better at responding" means getting prepared. One way to be prepared is to have information on disaster events and its determinants. WHO suggested that a preparedness system must ensure inputs such as data in relation to disasters including technical data and resource data, can be transformed into outputs to be used to improve effectiveness and capabilities. DHS recognizes that new efforts should be established to develop policies and guidelines that address sharing in all emergency phases, including defining the type of data that should be shared, roles and responsibilities of participating organizations, data quality requirements and interoperability requirements. For one, a CR design should be modelled to focus on domain requirements and business needs so as to be more adaptive to support coordination efforts.

C. Agreed Terminologies

Incompatibilities happen from many sources, and the lack of precise and agreed definitions is one of the main factors. A consensus must be reached between players involved. Engaging diverse stakeholders in a collaborative process is important but challenging (Sitas, et al., 2016). In the disaster domain, not having mutually agreed terminologies reflects towards poor communication, leading to delayed decisions or even unavailable services (Abbas, Norris, & Parry, 2018). Standard terminologies promote consistent data for strategic decision making and allow rapid retrieval of information. This leads to meaningful and actionable data, resulting in improved outcomes (Pandit, Debruyne, O’Sullivan, & Lewis, 2020).

D. Information Sharing

Inter-organizational information sharing, and interoperability is an increasing area of interest in the disaster domain in particular. Studies have proposed the importance of information sharing in disasters, especially in large scale events, and how a lack of interoperability is a major impediment (Contestabile, 2011).

Based on Figure 1, the concept of inter-agency collaboration in disaster management has been toyed with in the 1970s. But, only in 1994 the United Nations declared the Yokohama Strategy focusing on collaboration. Since then, its successors, the Hyogo and the Sendai frameworks, continue improving the initiatives promoting cooperation, communication and effective decision making enabled by technologies. The current Sendai Framework promotes sharing and use of non-sensitive data and information to address common disaster risks. Information sharing is important in the disaster domain in order to improve information
delay, which has been said to have a direct impact on slow response, poor prioritization and uncertainties (Waring, Alison, Shortland, & Humann, 2020).

F. Low Visibility of Disaster Issues

The Centre for Research on the Epidemiology of Disasters (CRED) maintains the Emergency Events Database (EM-DAT). A low visibility of disaster issues can be overcome with a central inter-operation sharing platform. Despite all efforts, disaster knowledge appears fragmented. There is a gap that needs to be patched to improve collective decision making (Strzelecki, 2019). CRED highlighted that central platforms can improve rational decision making (Strzelecki, 2019). In a report by WHO, it was found that several efforts leading to a central repository were made since 2006 (WHO, 2009). Information on disasters, particularly related to health issues, was available and collected. However, the following observations were recorded: • Fleeting and perishable – There was no single repository or category in the libraries (health libraries in particular) for this discipline. • Different types of materials – There were several types and formats such as published and unpublished materials, photos, audio/video resources, maps and presentations. • Information scarcity spread out in several places – No agency/institution seemed responsible for collecting and archiving disaster information. No method for collection was applied, and therefore it was not accessible to the domain (locally, regionally or nationally) • Not always published – “Grey literature”, including media reports provided a wealth of information on disasters and all their phases • Data available only from those involved in operations of a particular emergency – It was thus personalized/institutionalized in different and varying styles and formats, and with tremendous turnover rates of staff, this added another factor for the fleeting of information.

V CONCLUSION

Until a standard guideline for inter-agency data sharing for disaster management is relatively accomplished and produced, it will most likely result in a poor understanding of the domain. The recording of disaster events is largely accepted and important, but no standards or agreed definitions exists, making national and global statistics incomparable and unreliable. Many countries face data scarcity, and to integrate them is difficult, as heterogeneities in terms of technology, people and processes exists. The ability and the speed at which data can be shared will determine how well an incident will be managed. Therefore, this paper offers an alternative view towards a CR design for inter-agency collaboration.

REFERENCES


Verification of an Integrated Computational Model of Self-Efficacy, Motivation and Anxiety for a Human Mental State

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ABSTRACT
Knowledge acquisition has been considered a major bottleneck in the development of knowledge base systems. This problem can be narrowed through the development of models that helps in defining the set of knowledge to be acquired from domain experts, hence decrementing unfruitful knowledge elicitation efforts. The constructs of self-efficacy, motivation and anxiety have been established to define human mental states leading to behavioural complexities in the selected domain. Current researches in the field of human-centred AI are beginning to formally represent these constructs as leeway to building systems that understand human complexities. However, in order to ensure that the solutions of such computational models comply with the conceptual description of the theoretical foundations of the constructs, the models must be evaluated. This paper applied two techniques of mathematical analysis and automatic verification using Temporal Trace Language (TTL) for the verification of the formalized integrated model of the constructs. The formalized integrated model is suitable for further validation using a human experiment. The results will serve as the first stage into the computational understanding of the human state influence for knowledge elicitation.

Keywords: formal model, human-aware system, mental state, knowledge acquisition, model verification.

I INTRODUCTION
The understanding of human behavioural dynamics in a simulated environment using the technique of cognitive modelling is providing a platform for innovative applications and solutions that leads to the building of intelligent systems (Zhang et al. 2013). Knowledge acquisition has been considered a major bottleneck in the development of knowledge base systems. One of the major obstacles is to explicitly recognize and capture knowledge relevant to the intended application especially from domain experts due to their human behavioural dynamics. This can be narrowed through the development of models which helps in defining the set of knowledge to be acquired from the domain experts, hence decrementing unfruitful knowledge elicitation efforts (Akhavan, Shahabipour, and Hosnavi 2018). The constructs of self-efficacy, motivation and anxiety have been established to define human mental states leading to behavioural complexities in many domains (Piniel and Csizér 2013, 2014). Harnessing the interplaying factors to integrate the constructs is an essential aspect of identifying the mental framework in human cognition (Piniel and Csizér 2015; Piniel and Csizér 2014). Therefore, the integrated model of the mental state constructs can serve as an intelligent needed to be done to ascertain that the modelling processes are robust, and the attendant outcome is sufficiently accurate and credible (Antoniadou, Barthorpe, and Worden module of a computational framework for a human-aware system intended for a given domain knowledge acquisition (Robins, Margulieux, and Morrison 2019). There have been empirical studies with conflicting results on the interplays between these three distinct but related psychological constructs of self-efficacy, motivation and anxiety. Hence, a computational analysis of the integration of the constructs will narrow the contradictions.

However, for computational models to comply with authentic interpretations of the theoretical foundations of the constructs its meant to analyze, the models must go through a thorough evaluation procedure (Riedmaier et al. 2020). A model evaluation implies the sets of action taken to ensure that a model is developed correctly. It is a vital step in the computational modelling development process. It is the range of activities (2014). Therefore, model credibility and usability are related topics that are concerned with evaluation (Pace 2004). These procedures are used to evaluate evidence to determine the capabilities of simulation, its limitations and performance with the real-world situation or a given standard (Sargent 2013).

Mathematical analysis and logical verification are among well-known verification techniques for an agent-based computational modelling approach. Mathematical analysis methods have been applied such as stability analysis (mathematical proof for equilibrium point determination) (Bosse et al. 2014), and sensitivity analysis (the varying of the model parameters to observe the behaviour of the simulation).
Several techniques are available also for logical analysis or automatic verifications of models (Riedmaier et al. 2020). The formal verification of a program consists of proving that its execution satisfies a given specification of the possible temporal behaviours it should display (Antoniadou et al. 2014). In order to study the dynamics of a simulation model, specific dynamics statement (i.e., temporal logical expressions), which are either expected or not expected to hold, are automatically verified against simulation results (e.g., traces or patterns) (Ullah and Treur 2019). Temporal Trace Language (TTL) has been used extensively for automatic verification in cognitive models. TTL supports formal analysis of dynamic properties of a system, covering both qualitative and quantitative aspects. Dynamic properties are temporal statements that can be formulated concerning traces based on the state of the biological entity being analyzed. TTL is built on atoms trajectories (traces) of states over time (Hoogendoorn, Jaffry, and Van Maanen 2011). This technique has been implemented in (Azizi et al. 2016; Bouarfa, Blom, and Curran 2016; Hoogendoorn et al. 2014).

II METHODOLOGY
The tripartite constructs of motivation, cognition (self-efficacy), and affect (anxiety) is a fundamental part of an intertwined framework when the mental process is being investigated (Dörnyei and Macaro 2010). The review of these constructs has seen common external and internal factors as well as the output states of a construct causally influencing another construct. By leveraging on these interplays, an integrated model is designed and formalized.

In order to ensure the fidelity of the formalized integrated model, this paper adopts two verification methods, 1) mathematical verification using stability analysis, and 2) automatic verifications using temporal trace language. The integrated model consists of several temporal equations, which can be explored by analyzing the equilibrium points of the model. This concept is referred to as what stability analysis entails. Stability points are also verified using value substitutions to confirm if some sets of dynamic properties will behave when values are substituted. During this stage, a set of properties are identified from the literature to verify the correctness of the model. The identified properties are then specified by Temporal Trace Language (TTL). Once these techniques confirm the suitability of the equilibria points and conform with known facts from literature, then the model is ascertained else the model would have to be reconceptualized and formalized for further evaluation. The structural representation of this conceptual model and equations of the temporal relationships are visualized in Figure 1 and Table 1.

The cohesive integration of the model is conducted by considering the relationships between the factors of the three underlying models by applying merging and composition integration techniques.

![Figure 1. The architecture of the integrated mental states model](image)

The three models got their common input factors with the same conceptual definitions fused. The output from one of the models can serve as input to another.

| Table 1. Equations of the temporal relationships of the factors of the integrated model |
|---------------------------------|---------------------------------|
| Equation                        | Representation                  |
| $L_m(t+\Delta t) = L_m(t) + \frac{\beta_{lw}(L_w(t) - L_m(t))(1-L_m(t)) - L_m(t)}{\alpha_{lw}(L_m(t) - L_m(t) - \lambda)} \Delta t$ | Long-time motivation            |
| $L_w(t+\Delta t) = L_w(t) + \frac{\beta_{lw}(L_w(t) - L_w(t))(1-L_w(t)) - L_w(t)}{\alpha_{lw}(L_w(t) - L_w(t) - \lambda)} \Delta t$ | Long-time worry (Anxiety)       |
| $L_f(t+\Delta t) = L_f(t) + \gamma \cdot \left(1 - L_f(t) - L_m(t) - L_w(t)\right) \Delta t$ | Long-time efficacy              |

III RESULTS AND DISCUSSION
A. Mathematical Analyses of the Integrated Model
The equations as re-stated below are used to derive the equilibria states of 3 temporal equations representing the three key observed outputs from the integrated model (self-efficacy, motivation and anxiety).

Verification of Stability through Value Substitutions of $L_w$, $L_m$, and $L_f$ in the Integrated Model
The stability of the temporal factors in the integrated model shown in Figure 2 is used to illustrate this verification method as follows.
Considering the high states of long-term efficacy (Lt), Long-term memory (Lm) and Long-term worry (Lw) using numerical representation at time t=400. The simulation result shows Lt(400) = 0.76214, Lm(400) = 0.82046, Lw(400) = 0.74231.

The accuracy of the simulation results can be confirmed by substituting the numerical values at the time t into the temporal equations to make comparisons.

The equations expressing that each of the states in the equations in Table 1 (i.e. Lw, Lm, Lt) is stabilized at time t are

\[ Lm(t) = (Sm(t)) \]  
\[ Lw(t) = (Sw(t)) \]  
\[ Lt(t) = (St(t)) \]

For \( Lm(400) \approx 0.82046 \),

the equation for \( Sm(t) \) is

\[ Sm(t) = \psi_{sm}.Ve(t) + (1 - \psi_{sm}).Ep(t) \]  
Where
\[ Ve(400) = 0.78927, Ep(400) = 0.86101, \text{and} \ \psi_{sm} = 0.5 \]
\[ = (0.5 \cdot 0.78927 + 0.5 \cdot 0.86101) \approx 0.82046 \]

For \( Lt(350) \approx 0.76214 \),

the equation for \( Sf(t) \) is

\[ Sf(t) = \psi_{sf}.(\omega_{sf1}.Gp(t) + \omega_{sf2}.Ea(t) + \omega_{sf3}.LeE(t)) + (1 - \psi_{sf}).Be(t) \]  
Where
\[ Gp(350) = 0.78222, Ea(400) = 0.617516, LeE(400) = 0.784047, Be(400) = 0.8100 \]
\[ \psi_{sf} = 0.5, \omega_{sf1} = \omega_{sf2} = \omega_{sf3} = 0.33 \]
\[ = 0.5 \cdot 0.33 \cdot 0.78222 + 0.617516 + 0.784047 + 0.5 \cdot 0.8100 \]
\[ \approx 0.76214 \approx 0.76533 \]

With a negligible error margin of less than 0.01, the results above prove the fulfilling of the temporal equation. The result of the self-efficacy, as implemented in the model, agrees with the expected behaviour and therefore proven.

\[ \Rightarrow \text{For } Lw(400) = 0.74231 \]

the equation for \( Sw(t) \) is

\[ Sw(t) = (\psi_{sw}.Bw(t) + (1 - \psi_{sw}).Th(t)) \cdot (1 - (\psi_{sw}.Cr(t) + (1 - \psi_{sw}).Ap(t))) \]  
Where
\[ Bw(400) = 0.80841, Th(400) = 0.75340, Cr(400) = 0.06987, Ap(400) = 0.02564 \]
\[ \psi_{sw} = 0.5, \varphi_{sw} = 0.5 \]
\[ = (0.5 \cdot 0.80841 + 0.5 \cdot 0.75340) \cdot (1 - (0.5 \cdot 0.06987 + 0.5 \cdot 0.02564)) \]
\[ \approx 0.74231 \approx 0.74361 \]

The result shows an error margin of less than 0.001. This finding proves the fulfilling of the temporal equation of anxiety in the integrated model. The result of anxiety, as implemented in the model, equally agrees with the expected behaviour.

The three fundamental temporal equations which determine the behaviour of the integrated model have been proved to maintain stability. This is achieved by value substitution method above and each of the comparisons shows a negligible error. It is therefore correct to say that the integrated model achieves stability and behaving as expected.

B. Temporal Trace Language for Integrated Model

TTL is suitable for formal specification and analysis of dynamic properties of models and systems. TTL is an extension of order-sorted predicate logic with explicit facilities to represent dynamic properties of systems. It is assumed that the state language and the TTL define disjoint sets of expressions. Therefore, the same notations for the elements of the object language and their names in the TTL are used without introducing any ambiguity. Also used are t with subscripts and superscripts for variables of the sort TIME; and \( \gamma \) with subscripts and superscripts for variables of the sort TRACE. Some known cases from literature are analyzed as follows

VP1: The perceived sense of efficacy plays a crucial role in the arousal of anxiety.

\[ \forall \gamma: \text{TRACE, } \forall t1, t2: \text{TIME, } \forall V1, F1, F2, d: \text{REAL} \]
\[ \text{[state}(\gamma,t1)]= \text{perceived efficacy}(V1) \& \]
\[ \text{state}(\gamma,t1)]= \text{anxiety}(F1) \& \]
\[ \text{state}(\gamma,t2)]= \text{anxiety}(F2) \& \]
\[ V1 < 0.2 \& t2 \geq t1 + d] \Rightarrow F2 > F1 \]
The social cognitive theory asserts that one's perceived sense of self-efficacy plays a key role in anxiety arousal (Wood and Bandura 2013). An individual experiences anxiety when they are relatively doubtful of their capabilities (low self-efficacy) to manage potentially detrimental events. Consistently, the two main references in this area show that low levels of self-efficacy are usually accompanied by high levels of anxiety capable to affect performance (Yang et al. 2020).

**VP2: Threat affects motivation and anxiety**

\[
V P 2 = \forall \gamma: \text{TRACE}, \forall t1, t2: \text{TIME}, \forall V1, F1, F2, D1, D2, d: \text{REAL} \\
\text{state}(\gamma, t1) = \text{threat}(V1) & \\
\text{state}(\gamma, t1) = \text{anxiety}(F1) & \\
\text{state}(\gamma, t1) = \text{motivation}(D1) & \\
\text{state}(\gamma, t2) = \text{anxiety}(F2) & \\
\text{state}(\gamma, t2) = \text{motivation}(D2) & \\
V1 > 0.7 & t2 \geq t1 + d \Rightarrow F2 > F1 & D2 < D1
\]

The threat is a psychological or a mental state in which an individual perceives himself/herself as being unable to cope with a task (Riskind and Calvete 2020). This condition happens when coping resources is not enough to manage the task demand. Therefore, it can be linked to loss of faith in personal competence which can lead to a state of worry (Hirsch and Mathews 2012) and fail in the efforts and perseverance which are the critical ingredients of motivation (Owusu, Larbie, and Bukari 2020).

**VP3: Persistence in task mediate the complementary effects of motivation and self-efficacy**

\[
V P 3 = \forall \gamma: \text{TRACE}, \forall t1, t2: \text{TIME}, \forall X1, X2, X3: \text{REAL} \\
\text{state}(\gamma, t1) = \text{motivation}(v, X1) & \\
\text{state}(\gamma, t2) = \text{self_efficacy}(v, X2) & \\
\text{state}(\gamma, t2) = \text{motivation}(v, X3) & \\
X1 > 0.8 & tb \leq t1 \leq te & \text{tb} \leq t2 \leq te \\
\Rightarrow X2 \geq 0.5 & X3 \geq 0.5
\]

Self-efficacy improves an individual's motivation to undertake projects and persists in the pursuit of his/her goals, in the face of setbacks and difficulties that may periodically test his/her drive (Hasanah et al. 2019). High sense of self-efficacy, therefore enhances one's strength to persevere and persistence is an instrument to improving motivation in a task. A positive association between intrinsic and extrinsic exercise motivation and exercise self-efficacy, mindfulness and intrinsic exercise motivation, and mindfulness and exercise self-efficacy have also been reported in (Neace et al. 2020).

### IV DISCUSSION

The verification process ensures that a correct model has been built. First, the mathematical component of the verification analyses the possible equilibria points. The essential assumptions in such analysis are that external factors, that is, the inputs to the model are constant values and having non-zero parameters. Equilibrium of three temporal equations is verified through value substitution. The value an equilibria points is taken at a certain time \( t \) in the simulation and compared with the substituted numerical values at the time \( t \) into the temporal equations. The three substitutions show levels of consistency and accuracy as the values are almost equal.

Automatic verification of the traces in the simulation was carried out using TTL. The cases where this method is employed in this study are typical situations requiring a check of properties on a few sets of traces obtained by simulation. The resultant description in predicate logic format are statements that conform with known proven statement in the literature that was used to formulate the conceptual model. The models are built from concepts and theories that have been proven overtime.

### V IMPLEMENTATION

The verified integrated model of the constructs (self-efficacy, motivation and anxiety) would require validation with a human experiment in a natural environment to obtain a unified cognitive model in the domain. Consequently, the integrated cognitive agent model could serve as an underlying reasoning model to design an intelligent artefact that can provide supports to human actions in the domain. Therefore, the integrated cognitive model serves as an intelligent module of a computational framework for a proposed human-aware system intended for a specific domain. This type of system, known as an ambient intelligent system, can be developed by deploying the cognitive agent model as a reasoning engine (Robins et al. 2019). To this regard, therefore, more informed decisions based on the reasoning engine in a manner that show human-like behaviours can be achieved. Though this is still a developing concept, however, the intent is for a model that could be encapsulated within existing virtual agents to simulate a human mental state in addition to other verbal and non-verbal behaviours the systems are meant to realize.

### VI CONCLUSION

This paper describes model verification which is the final stage of formalization of an integrated model of three psychological constructs (self-efficacy, mindfulness and motivation).
motivation and anxiety) that have been studied to define the human mental state during activities. The equations of the temporal relationships of the integrated model were analyzed mathematically and TTL was used to verify known facts in literature against the simulated result of the final model. This result paved the way for further validation using human experiment.

The outcome is a first step to designing a human-aware system with an integrated model of mental state as an intelligent engine which can understand the dynamically changing human states. It will serve as a tool for knowledge elicitation from domain expert for a development of a knowledge-based system.

REFERENCES


Agile Approach and Adaptability into Complex Environment Management and Operation: A Case of Malaysia Battlement Against Covid-19

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ABSTRACT
Covid-19 disaster management is classified as complex management due to the rapid changes of the current situation, ad-hoc methods in the dissemination of latest information to society and public knowledge, mass media control, collaboration and coordination between agencies, national economic stability, and finances that contributes to the operation complexities. Several solutions have been made by the federal or state government involving various aspects, including the development of standard operating procedures that form the basis of overall management. However, not all efforts can run smoothly and efficiently given the large aspects of control and the involvement of a large population. Therefore, in this paper, we propose for the agile process in the agile framework for flood management to be adapted to provide new solutions for Covid-19 to cater to the activity’s complexity. The grounded theory is applied to construct the structure of the study by understanding the phenomena from multiple complex environments and established theories. Consequently, the suitability of the agile elements from flood management has shown a constructive relationship to be adopted into Covid-19 operational activities to support complex environmental processes.

Keywords: Covid-19, agile approach, complex environment, disaster management.

I INTRODUCTION
A novel coronavirus infectious disease (Covid-19) pandemic crisis response is classified as one of the complex managements since the operational activities are chaotic. Its management mechanism, which involves several facets, including the treatment of new and active cases, the distribution of the latest facts to the public, education and awareness of all citizens, mass media management, cooperation and coordination between agencies, national economic stability, and family finances, add to the complexity of its management, which has a significant effect on the economy and social (Altahir et al., 2020; Zainon, 2020).

Several solutions have been placed in force by the Malaysian federal government to curb this epidemic's spread. Among them, the Movement Control Order (MCO) declared by the Prime Minister of Malaysia on 16 March 2020 will take effect on 18 March 2020, followed by some subsequent phases until 12 May 2020.

During this MCO phase, all sectors involving colleges, schools, food stores, cinemas, shopping malls, and sectors considered needless to exist in their respective locations are directed to function from home, and exemptions are provided to critical sectors such as hospitals, supermarkets selling daily necessities and a variety of other prominent sectors.

However, the extended MCO had a negative influence on the national economy and led to a decision by the Prime Minister of Malaysia to enforce the Conditional Movement Control Order on 1 May 2020. It was announced on that day the new measure was to start on 4 May 2020. Due to the continued increase in the number been affected, thus Enhance Movement Control Order (EMCO) had been introduced at the specific location.

Despite all the MCO's introduction, Malaysia's prime minister declared a Recovery Movement Control Order (RMCO), where the effective date is 10 June 2020. During this time, all enterprises, social life, the economic sector, and other routine operations are permitted to function as expected.

Owing to the rapid changes’ situation, emergency recovery operations have to change according to the current situation's suitability. This scenario can be compared to the agile concept practised in project management, where a quick adjustment needs to be made to adapt to the current condition of the case.

A pandemic that is not yet certain when it will end shows the effects of an uncertain infection and rapid changes that require a quick response from all affected stakeholders, including the public. It can be seen through a series of infections wherein the initial period, the active case increased, then decreased at a time, sometimes it flattened, and increased again. The ad-hoc spike can be witnessed in early October 2020 due to the State Election Campaign (PRN) and the PRN conducted on 26 September 2020 in Sabah (Bernama, 2020).

Due to non-compliance with the prescribed Standard Operating Procedure, the number of infected people
increases up to four-digit daily (Bernama, 2020). Simultaneously, some areas with red zone status, such as Tawau, Kunak, Semporna, and Lahat Datu, are indeed the critical zone of Covid-19 infection. There is no denying the number of people returning from Sabah after PRN became one reason for the spread of Covid-19 infection in peninsular Malaysia (Yazid, 2020).

In this paper, we propose the agile approaches and adaptability be adopted into another discipline of a complex environment, as proposed in Agile Information-Based Framework for Flood Management (ALFA). The ALFA Framework is a dynamic framework developed by integrating the agile aspect from system development and other complex environment guided by COBIT principles. It is a framework to manage flood disasters specifically introduce for Electricity Supply Industry in Malaysia. By knowing the fact that, managing flood activities is complex and chaotic, thus ALFA was introduced. The complex nature of the environment due to the rapid change of circumstances makes managing the situation chaotic. Therefore, agile elements need to be considered to facilitate the management of a disaster and, at the same time, enable a decision to be made quickly and improve the operational activities.

Therefore, this article is devoted to the adoption of several elements from the agile framework of flood management to the handling of Covid-19, specifically in Sabah, Malaysia. It is believed this research is to be of vital importance in improving the management of Covid-19 activities to help in reducing the impact of this pandemic.

This paper is organized as follows: in the second section, an overview of the case of pandemic management in Sabah will be elaborated. The third section will discuss the methodology used in analyzing the case with the agile framework of flood management and followed with the mapping of the agile framework with the case in Sabah. Concluding, we discuss the suitability of the framework adoption with any disaster as well as future research of the framework.

II BACKGROUND

Even as the number of active case infections continues to escalate day by day, the government's decisive action to close all entrances and exits to deter travel to or from Sabah is seen as a wise move. Screening and quarantine are also conducted in Sabah to recognize and classify the possibility of infection among the population.

Sequence from the screening carried out; the authorities experience another problem where Covid-19 screening need to be carried out in some remote regions, and these areas have not been exposed to the real situation and the effects of the pandemic towards society and life. Therefore, the residents' involvement is not considered to facilitate the management of a disaster quickly and improve the operational activities. To reduce tension in the situation, a teacher who is also a resident tried to console the community by approaching them personally and explained the process relating to the Covid-19 screening. He accomplished the area residents, explained the problems encountered, the process to be taken, and answered all the residents' questions. With his efforts, he managed to bring almost 50 residents to undergo the Covid-19 screening test from the population of Omandal Island, where the living situation is as shown in Figure 1. The teacher explained to the medical officers that the residents' fear of being brought to the hospital which may cause them to be separated from their family and they are not familiar in living outside of the island.

The efforts and approaches made by this teacher are known as transformational leadership, which was introduced in the agile framework for flood management. He has taken appropriate measure to ensure the affected communities are screened for Covid-19 by the authorities by being a liaison person between the medical group and the community. By doing this, he managed to help in controlling the pandemic as he managed to get all residents in Omandal to be screened as part of the Ministry of Health initiative in decreasing the cases in Sabah.

![Figure 1. The Living Situation of Residents in Omandal Island, Sabah](image-url)
site in achieving the objective in controlling the pandemic. The success of this approach can be seen from the increasing numbers of people coming to be screened at the local clinics after the teacher has provided an explanation to the residents.

The following section will describe the methodology used in understanding the agile approach and its adaptability with Covid-19 situation in Sabah, Malaysia.

III METHODOLOGY
As this research is allowing for exploratory and discovery-oriented to understand the phenomena and introduce a new theory of agile elements in a complex environment, a methodology of grounded theory (GT) has been adopted. GT is implemented as an inductive and comparative approach that offers structural guidance for the selection, synthesis, review and conceptualization of qualitative evidence for construction theory.

Theory-based research will start with a query or even just the collection of qualitative data. The researchers analyze evidence, see it as the ideas or principles. The researchers mark these concepts with codes that outline the concepts briefly. When further data are obtained and reexamined, codes may be categorized into definitions and divisions at the higher rank.

GT uses qualitative knowledge to describe the occurrence of a particular event. It achieves this by analyzing a series of related events and using the evidence to provide causal knowledge in various situations. Researchers change or develop new theories by researching further cases before an interpretation that suits all cases is found.

Hence, in this research, we adopt the theory under the agile process introduced in the Agile Framework for Flood Management. We followed the principle for this study to be cross-analyzed with other complex management alluded to in Covid-19.

IV DISCUSSION
In this section, we presented the idea of agile elements adaptability between different disaster environments which refer to flood and pandemic Covid-19. Two main recommendations for the successful implementation of complex environments can conclude the study as the following:
1. Some components have to consider dynamic circumstances. It will adjust according to situations and transform over time by understanding the situation and making the catastrophe meaning special. Accordingly, adaptive steps are expected during implementation.
2. To ensure uniform and orderly implementation of such functions, strict requirements must be followed (where versatility is not permitted). Each organization must have a lean, unambiguous SOP. Nevertheless, a structural SOP is needed to control the consistency of the framework applied for the unique form of disaster management.

In this paper, we argue the implementation of some elements highlighted under point number one, where those elements can be found in the agile implementation of project management and other complex environment by integrating agile concept (Brown & Chennamaneni, 2013; Mahmoudi, Jahani, Abdi, Yaminfirooz, & Bahrami, 2018; Nawaz & Zualkernan, 2009), and it is adaptable into disaster management activities in Malaysia. The details of the agile elements are presented below:

A. Transformational Leadership
Disaster management in Malaysia is being guided by a standard or guideline known as Directive No. 20, produced by National Security Council in 1997. The activities performed in managing disaster are separated into three levels that are federal, state and district. Although Covid-19 is considered as a national issue, there is an acute challenge for the district as a local governance to manage the pandemic.

Covid-19 in Sabah has increased since the beginning of October 2020, and it was considered the third wave of the pandemic in Malaysia. The rapid increase in new cases in Sabah are contributed to the existing health constraints and socio-economic vulnerabilities that the state has been facing even before the pandemic. The access to basic medical resources remains uneven compared with other states which dampen the effort of tracing, testing, isolating and monitoring the infections. In this situation, local governance or district authorities' role in bridging the gap between the national initiatives and local realities is crucial as it is responsible for coordinating responses and efforts to manage Covid-19 (Dutta & Fischer, 2020). Local governance entities include both the authorities and local actors who are more knowledgeable and understand the local needs.

Local actors that act as the leader in dealing with Covid-19 in a rural area has the authority and power to motivate other people to work together in achieving specific goals. For Covid-19, the aim is to persuade all residents to get screened or tested for the disease. Transformational leadership is a critical aspect of disaster management. Leadership transformation is defined as an individual who has in-depth knowledge of a particular geography, phenomenon, settlement or other aspects that can help disaster management committee solving problems related to the disaster. This individual is likely to be a resident in the area surrounding the place who better understand the surrounding community's way of life.
In the case in Sabah, the individual that acts as the leader is a teacher who has lived in the area for several years and understand the culture and sociology of the island residents. The teacher who becomes the leader is the main reference point for the residents, and they rely on him for information or directions. He is believed to be a transformational leader as he was able to respond and take leads to unexpected changes when the residents refused to be screened by the authorities. He is responsible for the proactive and reactive plans, where he explained the best approach in tackling the locals’ residents to the medical officers. The leader understands that it is vital to building trust on the ground in ensuring the coordinated efforts plan by the authorities can be implemented by the community.

B. Skills and Experienced People
The case emphasized the teacher as a transformational leader that able to provide guide and directive to the local residents. A leader in a chaotic environment such as pandemic should also have proper skills and experiences as it is one of the requirements for an agile process to be successfully executed. Experience and knowledge can be utilized in making timely decisions and to minimize the impact on the problems encountered promptly. The quality of knowledge, skills, and experience achieved by each individual also contributes to the value of expertise development in the affected areas, especially during the time to face emergencies such as the pandemic.

Knowledge, skills and experience gained in handling Covid-19 is a critical strength in overcoming any potential problems in managing the disaster. The nature of Covid-19 infections varies according to location and communities, which requires different and dynamic actions. The ability to manage and respond to events require individuals to be equipped with optimal knowledge in the relevant field. Although the leader background is a teacher, he equipped himself by having proper communication with medical authorities to understand about Covid-19 and the right kind of information to be disseminated to the local residents.

C. Quick Respond
Agile requests for quick response over the process based on the situation. Quick responses in agile can be categorized as mentally and physically fast. Mentally quick individuals can think rapidly and clearly, while physically quick is someone who able to move their body fast and steady. To be physically quick, a strong and skilled workforce is required. A strong and skilled workforce is someone that knowing what to do and how to do it correctly, at a correct time, with a correct knowledge and execution process. A strong, skilled workforce should have the exact knowledge and understanding of the situation in dealing with a Covid-19 by identifying and choosing the best solution for the problems. Information can only be converted into knowledge when the person in charge had experience and memories, to either serve as an onsite committee during the Covid-19 activities or experience it as one of the victims. Thus, in any event of a disaster, quick response to the issues arise is mandatory to ensure holistic management in the disaster.

V CONCLUSION
As a conclusion, a complex environment requires a dynamic approach in operation where some flexibility must be observed and allowed. The idea is to increase flexibility by improving the management operation while promoting efficiency and effectiveness of the process, in dealing with a complicated situation. At the same time, agile provides increase productivity, increase transparency, higher quality deliverables, decrease the risk of missed objectives and increase stakeholder engagement and satisfaction. In this paper, we have presented the relationship of the agile process proposed in flood management to be adopted in covid-19 operational management, where both have shared the same characteristics of the complex environment. Results have bought to the mapped of (i) transformational leadership where it is an adaptive aspect to allows any person who experiences and knowledgeable of managing the situation. Second (ii) skills and experienced people is to promote better decision making or even spontaneous action to react to the emergency. While (iii) quick response is a crucial action in an emergency to mitigate or reduce the risk.

It is proven that some agile aspects are the alternative that can improve emergency operation while dealing with a complex environment as based on the finding above. Hence, we argue a consideration on the agile element's implementation in policy or framework development or even any practices and discipline of complex environments to improve the effectiveness and efficiency of the operation. Future research of those elements highlighted in this study and another agile process as introduced in the agile framework for flood management into another complex environment, hopefully, could bring substantial justification and advantages in the execution process.

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Design and Development of Quranic Parables Information System: A Web based System for Understanding Quran Verses

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ABSTRACT
The content of al-Quran needs to be read, observed, and understood so that it can be practiced. Nevertheless, today’s generation put less emphasis on understanding the content, rather they only read al-Quran without understanding the meaning behind it. This has caused a lot of immoral activities. Besides, the Islamic content learning media is claimed to be dry and not attractive enough. Thus, this study is conducted with the aim to attract the young generations’ interest on understanding al-Quran content by using the current technology: through a web-based system named as Quranic Parables Information System (QPIS). QPIS provides verses in the al-Quran which contains parables and their interpretation. The design and development of QPIS followed Rapid Application Development (RAD) methodology. The evaluation towards the completed system received positive feedback from users as all of the content and functionality of the system works accordingly and fully serve its purposes and more importantly the feedback indicates that QPIS is able to help users substantially in understanding Quranic parables. The study contributes by providing an understanding about the system requirements modelling on QPIS which can be referred by researchers in the same interest. More importantly, QPIS will enable the young Muslims to understand and practice the Quran content in their daily lives.

Keywords: Quranic parables, system design and development.

1 INTRODUCTION
Al-Quran is considered as one of the important possessions to the Muslim religion. It was passed down by Allah to mankind as an up most important guidance that should be followed throughout their lives. This holy scripture of Islam is undeniably having unique power in providing a way to heal mankind emotionally and physically, reduce anxiety as well as strengthen their spiritual and behaviour (Kosim, Kustati, Sabri, & Mustaqim, 2019; Yuliani, Djamal, & Endi, 2019). Ultimately, applying the content of al-Quran can promise mankind to have a successful life in every aspect (Saadah et al., 2017). Muhammad Quraish Syihab (1996) in Ahmad (2019) asserts that every Muslim is obliged to study and understand the scriptures he believes in. Even according to him, in the introduction to Tafsir al-Kasysyaf, al-Zamakhsyari argues that learning the meaning of al-Quran verses is fardu 'ain (must be learned and practiced by Muslim individual). Moreover, according to Nurul Zakirah and Zulkifli (2012), the practice of tadabbur should be cultivated in life of Muslim society. Manhaj al-Quran should be appreciated and be a source of reference in all matters and problems that arise in the society. Reading and studying the al-Quran will remove Muslims from backwardness, ignorance of knowledge or falling into moral decay.

In contrast, neglecting the al-Quran in life will lead to a lot of problems such as social and moral problems, especially to the young generations. With today’s advancement of Internet and social media, the youngsters are more exposed to the negative behaviors which leads to immoral activities such as promiscuity, pornography and adultery (Nur Anis Hanani, Latifah, & Nurliyana, 2019). The cases have been continuously reported through the media day by day, and there is no sign of reduced number of cases, but it keeps increasing. For instance, a teenager was jailed for killing 21 students and 2 teachers in a religious board school in fire. This case is reported as the worst tragedy in two decades (Reuters, 2020). Furthermore, the Inspector-General of Royal Malaysia Police, Mohamad Fuzi Harun, worryingly reported that there are 577 students involved in drug-related cases, which is an increase compared to 467 in 2017 (Bernama, 2019).

These problems arise because today’s generation are lack of affection and practice towards al-Quran since they lack the understanding of al-Quran content. If the content of al-Quran is understood and practiced, the society will be free from these kinds of problems. Al-Quran is a perfect reference that can be used by mankind either in their life in the world or hereafter, which covers various elements. It also acts as the guideline to face various challenges in life. The al-Quran is not only meant to be recited and memorized, but more importantly, the meaning behind it need to be understood and applied in the life. There are
various ways that can be used to understand the contents of the al-Quran. Among them is through al-
nasikh wa almansukh, which explains about the
verses that revokes and abolished. Apart from that,
mankind can also learn the al-Quran content by
learning the ashab al-nazul; knowledge that explains
the reasons behind the revelation of the verse. In
addition, one can also learn the content of al-Quran
through the knowledge of i’jaz al-Quran, where it is
a method used to explain about the strength of
the structure of al-Quran verses, which is seen as a
miracle that can weaken all Arab linguists. More
interestingly, amthaf method can also be learned,
where it explains the meaning of al-Quran content
through parables. Quranic parables are the verse of
al-Quran which are used by Allah to match the
meaning of the verse with issues in the real world
of human’s lives (Al-Zamakhshari, 1995). Previous
studies have proven that Quranic parables are
effective to give understanding about the Quran
where it can give clear understanding about the
message or content of the al-Quran verses (Rima,
2019; Akhavanmalayeri, Seifi, & Faghihi, 2018;
Morteza, 2016). It also plays an important role in
attracting human souls and feelings so that they can
be impressed with the verses that they read.
Consequently, readers will be able to practice the
lesson learned from those verses in their lives. On top
of that, the parables used in the al-Quran are
something that can be related with human’s
environment; thus, they can understand more easily.

Sadly, today’s society especially Muslims are only
concerned on reciting the al-Quran verses, without
understanding the meaning behind each of the verses.
To get the most benefit from the Quran, one need to
recite, understand and analyze the meanings behind
the verses. The challenge is that the verses are in
Arabic which is not a mother tongue of Malaysian
society. Moreover, as mentioned by Nurtihah,
Rahmah, Fakhrul Hazman and Marina (2018), mostly
the Islamic content learning is claimed to be very dry
and plain, which cause less attraction to the young
generations who are the digital native generations.
Only small number of people take initiative to read
the translation of al-Quran in their mother tongue
languages. This is evidenced by a preliminary study
conducted in a public university in Malaysia among
30 Muslim individuals. The outcome from a survey
reveals that majority of them read the translation of
al-Quran very rarely due to lack of awareness on its
importance. None of them has accessed legal online
website that provides an full interpretation and
explanation about the meaning behind each al-Quran
verse and lesson learned from the parables. With the
existence of this system, the Quranic parables can be accessed
in one platform and accessible everywhere at any
time. The parables also can be managed more
systematically and efficiently. It is hoped that the
knowledge and understanding about Quranic
parables can be spread more efficiently, besides
making the learning process more captivating and
meaningful. This paper discusses about the design
and development of QPIS.

The remaining of this paper is structured as follows:
the related studies are discussed in Section II,
continued with methodology in Section III. Then, the
paper continues with the requirements and design of
QPIS in Section IV. Next, the QPIS prototype
development and evaluation are discussed in Section
V and VI respectively. The paper ends with
conclusion.

II RELATED STUDIES
This section provides review on the Quranic parables
and the existing works done in this area.

A. Quranic Parables
One of the miraculous forms of the al-Quran is the
structure of its beautiful language. With the amazing
language, al-Quran is able to produce an abstract
meaning to a concrete phenomenon through the use
of clear language, allusions, symbols, and even
parables. Quranic Parables are one of the language
barrels featured in al-Quran al-Karim. It is used to
give explanation regarding various aspects of human
life which include creed, sharia and morality. It is
also capable of revealing the meaning behind an issue
in a realistic way. Therefore, it is not surprising that
the parable of the Qur'an can be a cure for the
disturbed human spirituality. Basically, there are
altogether 43 explicit (musarrarah) parables in the

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http://www.kmice.cms.net.my/
al-Quran while the rest are implicit (kaaminah). Explicit parables are those which use the word ‘mathal’ in the verse, which means alike. On the other hand, implicit parables are the ones used in al-Quran verses without the word ‘mathal’. They are categorized as verses which contains parables through the implicit meaning behind the verses. This study focuses on the explicit parables. One example of explicit parable in the al-Quran verse about creed is in surah al-Haj, verse 31:

وَمَنْ يُشْرِكْ بِإِلَهِ يَوْمَ يَقْتَلُهُ مَحْرُومًا فَإِلَّا مَمْكَانٌ عَلَيْهِ ﻟِلْهُ أُوُلِي الْبَلْدَةِ ﻟَوْذَا أَيْنَ ﺑِهِ ﺗَھْوَﯾِّإَبْرَزَّ وَمَنْ يُشْرِكْ بِإِلَهِ ﻧَّأْمُو ﺑِإِلَهِ الْمُؤْمِنِينَ ﻟَوْذَا أَيْنَ ﺑِهِ ﺗَھْوَﯾِّ إِبْرَزَّ ﻟَوْذَا أَيْنَ ﺑِهِ ﺗَھْوَﯾِّ إِبْرَزَّ

Interpretation: For whoever associates ‘others’ with Allah is like someone who has fallen from the sky and is either snatched away by birds or swept by the wind to a remote place.

In this verse, Allah uses a parable to explain about the retribution that will be faced by polytheist (the ones who believes that there is more than one God other than Allah). It explains that the distance of a polytheist from the truth is similar to the distance of a person who falls from the sky and struck by a bird or blown by the wind. To elaborate more, the verse is construed by explaining the implicit and explicit meaning, together with the Islamic scholar’s interpretation, its relationship with other verses as well as the lesson learned from this verse. These are included in the QPIS so that the user can learn from each Quranic parable. QPIS can be browsed through https://qpis.000webhostapp.com/index.php. Existing papers regarding Quranic parables included in the QPIS are also available (Syed Sultan Bee, 2019; Syed Sultan Bee, 2018). More researchers are discussed in the next sub section.

B. Existing studies on Quranic Parables

Research have been conducted to investigate Quranic parables to give better understanding to the readers. They convey the intended messages of al-Quran through the interpretation. Aghniya (2016) discussed about the parable contained in Surah Ibrahim verses. In these verses, the nature of a tree has been used by Allah as an analogy of morality formation. Furthermore, Mohd. Sukki and Zulkifli (2012) and Ni‘mah (2019) analyzed Quranic parables based on insects. Rima (2019) on the other hand, investigated al-Quran verses which contain parables related to donkey. Detailed explanation behind the verses are explained. More interestingly, Solehah (2017) analyzed Quran verses which utilize flora as Quranic parable. The researcher categorized the verses as good and bad deeds, signs of Allah’s oneness, glory and humiliation. Besides, the Quranic parables are also employed by Akhavanmalayeri et al. (2018) to investigate the difference of critical thinking ability between the students who were exposed to Quranic parables in the curriculum and those who were not exposed. The result shows that there is significant difference between both. However, these research are not accessible by the public, thus only academicians or researchers will get the benefit. On the other hand, today’s generation are more exposed to the Internet and apps. Currently, there exist blogs and websites regarding Quranic parables on the Internet, however they lack certain component that would make their blog and website better.

Sadaf (2010) provides explanation about the parables through Muslim Matters, an online magazine which writes about Muslim religion matters around the world. In this website, only the translation and information regarding to the verse of Quran are available. Similarly, archive:Islam (2020) and Consult Quran (2020) are among other websites which provide the interpretation of Quranic Parables and verses. Nevertheless, the content of Quran parables on these websites are limited and the explanation provided regarding the verse of al-Quran is not enough to explain the meaning implied in the al-Quran verses. Moreover, most of them do not reveal the background of the author for the information provided on the website, which cause the users to feel unconfident with the correctness of interpretation provided. Also, they are mostly in English, thus not suitable for those who are not fluent in English, especially for the Malaysian case. There are websites in Malay language like say@hafiz.com (2014) and Abdul Hamid (2014), but the explanation given are also not detailed enough. Considering the importance of Quranic parables in Muslims’ life and the limited access to its interpretation to the public, thus there is an urgent need to develop an information system which stores Quranic parables and their interpretation. Consequently, the QPIS is developed as a web-based system using Malay Language. The parables are interpreted by the experts in the field. It is hoped that with the emergence of digital devices and the widely used Internet, Quranic parables can be accessed, understood, and applied by the publics, especially the Muslims. It is also aligned with the knowledge management strategy where the knowledge is collected, used, enriched, shared, assessed, and sustained.

III METHODOLOGY

This project was conducted by following Rapid Application Development (RAD) (Pressman, 2010). RAD is a methodology which implies adaptive software development and puts less focus on planning. This methodology uses prototype in gathering the requirements. With the use of RAD, the software is segmented into pieces and demonstrated to the experts iteratively time by time. There are four phases in this methodology, namely requirement
planning, user design, construction and cutover. RAD is appropriate for this study since the user can be demonstrated with series of prototypes so that they can get the idea of the system from the beginning and they can review and suggest for modification as needed. The requirement planning phase involved three activities: (1) conducting survey with potential users of QPIS, (2) reviewing existing research and web applications related to Quranic parables and (3) gathering requirements from experts. The survey was carried out informally with 30 Universiti Utara Malaysia (UUM) graduates. They were required to answer a short questionnaire about their knowledge on Quranic parables and what information they would preferably have in a Quranic parables information system. Their opinion was recorded and utilized for the purpose of QPIS development. Furthermore, the existing research on Quranic parables were investigated from the online databases such as Scopus and IEEE. Besides, the existing websites and blogs such as MuslimMatters (Shadaf, 2010), say@hafiz (2014) and Consult Quran (2020) were analyzed to get some ideas and investigate the limitation of the systems. At the same time, meetings with the experts were conducted to gather the requirements and the Quranic parables with their interpretation. These meetings were able to create mutual understanding about the objective of this project development.

Next, the user design and construction phases involved with the design of the system using Unified Modelling Language (UML) diagrams consisting of use case and class diagrams. UML diagrams are commonly used to represent the system’s requirements, as can be found in Norliza, Jayasangar and Yuhaniis (2019) and Anas Farhan and Rohaida (2018). Besides, the user design phase also involves with the development of the system concurrently. The prototype was developed and demonstrated to the experts and feedbacks were gathered for improvement. Moreover, the flow of the system was also exhibited to the experts. The experts were among academicians who have background in the Quranic studies. Based on the feedback, the prototype was built iteratively until the experts are satisfied. The system was developed as a web-based system, which uses PHP programming language. The development tools that were employed are Macromedia Dreamweaver and Netbeans while PhpMyadmin in the 000webhost site was utilized for the database.

Finally, the prototype was evaluated during the cutover phase. The aim of the evaluation is to measure the usability of QPIS. Once the full-scale testing is complete, the developer implemented the system for the last time before officially presenting it to the potential users. Then, the QPIS was formally launched to the public. The system was evaluated by 33 respondents comprise of student and lecturers. A survey question was answered by the respondents to evaluate usability of QPIS based on ease of use, usefulness and satisfaction.

IV QPIS REQUIREMENTS AND DESIGN
Outcome from the requirements planning phase is the list of requirements for QPIS, as in Table 1.

<table>
<thead>
<tr>
<th>No.</th>
<th>Requirement Description</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Register</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>New admin or user must click on “Register” link.</td>
<td>M</td>
</tr>
</tbody>
</table>
| 3.  | System will display a page that allow admin or user to fill in their details: -
|     | a) Nama                 |          |
|     | b) Nama Pengguna        |          |
|     | c) E-mel               |          |
|     | d) Kata laluhan         |          |
| 4.  | New admin or user fill in the information and click on “Submit”. | M |
| 5.  | The new admin or user will be registered, and their details are added into the database. | M |
| 6.  | Login                   |          |
| 7.  | Admin or user must click on “Login” button. | M |
| 8.  | Admin or user must key-in the Username and Password. | M |
| 9.  | The QPIS must verify the Username and Password of admin or user. | M |
| 10. | If admin or user forgot password, user has to key in email address to recover username or password | O |
| 11. | The system will display main page. | M |
| 12. | Manage QPI              |          |
| 13. | Admin can add, update or delete QPI. | O |
| 14. | Add QPI                 |          |
| 15. | Admin can click on “Add QPI” link. | O |
| 16. | The system will display a form to add QPI. | O |
| 17. | Admin must fill in the QPI info which are:
<p>|     | a) Tajuk                |          |
|     | b) Surah                |          |
|     | c) No. Ayat             |          |
|     | d) Ayat                 |          |
|     | e) Tema                 |          |
|     | f) Maksud Tersurat      |          |
|     | g) Maksud Tersirat      |          |
|     | h) Perkaitan Ayatselamnya |          |
|     | i) Tafsiran Ulama       |          |
|     | j) Pengajaran           |          |
|     | k) Bilangan Pecahan Ayat |          |</p>
<table>
<thead>
<tr>
<th></th>
<th>Description</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>18.</td>
<td>Admin can click on the “Add QPI” button.</td>
<td>O</td>
</tr>
<tr>
<td>19.</td>
<td>The system will add the QPI into the database</td>
<td>M</td>
</tr>
<tr>
<td>20.</td>
<td><strong>Update QPI</strong></td>
<td>O</td>
</tr>
<tr>
<td>21.</td>
<td>Admin can click on “Update QPI” link.</td>
<td>O</td>
</tr>
<tr>
<td>22.</td>
<td>The system will display list of available QPI to be selected.</td>
<td>O</td>
</tr>
<tr>
<td>23.</td>
<td>Admin click on the desired QPI and a form will be displayed.</td>
<td>O</td>
</tr>
<tr>
<td>24.</td>
<td>Admin must update the QPI field which are: a) Tajuk b) Surah c) No. Ayat d) Ayat e) Tema f) Maksud Tersurat g) Maksud Tersirat h) Perkaitan Ayat Sebelumnya i) Tafsiran Ulama j) Pengajaran k) Bilangan Pecahan Ayat</td>
<td>M</td>
</tr>
<tr>
<td>25.</td>
<td>Admin can click on the “Update” button.</td>
<td>O</td>
</tr>
<tr>
<td>26.</td>
<td>The system will update the QPI in the database</td>
<td>M</td>
</tr>
<tr>
<td>27.</td>
<td><strong>Delete QPI</strong></td>
<td>O</td>
</tr>
<tr>
<td>28.</td>
<td>Admin can click on “Delete QPI” link.</td>
<td>O</td>
</tr>
<tr>
<td>29.</td>
<td>The system will display list of available QPI to be selected.</td>
<td>O</td>
</tr>
<tr>
<td>30.</td>
<td>Admin click on the selected QPI to be deleted.</td>
<td>O</td>
</tr>
<tr>
<td>31.</td>
<td>QPI will be deleted from database.</td>
<td>M</td>
</tr>
<tr>
<td>32.</td>
<td><strong>Manage Quiz Question</strong></td>
<td>O</td>
</tr>
<tr>
<td>33.</td>
<td>Admin can add, update or delete quiz question.</td>
<td>O</td>
</tr>
<tr>
<td>34.</td>
<td><strong>Add quiz question</strong></td>
<td>O</td>
</tr>
<tr>
<td>35.</td>
<td>Admin can click on “Add Quiz Question” link.</td>
<td>O</td>
</tr>
<tr>
<td>36.</td>
<td>The system will display a list to add question.</td>
<td>O</td>
</tr>
<tr>
<td>37.</td>
<td>Admin can fill in the question details which are: a) Soalan b) Jawapan Pengguna c) Jawapan Betul</td>
<td>M</td>
</tr>
<tr>
<td>38.</td>
<td>Admin can click on “Add” button.</td>
<td>O</td>
</tr>
<tr>
<td>39.</td>
<td>The system will add the question into the database</td>
<td>M</td>
</tr>
<tr>
<td>40.</td>
<td><strong>Update quiz question</strong></td>
<td>O</td>
</tr>
<tr>
<td>41.</td>
<td>Admin click on the “Update Quiz Question” link.</td>
<td>O</td>
</tr>
<tr>
<td>42.</td>
<td>The system will display available quiz question.</td>
<td>M</td>
</tr>
<tr>
<td>43.</td>
<td>Admin click on the question and a form will be displayed.</td>
<td>O</td>
</tr>
<tr>
<td>44.</td>
<td>Admin can update the question fields which are: a) Soalan b) Jawapan Pengguna c) Jawapan Betul</td>
<td>M</td>
</tr>
<tr>
<td>45.</td>
<td>Admin can click on the “Update” button.</td>
<td>O</td>
</tr>
<tr>
<td>46.</td>
<td>The system will update the question in the database.</td>
<td>M</td>
</tr>
<tr>
<td>47.</td>
<td><strong>Delete quiz question</strong></td>
<td>O</td>
</tr>
<tr>
<td>48.</td>
<td>Admin can click on “Delete Quiz Question” link.</td>
<td>O</td>
</tr>
<tr>
<td>49.</td>
<td>The system will display list of available question to be selected.</td>
<td>O</td>
</tr>
<tr>
<td>50.</td>
<td>Admin click on the selected question to be deleted.</td>
<td>O</td>
</tr>
<tr>
<td>51.</td>
<td>Question will be deleted from database.</td>
<td>M</td>
</tr>
<tr>
<td>52.</td>
<td><strong>View Report</strong></td>
<td>O</td>
</tr>
<tr>
<td>53.</td>
<td>Admin can view monthly or weekly report of quiz answered by users and their marks by clicking on the “View Report” link.</td>
<td>O</td>
</tr>
<tr>
<td>54.</td>
<td>Admin click on the view “monthly report” or “weekly report” link.</td>
<td>O</td>
</tr>
<tr>
<td>55.</td>
<td>The system will display the report based on the selected report type.</td>
<td>M</td>
</tr>
<tr>
<td>56.</td>
<td>Admin click on the print button.</td>
<td>O</td>
</tr>
<tr>
<td>57.</td>
<td>Admin can select monthly or weekly report to be printed.</td>
<td>O</td>
</tr>
<tr>
<td>58.</td>
<td>The report will be printed.</td>
<td>O</td>
</tr>
<tr>
<td>59.</td>
<td><strong>Search Quranic Parables Information</strong></td>
<td>O</td>
</tr>
<tr>
<td>60.</td>
<td>User can search Quranic parables.</td>
<td>O</td>
</tr>
<tr>
<td>61.</td>
<td>User can fill the search text field and press “search” button.</td>
<td>O</td>
</tr>
<tr>
<td>62.</td>
<td>The system will display QPI based on the searched keyword.</td>
<td>O</td>
</tr>
<tr>
<td>63.</td>
<td>User can click on the desirable QPI.</td>
<td>O</td>
</tr>
<tr>
<td>64.</td>
<td>QPI must be viewed.</td>
<td>M</td>
</tr>
<tr>
<td>65.</td>
<td>User can print Quranic parables.</td>
<td>O</td>
</tr>
<tr>
<td>66.</td>
<td>User click “print” button.</td>
<td>O</td>
</tr>
<tr>
<td>67.</td>
<td>The QPI will be printed.</td>
<td>O</td>
</tr>
<tr>
<td>68.</td>
<td><strong>Answer Quizzes</strong></td>
<td>O</td>
</tr>
<tr>
<td>69.</td>
<td>User can answer the quizzes.</td>
<td>O</td>
</tr>
<tr>
<td>70.</td>
<td>User can click on “Answer Quiz” link.</td>
<td>O</td>
</tr>
<tr>
<td>71.</td>
<td>The system will display list of quiz questions.</td>
<td>O</td>
</tr>
<tr>
<td>72.</td>
<td>User can answer the quiz.</td>
<td>M</td>
</tr>
<tr>
<td>73.</td>
<td>User can click “Submit” button when finish.</td>
<td>O</td>
</tr>
<tr>
<td>74.</td>
<td>User can view their marks and quiz answers.</td>
<td>O</td>
</tr>
</tbody>
</table>

*Priority: M– Mandatory, O– Optional, D– Desirable*
The next process is visualizing and modelling the requirements of the web application using UML. The models used in this work are use case and class diagram, which are drawn using StarUML. Figure 2 illustrates the use case diagram and the communications between the use cases and the actors for QPIS.

![Use Case Diagram](image1)

**Figure 1. The Use Case Diagram of Quranic Parables Information System**

There are seven major use cases which are Search Quranic parables information, Answer quiz, Register, Login, Manage Quranic parables information, Manage quiz questions, and View report. These use cases are implemented by two actors which are user and admin. The use case of manage QPI allows admin to perform subfunctions including Add QPI, Delete QPI and Update QPI. The Manage quiz question use case allows admin to perform subfunctions which are Add question, Delete question, and Update question. Meanwhile for View report use case, admin can perform subfunctions which includes View monthly report, and View weekly report. Figure 3 exemplifies the structural components of QPIS as the class diagram.

![Class Diagram](image2)

**Figure 3. The Class Diagram for QPIS**

### QPIS PROTOTYPE DEVELOPMENT

A prototype of a web application for providing detailed interpretation about Quranic parables was developed. Figures 4, 5 and 6 show the selected interfaces of QPIS which comprise of the QPIS homepage, users’ view and admin’s view.

![Home Page](image3)

**Figure 4. The QPIS Home Page.**
EVALUATION OF QPIS

The QPIS was evaluated by 33 respondents who were the potential users of this system, from both perspectives: user and admin. To perform the evaluation, respondents were provided with the links of the system and an online post-task questionnaire form. They completed the following step-by-step procedure: (1) read and signed a consent form, (2) interacted with QPIS as stated in the experiment procedure, and (3) answered the post-task questionnaire. The post task questionnaire was adapted from Lund (2001) which consist of 20 items in four sections. Section A asked about the respondents’ demographic information while Section B asked the respondents’ opinion on the usefulness of QPI System. Section C and D were about the ease of use and satisfaction on QPIS respectively. The scale used for these questions is five-point Likert scale which ranges from strongly disagree as one, and strongly agree as five (Sekaran & Bougie, 2016). At the end of the survey, an open-ended question was also provided to get the general comment about QPIS. The next sub sections provide the result of the post-task questionnaire.

A. The Respondents Demographic Information

Analysis on the respondents’ demographic information as demonstrated in Table 2 shows that majority of the respondents are students (63.6%), followed by civilian (18.2%). Moreover, 12.1% are lecturer while the rest (6.1%) are elderly. In the same sense, the data indicates that most of the respondents are female (60.6%) while 39.4% are male. Meanwhile, most of the respondents are from the age in the range of 21-30 (63.6%), followed by the range between 51-65 (15.2%). The rest are 12.1%, 6.1% and 3.0% for below 21, 41-50 and above 65, respectively. There is no respondent at the age of 31-40.

<table>
<thead>
<tr>
<th>Description</th>
<th>Category</th>
<th>No. of Respondents</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Role</td>
<td>Student</td>
<td>21</td>
<td>63.6</td>
</tr>
<tr>
<td></td>
<td>Lecturer</td>
<td>4</td>
<td>12.1</td>
</tr>
<tr>
<td></td>
<td>Civilian</td>
<td>6</td>
<td>18.2</td>
</tr>
<tr>
<td></td>
<td>Elderly</td>
<td>2</td>
<td>6.1</td>
</tr>
<tr>
<td>Gender</td>
<td>Male</td>
<td>13</td>
<td>39.4</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>20</td>
<td>60.6</td>
</tr>
<tr>
<td>Age Group</td>
<td>Below 21</td>
<td>4</td>
<td>12.1</td>
</tr>
<tr>
<td></td>
<td>21-30</td>
<td>21</td>
<td>63.6</td>
</tr>
<tr>
<td></td>
<td>31-40</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>41-50</td>
<td>2</td>
<td>6.1</td>
</tr>
<tr>
<td></td>
<td>51-65</td>
<td>5</td>
<td>15.2</td>
</tr>
<tr>
<td></td>
<td>Above 65</td>
<td>1</td>
<td>3.0</td>
</tr>
</tbody>
</table>

B. The Usability of QPIS

QPIS was evaluated based on the usability test which comprises of the satisfaction, ease of use and usefulness of QPIS through the post-task questionnaire. Tables 3, 4, and 5 report the frequency and percentage of the responses. Majority of the respondents rated four or five for the three aspects of the usability. Only some respondents who rated two.
The outcomes of the evaluation suggested that QPIS is useful and easy to use. Further, the respondents reported that they are satisfied with the feature of the system that provides them with understandable and meaningful interpretation of Quranic parables. In terms of the user interface, the respondents reported that QPIS is easy to use without the need for written instruction and they can easily remember the navigation of QPIS. Furthermore, the respondents are satisfied with the appearance of the system which is suitable for Islamic content website and pleasing to the eyes. The respondents also suggested that QPIS
can be enhanced by providing the English version to make it understandable worldwide. Besides, one of the respondents suggested to use coherent technique in understanding the al-Quran content, which can be included as future work. Most importantly, the respondents feel that this system is beneficial in providing understanding of al-Quran content through the parables and can be a starting point to encourage the youngsters in understanding al-Quran and apply it in their daily lives.

VII CONCLUSION AND FUTURE WORKS

This paper described the design and development of a web-based application that provides detailed interpretation of Quranic parables. Findings from the evaluation has revealed that the respondents are engaged with QPIS. Users are very satisfied with the interface as well as the functionality of the application. Users also praised QPIS for being a platform which enables users especially the young generations to seek for detailed explanation and interpretation on Quranic parables. It is hoped that with the existence of this system, the affection towards Quran can be enhanced especially among Muslim young generations. Moreover, the collected knowledge can be used, enriched, shared, assessed, and sustained through the use of this system. For future work, the parables can be represented as a mobile application and focus on attracting children’s attention on the Quranic parables as it will be a good exposure to them since they are small. To add more, the Quranic parables can be enhanced by including gamification in the near future to make the system more attractive.

REFERENCES


WasteBOT: Conceptual Design of Smart Bin and Web Service for IoT Waste Management System

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ABSTRACT
A green and clean environment has become one of the most concerning issues in our society, especially when environmental pollution cases are on the rise. Everyone wants to live in a clean environment to minimize the risk of getting any diseases because of the dirty environment. The initiative to have a better living environment for our future has to start within our community. Therefore, this paper introduces an Internet of Things (IoT) Waste Management System, WasteBOT with two easily attachable and detachable embedded sensing modules and a web service platform. The embedded sensing modules able to turn any wastebin into a smart wastebin with sensing capabilities to collect the bin status such as waste level and environmental data such as temperature. The conceptual hardware design of the embedded sensing modules is presented with a real prototype using microcontrollers and different sensors. The collected data will be upload to the server using Wi-Fi. The web service platform processes the collected data and provides monitoring and navigation services to different categories of users such as waste management companies and normal users. The WasteBOT system with the embedded sensing modules will help everyone to easily join in the effort to keep a clean environment in the society without the need to replace a conventional wastebin with a brand-new smart bin.

Keywords: internet of things, waste management, smart bin, embedded system, web service.

1 INTRODUCTION
The waste management system is very important as it helps to create a healthy and clean environment. Malaysia’s government implements the Reuse, Reduce, and Recycle (3R) campaign to manage waste many years ago (“Enforce Reduce, Reuse and Recycle Campaign,” 2014). However, the existing system is lacking behind as the technology advanced. Common issues such as rubbish overflowing or wastebin vandalism still require manual reporting to get attention from the authorities for further action. The lack of information on the wastebin location also incurs inconveniences to the public. (Abdulla, Salkh, & Ismael, 2017; Zaipul & Ahmad, 2017). Many foreign countries have been using technologies in the Internet of Things (IoT) paradigm to improve their waste management system. Recently, some research efforts have been done in Malaysia in the interest of leveraging IoT technology in creating a better environment for sustainability. For example, Shamshiri, Gan, Baharin, & Azman (2019) introduced the electricity monitoring system using IoT-enabled devices, and Singh, Lim, & Manaf (2019) presented SAHOMASI that allow house appliances to communicate using a standardized protocol to provide a better home environment for the elderly. In terms of waste management, Kang, Kang, Ilankoon, & Chong (2020) proposed a reinvented smart e-waste collection box for household electronic waste with an Arduino board and ultrasonic sensor.

University Sains Malaysia (USM) practices sustainability policy aligns with the Sustainable Development Goals to create a healthy, clean, and green campus environment (Ilham, Zaihan, Hakimi, Ibrahim, & Shahrul, 2020). USM applies the 3R policies within the campus and promotes the idea to the neighboring communities (Norizan & Ridzlie, 2011). However, the current waste management system in the campus is lacking behind due to its inefficiency, and it is not environmentally friendly and user-friendly. The wastes on the campus are not being managed systematically whereas people on the campus face difficulties in finding available wastebin due to the lack of information on the wastebins location. Furthermore, the waste collector only collects waste at a certain schedule but some wastebin got overflows in a shorter timeframe. The motivation behind the idea to incorporate IoT into the conventional waste management system using IoT was conceived after a careful investigation of the existing systems and their problems. It is important to have a system that can manage the waste with minimal human intervention and keep track of the wastebins’ status on the campus. Waste and environmental data will be collected to provide services for respective users. Thus, a sustainable campus towards a greener and cleaner environment can be created.
The paper presents an IoT waste management system, WasteBOT with easily attachable and detachable embedded sensing modules and a web service platform to create a better, green and healthy environment, not only on the campus but also applicable to the community. The outline of the paper is as the following. Section II briefly describes the existing related works applying IoT in the waste management system, while section III depicts the methodology of the WasteBOT system. The details on the hardware design of the embedded sensing modules are presented in Section IV and section V describes the software design for the sensing program and web service platform. The paper is concluded in section VI.

II RELATED WORK

A. Waste Management in Malaysia
The waste generated by Malaysians had become a great issue as it increased over the years. The deputy chief executive officer of Solid Waste Management and Public Cleansing Corporation (SWCorp), Dr. Mohd Pauze Mohamad Taha reported that the waste generated by Malaysians in 2018 was 38,142 tons per day and it had increased enormously compared to 2005 which was 19,000 tons per day. He added that 44.5% of the waste was food waste, 13.2% of it was plastic waste and the remaining were diapers made up 12.1%. According to Dr. Mohd Pauze, the recycling rate of waste was not satisfied as it was only 28%, they hope that in 2020 the rate will increase to 30% (Mei Mei, 2019). Although Malaysia practiced the 3Rs policy, the waste management system in Malaysia is still left behind compared to other modern countries. Malaysia does not have enough facilities and technologies to manage waste systematically. As a result, there was a lot of decomposed and non-decomposed waste such as plastic, glass, and aluminum were not managed properly and overloaded. These non-decomposed wastes can be harmful to the public and the environment without proper management as they are hazardous.

B. Waste Management and IoT
There is plenty of research on waste management in the literature. Most of them were focusing on manual waste collection, distribution, and recycling. Recently, people started to use technology in waste monitoring and collection. Table 1 shows some of the existing systems or research that incorporate IoT into waste management systems. The table focuses on the sensors and microcontrollers used in their system, and also the strengths and weakness of each existing system.

III METHODOLOGY

Table 1. Comparison of Existing Solutions.

<table>
<thead>
<tr>
<th>Reference</th>
<th>Microcontroller/Sensor</th>
<th>Strength</th>
<th>Weakness</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Rupa, Kumari, Bhagchandani, &amp; Mathur, 2018)</td>
<td>ATMega 16/Ultrasonic sensor/SIM800 (GPRS/GSM) module</td>
<td>It helps improve the quality of the environment and is a step towards fulfilling the goal of a government initiative for environmental cleanliness.</td>
<td>Other users cannot use the system as it is built for the employees of Municipal Corporation (higher authority) but can be implemented for other users.</td>
</tr>
<tr>
<td>(Gutierrez, Jensen, Henius, &amp; Riaz, 2015)</td>
<td>Arduino Uno/ Ultrasonic sensor/CC3000 WiFi module</td>
<td>The author presented the concept of using location intelligence to manage waste with simulation experiments.</td>
<td>It lacks actual implementation of the forecasting capability and the server only serves as a data sink from the bin.</td>
</tr>
</tbody>
</table>
The WasteBOT system is mainly comprised of the conceptual design of embedded sensing modules in the wastebin and the web service that make use of the collected sensor data to generate useful output. Figure 1 shows the system architecture of the WasteBOT system. The wastebins equipped with WasteBOT hardware modules collect the status (e.g., the level and weight of waste) and environmental condition (e.g., temperature and humidity). The collected data are sent to the server over the air through WiFi. The authorities will be able to monitor the status of wastebin in real-time through the monitoring dashboard provided by the web service and trigger necessary action to notify the waste collection company to send collection trucks for waste collection. Furthermore, the web service enables mobile application users to locate the available wastebin nearby and navigate to the designated destination. The details of hardware design on the embedded sensing modules and software design on the web service are presented in sections IV and V respectively.

IV HARDWARE DESIGN

The conceptual hardware design of the WasteBOT system is comprised of two embedded sensing modules as shown in Figure 2. Each module is a hardware bundle embedded with a microcontroller and a few different sensors so that they can be installed easily on the top and bottom of the bin.

A. Embedded Sensing Modules (Top)

The first module is to be placed at the top of the bin facing down (e.g., underneath the lid) with the following sensors and their respective functionalities:

**Ultrasonic sensor.** The ultrasonic sensors are to detect the presence of waste by measuring the distance using ultrasonic waves. The distance between the ultrasonic sensor and the waste surface is measured to determine the availability of the bin (Fadel, 2017; Zhmud, Kondratiev, Kuznetsov, Trubin, & Dimitrov, 2018). The status of the bin will be marked as full in the web service when the measured distance is below a certain threshold such as 3 cm.

**Temperature and humidity sensor.** This sensor is to detect the environmental condition inside the wastebin and trigger an emergency notification if the temperature is higher than a certain threshold or the humidity is lower than a certain threshold. For example, a burning cigarette butt might cause a fire inside the bin and remedial can be taken in the shortest possible time frame.

**PIR sensor.** The PIR sensor is to detect the usage of wastebin whenever the wastebin’s flip-door or lid is opened. The usage information is also useful for the authorities to assess the usability of the wastebin and perform bin relocation if necessary.

**OV2640 camera.** The camera module is to capture the image of the most recent waste and upload it to the server. Further processing can be done on the image such as waste object identification and trash classification, but it is not in the scope of the paper.
The hardware prototype of the top embedded sensing module is shown in Figure 3 and Figure 4 illustrate the operation and workflow of the top module. The microcontroller is configured to enter deep sleep mode after all required actions upon every rubbish throwing event to conserve energy because the module is expected to be battery operated and long-lasting. Whenever the flip-door or lid cover is opened, the sensor detects the motion and sends a wake-up signal to the microcontroller. The microcontroller starts to measure trash level, temperature, and humidity, followed by camera module activation to capture the most recent trash in the wastebin. Next, the microcontroller connects to Wi-Fi and upload the data and image captured to the server for further action in the web service platform. The microcontroller will enter deep sleep mode again after completing the necessary action and wait for another occurrence of rubbish throwing event.

**Vibration Sensor.** The vibration sensor is to detect wastebin usage through vibration when the user opens the flip-door or lid cover. Besides that, continuous vibration could indicate that the bin is under vandalism when the bin is not upright as detected by the tilt sensor.

The hardware prototype of the bottom embedded sensing module is shown in Figure 5 and Figure 6 illustrates the operation and workflow of the bottom module. The microcontroller with deep sleep mode enabled will be wakened up once vibration is detected by the vibration sensor upon a rubbish throwing event. The module first detects if there is any continuous vibration that could result from ongoing vandalism and triggers to send a notification to the authorities. When no continuous vibration is detected, it further checks if the wastebin is upright and sends a notification when the bin is fallen. When everything is normal, it will start weight measurement and retrieves GPS coordinate in latitude and longitude pairs. All the data will be uploaded to the server for further action in the web service platform.

### B. Embedded Sensing Modules (Bottom)

The second module is placed at the bottom of the bin facing up with the following sensors and their respective functionalities:

- **Load cell.** The load cell with HX711 analog-to-digital converter (ADC) is to measure the weight of waste that currently residing in the bin. It is important to monitor the weight of trash inside the bin especially the recycling bin for metal and glass because overweight wastebin might cause injury to waste collectors when they are clearing the bin.

- **GPS Module.** The GPS module is to obtain the current latitude and longitude coordinates of the bin and keep track of the wastebin location.

- **Tilt Sensor.** The tilt sensor is to detect if the wastebin remains upright. For example, a fallen wastebin required immediate attention to avoid wild animals searching for food and mess up the surrounding.
V SOFTWARE DESIGN

The conceptual software design for the WasteBOT system consists of the program to run the sensing modules and the web services for monitoring and navigation.

A. Programming Sensing Modules

The microcontrollers are programmed using Arduino programming with a wide variety of ready-to-use libraries. The program for the sensing modules, namely Arduino sketch, is uploaded to the microcontrollers to perform their respective sensing functions. The microcontrollers collect the sensor data and pre-process them to become the input for the web service. For example, the ultrasonic sensor measures the distance to the trash surface and outputs analog signals to the analog input of the microcontroller. The microcontrollers have to convert the raw value into human understandable numbers such as centimeters. However, the actual distance is not critical to the web service since the user only needs to know which waste bin is available. Therefore, only one of the states (i.e., full or available) is sent to the server to determine the respective wastebin availability. Figure 7 shows an example of the debugging output of the Arduino sketch when running on the top embedded sensing module.

B. Web Service

The WasteBOT system also provides different web services such as wastebin monitoring and navigation. The provided services are accessible by different categories of the user such as waste collection company employees and normal users according to their privilege level.

Figure 8 shows the monitoring dashboard of the WasteBOT system. The authorities can monitor the status of wastebins deployed over a certain map area and check their condition in real-time with the dashboard. Based on the data and information collected from the wastebins, the waste collection company can schedule an optimized route to send out a collection truck and make wastebin reallocation decisions when a wastebin is not fully utilized.
Management that requires a lot of manpower. The common users can use the web service to help them bins in real-time through the dashboard while the users. Authorities will be able to monitor the status of upload to the server and provide web service to the environmental condition. The collected data will be overall cleanliness of the surrounding environment. Overflowing of rubbish in hotspot and improve the navigate to the nearest available waste to prevent unsystematic waste management system in the chosen wastebin.

The WasteBot system was proposed to address the university campus which improves the current 3R now able to collect information on the waste and its to turn them into a smart bin. The existing bin will be easily attached to the existing wastebin that they are easily attached to the existing wastebin to turn them into a smart bin. The existing bin will be now able to collect information on the waste and its environmental condition. The collected data will be upload to the server and provide web service to the users. Authorities will be able to monitor the status of bins in real-time through the dashboard while the common users can use the web service to help them navigate to the nearest available waste to prevent overflowing of rubbish in hotspot and improve the overall cleanliness of the surrounding environment. A healthy, clean, and green environment with the WasteBOT system is the head start to sustainable development not only on the university campus but also can be in our community and society with the emerging LoRa and 5G wireless technologies.

VI CONCLUSION

The WasteBot system was proposed to address the unsystematic waste management system in the university campus which improves the current 3R management that requires a lot of manpower. The embedded sensing modules are designed in a way that they are easily attached to the existing wastebin to turn them into a smart bin. The existing bin will be now able to collect information on the waste and its environmental condition. The collected data will be upload to the server and provide web service to the users. Authorities will be able to monitor the status of bins in real-time through the dashboard while the common users can use the web service to help them navigate to the nearest available waste to prevent overflowing of rubbish in hotspot and improve the overall cleanliness of the surrounding environment. A healthy, clean, and green environment with the WasteBOT system is the head start to sustainable development not only on the university campus but also can be in our community and society with the emerging LoRa and 5G wireless technologies.

ACKNOWLEDGMENT

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REFERENCES


System Dynamics Model for Financial Management among University Students

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ABSTRACT
Financial management defined as behaviour and perceptions about how financial is managed. Lack of sufficient knowledge on financial management will produce low savings, no budgeting, and failure to service debts on time and make impulsive buys. Low financial knowledge strongly resulted to higher level of debts. It is an urgency for Malaysians to improve their financial knowledge to improve their spending and investment habits especially among young adults. However, good practice of personal finances among students in Malaysia are still low whereby university students are found to have difficulties in managing their financial source. Therefore, the aim of this study is to assess university students’ financial management skills. This study determines factors that influence the financial situation and examine consequences of financial situation for university students. Data were collected among university students and system dynamics model was developed using Vensim Software. The results revealed factors that associated with financial situation are financial knowledge and financial skills. The model indicated that the impact on increasing the number of people that fails to manage future need caused by financial knowledge factor, will cause a decline in the number of people that are aware about their financial management, and vice versa.

Keywords: Financial management, financial knowledge, system dynamics.

I INTRODUCTION
Financial management is mostly involves in managing cash flow and liability. Although important, this aspect of life is still under exposed among individual. Malaysia National Strategy for Financial Literacy 2019-2023 currently highlighted that 1 in 10 Malaysians believe that they are not disciplined in managing their finances, with 1 in 5 Malaysian working adults did not save in the previous six months (Financial Education Network, 2019). Based on the dire current condition, it also important to expose students especially in the tertiary education with sufficient knowledge on financial management as they will enter the working environment in the next phase of their life.

II LITERATURE REVIEW
Leskenen and Rajias (2006) identified demographic features (age, gender, education, values, attitudes, or habits), life phase and immediate surroundings (family and socialization), and macro environment (society, economic and cultural background) as key factors in acquiring financial skill. By assessing students’ financial management skills, policy makers such as the university management can understand better on their current financial practices. Policy makers are also able to offer structured programs and better strategies for them (Falahati et al., 2011). Borden et al., (2008) believed that educational financial programs can be utilized to improve this knowledge and skills. Such programs can be in a form of seminars, workshops.
and printed brochures. It is important to assess the financial management skills of university students in the early years. Sound financial management skills among students will assist in reducing the number of cases of bankruptcy among young people in Malaysia, thus will improve domestic economy and the growth of economy in the future.

As understanding financial management among students deals with complex and dynamics interrelation between its contributing factors, system dynamics is deemed suitable to be utilized to illustrate better the overall system under study. Its cause-effect relationships accompanied by underlying mathematics and logic, time delays, and feedback loops can capture the underlying dynamics within this system. Work by Campbell (2014) utilized a simulation model as platform for self-directed financial economics learning for students, where macro and microeconomics are considered interchangeably in project financing decision making.

The use of system dynamics in financial environment started slowly, where Srijaririya, Riewpaiboon & Chaikiledkaew (2008) used system dynamics to construct, validate, and simulate a system dynamics financial model. They showed that this model can be useful tool for financial management, although difficult to construct. The argued that though difficult, it is more accurate in prediction, and able to provide larger and complex real world situations analysis compared to conventional method. To note, Nair (2013) begin incorporating simulation works with system dynamics modelling by considering dynamics variables such as net cash flow, gross income, net income, pending bills, receivable bills, debt, and book value to provide more accurate assessment of financial situation in a company. More recent, Vries and Egmond (2017) adopted system dynamics model that explored the creation of debts free money as an alternative to the current debts system. In the following sections, system dynamics approach will be utilized to investigate the complexity of interaction between financial management among university students with their underlying factors.

III METHODOLOGY
This study used system dynamics modelling as the method to illustrate the financial management among university students. A system dynamics model is based upon nonlinear dynamics and feedback control among variables. The causality relationship in system dynamics is useful in many areas of studies such as in housing area (Hashim et al., 2018), healthcare (Halim, Sapiri & Abidin, 2019) and food science (Rahim & Abidin, 2018), to name a few.

To date, the issue of financial management in Malaysia needs to be catered urgently, university students included. Lower understanding in financial knowledge can pose risk of negative financial consequences. Figure 1 shows the impacts of lack of financial knowledge based on study from Leach, Hayhoe, and Turner, 1999. Hilgert, Hogarth, and Beverly (2003) further established significant relationships between financial knowledge and cash flow management, credit management, stress levels, savings, and investment. While Norvilitis et al., (2006) also agreed that low level of financial knowledge was strongly correlated to higher debts acquisitions. The listed impacts of financial knowledge in Figure 1 will be used as a guideline to further describe the factors that involved in assessing the university students' financial management skills.

Figure 1. The Impacts Associated with Financial Knowledge.

A. Formulation of the Model
Model formulation refers to the construction of a model by using system dynamics software (Vensim) with accompanied equation as underlying fundamental. Table 1 briefly presents the elements, symbol, and description of system dynamics model.

<table>
<thead>
<tr>
<th>Elements</th>
<th>Description</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stock</td>
<td>Known as levels, it acts as a reservoir to accumulate quantities and describe the condition of the system</td>
<td><img src="stock.png" alt="Stock" /></td>
</tr>
<tr>
<td>Flow</td>
<td>Flows function to increase (inflow) and decrease (outflow) the value of stock</td>
<td><img src="flow.png" alt="Flow" /></td>
</tr>
<tr>
<td>Connector</td>
<td>The connector represents the cause and effect link within the model structure</td>
<td><img src="connector.png" alt="Connector" /></td>
</tr>
<tr>
<td>Auxiliary</td>
<td>A link from one variable to another</td>
<td><img src="auxiliary.png" alt="Auxiliary" /></td>
</tr>
</tbody>
</table>
This diagram is the basic building blocks in a system dynamics model. Stocks represent accumulation of quantities that capture the state of a system, while flows consider accumulated quantity over a period of time. Figure 2 is an example of a stock and flow diagram in system dynamics model.

Figure 2. Stock and Flow Diagram.

B. Stock and Flow Diagram

Figure 3 shows the model of stock and flow diagram of financial management for university students.

Figure 3. Stock Flow Diagram of Financial Management for University Students.

The stock and flow diagram in system dynamics model was developed based on findings of factor analysis in Che Mohd Khalid & Sapiri, 2019. Figure 3 summarizes the diagramming notations in the stock and flow model. Note that stocks representing factors of financial management i.e., financial knowledge and financial skills. The inflow are the future needs, time management, career planning, interaction skills, problem solving and use of loan. The auxiliaries are credit/debts, stress management, purpose of loan, manage daily, saving and decision making are used to compute the rate of every inflow item. The stock accumulates the effect of the flows and will remain unchanged if there are no flows to increase and decrease the current level of stock.

The stock and flow model in Figure 3 described when the number of people fail to manage credit/debts increase, it will decrease the future needs cause by financial knowledge factor. Alternatively, when the number of people fail to manage credit/debts will decrease, it will increase the future needs cause by financial knowledge factor. Besides, the increment of people understands the purpose of loan, it will also increase career planning in a certain period and manage to handle stress effectively.

On the other hand, when the number of people know on how to use of loan increase, it will increase the number of people can manage daily expenses and will increase the saving, caused by financial skills factor. In addition, when the number of people can make good decision increase, it will increase the number of problems that can be solved. Furthermore, when the number of problems that can be solved increase, it will also increase the interaction skills. Therefore, when the number of people have good financial knowledge and skills increase, it will increase the number of people aware about financial management.

IV ANALYSIS

Next, two validation tests are conducted which are behaviour reproduction test and policy evaluation test. For behaviour validation test, Ahmad et al., (2019) highlighted the aim is to develop confidence that the behaviour of the developed model can mimics real world behaviour. While policy evaluation test is conducted to seek for model improvement.

A. Validation of the Model

Validation of the system dynamics model involves behaviour reproduction test. In this test, the behaviour generated from simulated model should not diverge far away from the selected historical data. However, having the model that fit historical data does not mean that the model necessarily corrects in some case. Rather, it means that the model cannot be rejected (Sapiri et al., 2017).

Figure 4 and Table 2 are the baseline findings which are the outputs generated from the behaviour test of the system dynamics model.

Figure 4. Behaviour of Financial Management Awareness among University Students.
### Table 2. Result for Baseline Scenario.

<table>
<thead>
<tr>
<th>Month</th>
<th>Baseline Scenario</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>13</td>
</tr>
<tr>
<td>2</td>
<td>919</td>
</tr>
<tr>
<td>3</td>
<td>1823</td>
</tr>
<tr>
<td>4</td>
<td>2732</td>
</tr>
<tr>
<td>5</td>
<td>3638</td>
</tr>
<tr>
<td>6</td>
<td>4544</td>
</tr>
<tr>
<td>7</td>
<td>5450</td>
</tr>
<tr>
<td>8</td>
<td>6357</td>
</tr>
<tr>
<td>9</td>
<td>7263</td>
</tr>
<tr>
<td>10</td>
<td>8169</td>
</tr>
<tr>
<td>11</td>
<td>9076</td>
</tr>
<tr>
<td>12</td>
<td>9982</td>
</tr>
</tbody>
</table>

Each equation dimensionally is consistent without the use of a parameter having no real-world counterparts. And for the result, if the inputs change to extreme values, each equation will make sense. Figure 4 and Table 2 show the number of people that are aware of their financial management within 12 months are increasing. Based on the results, most of the respondents were able to understand the financial knowledge and skills that will be applied to the financial management behaviour in daily life.

### B. Intervention Scenarios

Once the established model passes through validation test, model evaluation is conducted to seek for model improvement through policy evaluation. The choice of policy evaluation depends on the purpose of the model. Several tools are available to conduct policy testing analysis, two most common are worst case scenario and optimisation approach (Sterman, 2000). In the worst scenario approach, changes are made in parameter values considering worst case scenario. On the other hand, policy optimisation requires setting the objective function such as maximises and minimises the parameter.

This study conducted intervention scenarios by changing several parameters in the model for policy evaluation. This intervention has been simulated in the same model to see the difference of behaviour between current (baseline scenario) and intervention scenario that has been conducted. Two scenarios are considered. In Scenario 1, parameter of variable use of loan was changed. The purpose of choosing variable use of loan is because most of the respondents depend on their education loans. When the parameter use of loan was changed to small value (meaning the decrement number of respondents that know on how to use the loan), then it will cause the decrement of people that are aware about financial management as shown in Figure 5 and Table 3.

#### Figure 5. Result of Intervention for Scenario 1.

### Table 3. Result of Financial Management of Scenario 1.

<table>
<thead>
<tr>
<th>Month</th>
<th>Baseline Scenario</th>
<th>Intervention Scenario</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>13</td>
<td>12</td>
</tr>
<tr>
<td>2</td>
<td>919</td>
<td>503</td>
</tr>
<tr>
<td>3</td>
<td>1823</td>
<td>994</td>
</tr>
<tr>
<td>4</td>
<td>2732</td>
<td>1485</td>
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<tr>
<td>5</td>
<td>3638</td>
<td>1975</td>
</tr>
<tr>
<td>6</td>
<td>4544</td>
<td>2466</td>
</tr>
<tr>
<td>7</td>
<td>5450</td>
<td>2957</td>
</tr>
<tr>
<td>8</td>
<td>6357</td>
<td>3448</td>
</tr>
<tr>
<td>9</td>
<td>7263</td>
<td>3939</td>
</tr>
<tr>
<td>10</td>
<td>8169</td>
<td>4429</td>
</tr>
<tr>
<td>11</td>
<td>9076</td>
<td>4919</td>
</tr>
<tr>
<td>12</td>
<td>9982</td>
<td>5410</td>
</tr>
</tbody>
</table>

Majority of respondents are the recipients of education loans. Therefore, when they fail to manage their loans well, it will affect their financial situation. As respondents age increase, they will probably have more money under their control and become more mature and responsible about their personal spending. Student should know to differentiate between need and desire, to make sure that financial support is sufficient throughout their study duration. Need must come first before desire. Poor financial situations (Andrews & Wilding, 2004) and compulsive buying...
(Brougham et al., 2011) contribute significantly to depression levels.

Next, in Scenario 2, parameter of the variable credit/debts caused by financial knowledge factor is changed. The purpose of choosing variable credit/debts because some of respondents have their own credit card. The parameter was change to small value (meaning number of people able to manage their credit/debts decrease), it will also decrease the number of people that are aware of financial management as shown in Figure 6 and Table 4.

![Figure 6. Result of Intervention for Scenario 2.](image)

**Table 4. Result of Financial Management of Scenario 2.**

<table>
<thead>
<tr>
<th>Month</th>
<th>Baseline Scenario</th>
<th>Intervention Scenario 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>13</td>
<td>12</td>
</tr>
<tr>
<td>2</td>
<td>919</td>
<td>881</td>
</tr>
<tr>
<td>3</td>
<td>1823</td>
<td>1749</td>
</tr>
<tr>
<td>4</td>
<td>2732</td>
<td>2617</td>
</tr>
<tr>
<td>5</td>
<td>3638</td>
<td>3485</td>
</tr>
<tr>
<td>6</td>
<td>4544</td>
<td>4353</td>
</tr>
<tr>
<td>7</td>
<td>5450</td>
<td>5221</td>
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<tr>
<td>8</td>
<td>6357</td>
<td>6089</td>
</tr>
<tr>
<td>9</td>
<td>7263</td>
<td>6957</td>
</tr>
<tr>
<td>10</td>
<td>8169</td>
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<tr>
<td>11</td>
<td>9076</td>
<td>8693</td>
</tr>
<tr>
<td>12</td>
<td>9982</td>
<td>9561</td>
</tr>
</tbody>
</table>

The growing rate of credit/debit cards uses had dramatic impact on how individuals manage their personal finances. Today, tertiary students are more inclined to utilize online financial management products and services, compared to a more conventional in-house products favored by their parents. This trend promotes better knowledge and awareness on financial products among students, on how to use this product and its benefits. Among this product is a credit card. Studies by Grable & Joo (2006) and Norvilitis et al. (2003) showed that student debt level have direct relation to financial stress levels. In which, financial stress causes the decline in academic performance and physical health among students (Gudmunson et al., 2015). Based on the results above, it is in line with the research by Goi and Nee (2008), in Malaysia, credit card bankruptcies tripled from 2006 to 2007 and study loan defaulters increased by 103 percent in the same period of time.

Results from both of intervention scenarios indicated that the model responds to parameter changes. Therefore, the system dynamics model of financial management for university students has passed the validation test and can be used for further amendments.

**V CONCLUSION**

The system dynamics model constructed in this study, displayed the information on financial management skills and the influence of university students on their financial management. This information can assist policy makers to reduce the number of cases of bankruptcy among young people in Malaysia. Therefore, the model can be use by financial educators to employ efficient methods in teaching financial matters. An effective program must be developed based on students’ needs and should be presented in an integrated way to cover the wider population with a variety of life stages and characteristics. Indeed, the policy makers must take a more active role in educational planning by enhancing the importance of financial education during high schools and in the case of adult learning.

**REFERENCES**


The Development of an e-Driver: Creating Awareness of Ethics in Driving via Game-Based Learning

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ABSTRACT

Ethics in driving should be followed in reducing the number of road accidents. According to the research, most of the road accidents in Malaysia are caused by not following driving ethics and unethical drivers. This study aims to develop a game-based learning application for driving ethics awareness (e-Driver) and implement the ADDIE model to provide a stable and effective development process. The evaluation phase adopted the Technology Acceptance Model (TAM) that involved 20 respondents and produced 82% of the acceptability. The findings suggest that the application is enjoyable and effective in delivering the instructions for creating awareness of driving ethics. The impact of morality in driving will create a safe and systematic traffic environment since most road users respect others' rights to road usage.

Keywords: ADDIE, EPIC framework, ethics, game-based learning, TAM

I INTRODUCTION

Nowadays, most of the citizens in Malaysia utilize their vehicles as their main transportation. Despite that car ownership in the South-East Asian markets is ranked among the world’s lowest, Malaysia was ranked the third-highest trend of owning a car among its member countries (Mueller, 2020).

On the other hand, Malaysia was placed among the top three countries with the deadliest roads in ASEAN and Asia. A report by the WHO Global Status Report on Road Safety in 2018 (WHO, 2018), Malaysia recorded a 23.6/100,000 road accident fatality rate equal to 7,152 cases (Abdullah, 2019). It was estimated that around 7,000 to 8,000 people in Malaysia died in road traffic annually (George, 2019). The extreme amount of Malaysian road fatality rate should be fixed as it is extremely close to the average rate among low-income nations.

The massive number of road accidents in Malaysia is due to all drivers in the country not following the road safety procedure, ethics, and morality in driving (Eusofe & Evdorides, 2017). Some of the immoral and unethical actions were switching lanes without giving indicator lights, using smart devices while driving, swerving recklessly in and out of traffic, and driving beyond the speed limit (Abas, 2020). Hence, the misbehavior victims and non-ethical experienced drivers are the new drivers, as they lack driving experience and skills on the road. As Director-General of the Road Safety Department (JKJR), Datuk Rosli Isa (Raaf, 2017), various parties such as parents, schools, and Road Transport Department need to increase the awareness of their role of driving ethics among new drivers.

Hence, this research is initiated to increase the awareness of driving ethics by using game-based learning. Game-based learning is considered a unique instructional approach and significantly impacts achieving the learning objective (Dimitra, Konstantinos, Christina, & Katerina, 2020). Furthermore, the educational game enables the learner to find the learning process easier, more interesting, and more effective.

II LITERATURE REVIEW

A study showed that Malaysia has the biggest road death risk among the ASEAN countries (Harith & Mahmud, 2018). This scenario is due to a lack of awareness of driving ethics and morality. Individual awareness is very important towards a healthy living culture without harming others' safety (ASP Dr. Mohd Roslan, Harian Metro, 2020). According to Dr. Haslinda (Bernama June 17, 2018), there must be a psychotic concept to produce a calm and soothing driver in forming a quality drive. Drivers who have a unified spiritual and physical system will indirectly display a better quality and prudent driving pattern on the road.

Based on the Oxford dictionary, ethics is meant by the moral principles that guide a person’s activity, conduct, or behavior (Kramer, "Definition of Workplace Ethics," 2019). Ethics and morals are terms used in the plural and often regarded as synonyms, but there is some distinction in how they are used (Habibullah, 2018). Morality, however, is the principle concerning the distinction between good and bad behaviour. The Qur’ān also states that morality is one of the keys to success, “and from among you there should be a party who invite good and enjoin what is
right and forbid the wrong and these are those who shall be successful” (Qur'ān, 3:104).

Furthermore, studies have proved that lacking proper ethics in driving presents a problem on the roads. This scenario is because it has been identified as a predictor of traffic crashes and precursor to behaviours that increase the probability of traffic crashes (Idris, Hamid, & Teik Hua, 2019). One of the problems of driving ethics is the emotional distraction of driving. This phenomenon is important as prior studies have shown that emotional disturbance can lower task performance and safety awareness (Choudhary & Velaga, 2019). Besides, drowsy driving is one of the problems of not following driving ethics.

Moreover, studies found that “tiredness and sleepiness is a major cause of road traffic injuries” (Higgins et al., 2017). Not to mention that texting while driving is also a problem in driving ethics. Studies proved that students around the age of 17 to 18 are likely to text while driving, increasing the risk of road accidents and careless driving (Hill, Sullivan, & Stephens, 2019; Li et al., 2018). Young drivers among the stated age are most likely to perform risky driving, especially when they are not under adult supervision. This scenario is a major concern as it may become one of their common habits if they do not acquire enough supervision.

This study was presented in game-based learning using Windows 10 to attract learners’ interests and attention. Game-based learning immerses learners in observing, exploring, and making decisions in a virtual world, creating higher interactivity. High interactivity is a basic component for powerful learning and may result in students' strengthening, at last improving their adequacy and awareness (Vlachopoulos & Makri, 2017).

Tobar-Muñoz, Baldiris, and Fabregat (2017) demonstrated that well-designed educational video games might have incredible potential for enhancing students' learning accomplishments. It is because educational computer games could make the students interested and motivated to use the application (Huang, Chang, & Wu, 2017). A study has shown that “learning motivations of students have a significant impact on learning achievement using game-based learning” (Hartt et al., 2020). Zainab et al. (2020) indicated that game-based learning helped students visualize, memorize, and understand the theories of driving easily. This study shows that game-based learning is a better approach than using the traditional way of learning.

The EPIC (Ethics Practice and Implementation Categorization) framework was implemented in this study's development phase. The framework enables teachers to recognize the beneficial games to utilize for ethics practice in learning situations. Designers create a game for ethics education using the EPIC framework to meet specific objectives or procedures (Schrier & Schrier, 2015). Moreover, the EPIC framework analyzes the instructive needs on systems used to teach morals and does not rely upon students' past ability level.

The EPIC Framework's educational goals could be mixed, matched, and selected to suit the study development (Schrier & Schrier, 2015). It contains seven ethics education target outcomes: forming ethical awareness, practicing reflection, improving the character, and 12 strategies related to ethical learning. Therefore, this study used the EPIC framework to increase the effectiveness of ethical education application development. This game used the current multimedia technology and 3D visuals. The utilization of 3D vision in a virtual learning condition has a meaningful, beneficial outcome on the students' performance and appreciation of the environment (de Boer, Wesselink, & Vervoorn, 2016).

Implementing the driving ethics application via game-based learning created the awareness of users and Malaysian drivers about important driving ethics. It motivated them to engage with morality in daily driving. The impact of morality in driving will create a safe and systematic traffic environment since most road users respect other road usage rights. The game-based learning application also positively impacted students, as most of them are new to road driving. Training new drivers at an early stage will produce better road users with ethics in the future.

Lastly, this application is mainly intended to create a safe road environment in Malaysia as the accident rate will decrease. This scenario is due to the increment of drivers that apply ethics and tolerate other road users in their driving.

III METHODOLOGY

The ADDIE model was selected as a methodology and used as the procedure to fulfill the study objectives. The model contains five important phases: Analysis, Design, Development, Implementation, and Evaluation Phase. The ADDIE model is suitable for the development of teaching or educational courses. It is a model that is commonly used by training developers and instruction designers. This model also helps the instructors or educational design to produce an effective educational design. Furthermore, the ADDIE Model components can be used as the development guidelines in any environment (Aldoobie, 2015).

The analysis phase was done by gathering all of the information related to the study scope, constraints, and literature review gathered from numerous sources. All of the information is usually referred from dependable
sources such as journals, online journals, books, articles, and more. This important information is crucial for better planning to produce a better study outcome. This phase ends when the developer agrees on the key issues and obtains possible problem solutions to continue.

Next, the design phase contains tasks such as designing a flowchart and storyboard of the game, which is necessary as a guide to see the flow of the planned product while programming and developing. The development phase uses several tools to create all detailed interfaces, technical design, script, and coding.

IV DEVELOPMENT

The design phase of every game-based study needs integration from various platforms and software. The e-Driver game-based learning study requires a great amount of important design phase before integrating it into the game engine. Furthermore, early planning and rough design on the study's overall structure are necessary to determine which platform is the fittest to be utilized. Components and structure examples required to be designed from early development are the game environment, character objects, obstacles, scoring, and penalty system. Figure 1 shows the process of developing the study overall.

V IMPLEMENTATION

EPIC Framework criteria and required development goals are implemented in the study development to create awareness of ethics in driving. Every necessary goal implemented will be explained and shown.

A. Ethical Awareness

The application's user interface will alert and make the user aware of the specifically required ethics in driving specific areas. Figure 2 is an example where the game asks the user to slow down when they drive over the school area's speed limit. Developing ethical awareness identifies a person’s perspectives on a given situation and imagines the effect and consequences (Meng et al., 2014).

Figure 2. Snapshot of Ethical Awareness Criteria.

B. Emotional Intelligence

The game trains the user to drive, especially when there are heavy traffic and inevitable obstacles. If the user drives in a hurry or makes unethical decisions despite the situation, they will acquire violation points, affecting the game points and penalty, as in Figure 3.

Figure 3. Snapshot of Emotional Intelligence Criteria.

C. Ethical Reasoning

The game involves the user in ethical decision-making on scoring ethical points and avoiding violation points (Figure 4). The user must give a signal light at right turns and obey the speed limit at times to obtain ethical points. This scenario enables the user to think thoroughly about their decisions in driving. Ethical reasoning is making and interpreting choices and evidence, along with its pros and cons effect (Schrier, 2011).

Figure 4. Overall Process of the Study Development.
D. Ethical Reflection

The game makes the user reflect on the ethical issues made in the game and help them overcome them by providing the related unfinished objectives as in Figure 5. The game also limits that the user can only get violation points with the maximum value of three to pass a level. This scenario enables the user to reflect on their decisions to avoid as many violations as possible.

VI RESULT AND ANALYSIS

The evaluation process is done by collecting data and getting user feedback. Technology Acceptance Model (TAM) was implemented for the evaluation phase before this application was given to the targeted users. The participants have also received the study application for the testing before responding to the evaluation instrument. The purpose of the TAM is to know user acceptance of the technology.

A. Technology Acceptance Model

The study's evaluation is placed to determine whether the target users accept the game to create awareness of driving ethics. The evaluation is also conducted to check whether the study fulfills the output requirements and objectives. The minimum number of participants needed to answer the questionnaire is 20 people. This study is for a minor subgroup that is purposely for students at UiTM Shah Alam (ex-students from SMK Puncak Alam) for the case study. It is sufficient to use 20 respondents because ex-SMK Puncak Alam students who become the UiTM Shah Alam are a minor subgroup. In survey research, 100 samples should be identified for each major sub-group in the population and between 20 to 50 samples for each minor sub-group (Cohen et al., 2000). The evaluation contains five parts, but only three are used (perceived usefulness, perceived ease of use, and perceived satisfaction) in this study.

B. Participants

The proposed study's evaluation process involves the target audience, including University students around the age of 17 to 19, common to have a driving license and still adapting to driving on the road. The evaluation is conducted among UiTM Shah Alam students, and the evaluation was performed by distributing the Google Form link after they tested and understood the product. Since most of the targeted audience is officially a university student, using complex English is suitable in the questionnaire for a correct evaluation. The participants who are involved with the evaluation are briefed, and the demo is provided online. The participants must finish the game within the time frame given, which is about an hour. After finishing the game, the participants need to fill in the provided online questionnaire, the technology's user acceptance evaluation.

C. Instrument

The questionnaire is used in this evaluation of the study to evaluate the users’ acceptance. This method is chosen because it is very effective and does not require much cost. The questionnaire is created based on the TAM containing five criteria: Perceived Usefulness, Perceived Ease of Use, Behavioral Intention To Use, Actual Usage, and User Satisfaction. However, there are constraints for not using all five criteria since the study is currently only a prototype. Therefore, Behavioral Intention and Actual Usage are removed from the evaluation questionnaire. Furthermore, the questionnaire consists of 11 items listed in three sections, as displayed in Table 1.

Every item in the questionnaire is ranged from 1 to 5 to value the level of agreement of each item. Then, the value will be added and averaged to calculate the score related to the percentage. An overall conclusion is made with the mean value of each item and each dimension. Each dimension has been calculated for its mean total value to display the agreeability on the specific dimension. IBM SPSS software is used to process such data, including the mean and standard deviation values for each item in a table format. IBM SPSS is commonly used as a statistical software to produce calculations for research and business purposes.
Table 1. Evaluation Items.

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perceived Usefulness</td>
<td>The game makes you more aware of driving ethics</td>
</tr>
<tr>
<td></td>
<td>The game makes you more aware of the importance of driving ethics</td>
</tr>
<tr>
<td></td>
<td>The game makes you reflect on every decision you make while driving</td>
</tr>
<tr>
<td></td>
<td>The game encourages you to become a more ethical driver</td>
</tr>
<tr>
<td>Perceived Ease of Use</td>
<td>You are able to control the car and navigate easily</td>
</tr>
<tr>
<td></td>
<td>It is easy for me to understand the game objectives</td>
</tr>
<tr>
<td></td>
<td>The user interface (UI) is simple and easy to operate</td>
</tr>
<tr>
<td></td>
<td>I think this application is easy to use</td>
</tr>
<tr>
<td>User Satisfaction</td>
<td>You had fun using e-Driver.</td>
</tr>
<tr>
<td></td>
<td>You find the gameplay included in e-Driver to be interesting</td>
</tr>
<tr>
<td></td>
<td>In the future, if there were similar learning application or software were to be created, I would use it.</td>
</tr>
<tr>
<td></td>
<td>Overall, you find e-Driver application interesting and satisfying</td>
</tr>
</tbody>
</table>

Table 2. Total Mean for Each Dimension and Overall Average Value.

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Total mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perceived Usefulness</td>
<td>4.13</td>
</tr>
<tr>
<td>Perceived Ease of Use</td>
<td>3.91</td>
</tr>
<tr>
<td>Perceived Level of Satisfaction</td>
<td>4.28</td>
</tr>
<tr>
<td>Overall mean</td>
<td>4.10</td>
</tr>
<tr>
<td>Percentage of overall mean</td>
<td>82%</td>
</tr>
</tbody>
</table>

D. Findings

Based on Table 2, the overall mean is determined based on each dimension's mean value to calculate the overall mean percentage. The percentage of the proposed study's overall mean is 82% of the acceptability, which shows that the e-Driver application effectively creates awareness in driving ethics to users. The highest average mean from all the dimensions stated is from the Perceived Level Satisfaction dimension with 4.28. It shows that the users are satisfied and interested in the gameplay and instructional delivery method. Besides, the respondents are satisfied with the approach method and usability of the e-Driver application that helps them create awareness of driving ethics. This finding strengthens the study by Sailer, Hense, Mayr, & Mandl (2017) that stated the effects of specific game design elements on psychological need satisfaction.

Moreover, the second-highest dimension is the Perceived Usefulness with 4.13. This result indicates that users can understand the lessons through the game's challenges and understand the benefits of following the application's driving ethics. In conclusion, the results also show that the users are satisfied and interested in the study application's gameplay and instructional delivery method. Not to mention that the respondents generally find the application easy to use and navigate for the user interface and menu navigation.

VII CONCLUSION

Applying game-based learning and epic framework as the instructional approach is very effective for this study application. This study helps the user, especially new drivers, to enjoy and gain benefits from the ethical educational experience provided in the application. The evaluation determined that the game is suitable and beneficial to new drivers such as form 5 students and university students. Furthermore, e-driver is a game that creates awareness of driving ethics and is an enjoyable experience for the study's target users. Future improvements can be applied to this study to become a beneficial application that will contribute to road safety, especially in Malaysia. Ethical game-based learning application has many ways to be explored in this country, although the gaming industry has evolved. Creating such a clear focus on enjoyable ethical learning could increase road safety and moral traffic usage in Malaysia.

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Knowledge Management International Conference (KMICe) 2021, 1 February 2021
http://www.kmice.cms.net.my/


ABSTRACT
The rapid development of technology has changed the world with various computer-based inventions and innovations. Education from primary to tertiary level is no exception in facing this change. With the curriculum changes that have begun to introduce courses related to programming at the primary and secondary level, the tertiary level curriculum should also change for quality education. This paper presents a new curriculum structure for the Software Engineering Undergraduate Program at University Malaysia Sarawak (UNIMAS). The current structure of Software Engineering programme does not follow the Malaysian Qualifications Agency (MQA) Programme Standards. The objective of this paper is to develop a new curriculum structure of Bachelor of Software Engineering based on MQA. The processes involved data collection, document analysis, and meeting with industries to restructure the curriculum. As a result, four new courses have been added to the new curriculum structure the Bachelor of Software Engineering programme for improvements. It is hoped that the graduates from this programme will fulfil the job skills and knowledge as required by the current industries.

Keywords: Software Engineering, curriculum, industry, students, quality education.

I INTRODUCTION
Bachelor of Computer Science with Honours (Software Engineering) is one of the five programmes offered by Faculty of Computer Science and Information Technology, UNIMAS. In the first year, students will take the same fundamental courses for all programmes. The majoring for each program starts during the second year. The total number of credits for Software Engineering graduates is 132 credits, and the duration of study is four years. However, the programme has to change the degree name as advised by MQA.

II BACKGROUND OF STUDY
A. Requirement to Change
In the current MQA Programme Standards, Computing (2014) the computing field has four major disciplines, namely Computer Science, Software Engineering, Information Technology and Information Systems. The current name of Degree is Bachelor of Computer Science (Software Engineering) is not compliance with these as it seems has two major disciplines; computer science and software engineering. As a software engineer, graduates from this discipline should be able to perform and manage activities at every stage of the life cycle of large-scale Software systems; they become specialist in designing and implementing software in the large (MQA, 2014)

The current name of the degree is not allowed according to Programme Standards. Thus the programme needs to be changed as required. Once the name agreed at the Programme level, programme member needs to revamp the currents structure. For this purpose, the programme members held a few meetings and discussions on these.

B. The Proposed Changes
The proposed new program of Bachelor of Software Engineering (BSE) from the existing program of Bachelor of Computer Science (Software Engineering) is following the standard programme of MQA and SWEBOK (Software Engineering Body of Knowledge).

The percentage of newly revised curriculum review for Bachelor of Software Engineering is 21.43%. There are 25 core courses, and programme core has been offered in this programme. One core course (Mathematic for computing) and One programme core (Advanced Topic in Software Engineering) has been removed since both courses are not in the SWEBOK. The courses such as Intelligent System, Expert Systems, Data Mining and Computer Security has been replaced with Automata Theory and Formal Language, Software Economics.
Software Maintenance, Configuration Management and Software Security Engineering respectively in aligning with SWEBOK. One of the strengths of the programme is that the syllabus of the courses Software Requirement dan Software Testing are from MSTB (Malaysian Software Testing Board) and teach by Certified Trainer besides UNIMAS is chosen as a pilot university from MSTB. The programme has been designed in response to industry demand for innovative software engineers who can design and develop complex software systems for the modern world.

III LITERATURE REVIEW

A. Compliance with SWEBOK

The Software Engineering Body of Knowledge (SWEBOK) is published by The IEEE Computer Society (Bourque & Fairley, 2014) to serve as a guide for the advancement of both theory and practice in the field of software engineering. It includes curriculum development for undergraduate, such as the BSE. The SWEBOK has become an international standard; ISO/IEC TR 19759:2015 (www.iso.org) that defines the acceptable body of knowledge for software engineering discipline.

Although the SWEBOK and curriculum are not the same (www.computer.org), it is important for BSE to be compliant with the body of knowledge set in the SWEBOK for software engineering related courses. Just like any other standards, compliance with the SWEBOK will give BSE the recognition and accreditation from other institutions especially the Malaysia Qualifications Agency (MQA) that accredited programmes offered by the Higher Education Provider (HEP) in Malaysia (MQA, 2014).

There have been many accounts of adaptation of SWEBOK in the academic curriculum, for example in (Thompson & Hardy, 2002) as well as in the industry (Samarthyam et al., 2012 and Narayanan & Neethi, 2001). Adaptation of SWEBOK based curriculum in the industry has been mainly described to have fulfilled organisational goals (Samarthyam et al., 2012). SWEBOK based curriculum has also been used in universities as a means to support and improve the quality of Software Engineering programmes, for example in, (Alarifi et al., 2016).

Due to the comprehensive SWEBOK Knowledge Areas, it can be used to evaluate the academic curriculum at different levels of detail (Frailey & Mason, 2002 and Alafiri et al., 2016). Software engineering is a dynamic field, and new topics emerge regularly. SWEBOK is also intended to be revised from time to time; hence it is suitable to accommodate the dynamic nature of the software engineering field (Frailey & Mason, 2002).

B. Towards IR4.0

Industry 4.0 was first publicly introduced as “Industrie 4.0” by Germany in 2011 (Schwab, 2016). Industry 4.0 combines physical, digital and biological worlds has brought a new fundamental paradigm shift in the ways we work, communicate and live. These fusion technologies impact our society across all disciplines, which includes the field of education.

Industry 4.0 revolution led to changes in professions and employment trends. The workforce is expected to be problem solvers, critical thinkers, possessed soft skills and other essential skills to thrive in the fourth industrial as depicted in the report The Future of Jobs (2016) published by World Economic Forum. World Economic Forum highlighted the changing job market where many jobs will be replaced by technologies and robots in the future in The Future Job 2020 report (2020), for instance, artificial intelligence and data science automation graduates might be unable to find a job due to misalignment of qualifications current market demands or lack of future-ready skills and competencies required for the future of work. In short, we need to prepare our students for the future.

Figure 1. Top 10 skills in 2015 and 2020 (Gray, 2016) and (The Future of Jobs Report 2020, 2020)

Similar to other disciplines, the emerging technologies like Internet of Things (IoT), big data and artificial intelligence (AI) have transformed the way in teaching and learning in education and led to the rise of Education 4.0 in response to the fourth Industry revolution (Maria et al., 2018). There are needs to redesign the education system mainly on transforming the learning and teaching strategies around the world (Lawrence et al. 2019).

IV METHODOLOGY

Few processes have been conducted to restructure the curriculum to fulfil MQA requirements. The process involved data collection, such as survey, meetings and document analysis from SWEBOK.

A. The Survey

A survey from industries was conducted to get their feedback on the new curriculum structure of software engineering courses. A market survey was conducted...
to get a response from industries on the new programme. An online questionnaire has been shared online with industries. Out of 100 respondents, 92% from locally owned and 8% from foreign-owned organisation/industry.

Students survey is also conducted to identify the current problems of the Software Engineering curriculum structure. The total no of respondents is 102 students consist of 47.1% third-year students, 28.4% second-year students, 20.6% fourth-year students and 3.9% fifth-year student.

B. Meeting

Software engineering programme held a few meetings and online discussion to discuss the changes needed for a new programme. Other than programme and faculty level meeting; industry meeting also held by the faculty to get feedback from the industries on a new programme of Bachelor of Software Engineering.

Industry Meeting

“Board of Studies” refer to the committee responsible for offering professional recommendations on academic programmes to be set up or checked by each Centre of Studies. The Faculty of Computer Science and Information Technology (FCSIT) Board of Studies (BoS) has ultimate responsibility for student teaching and learning and quality improvement in all faculty programmes.

The Board ensures the successful execution of the University’s teaching objectives and is solely responsible for content, structure, delivery, quality assurance and final results recommendations. The consistency of programme is maintained by measuring and reviewing the teaching programmes of the faculty by external and internal processes, including student feedback and individual student performance and progress. The Board of Studies meets once a term. Its committee includes staffs who contribute to the undergraduate programmes in the faculty, student representative, alumni, and industry stakeholders.

The programme has appointed an External Examiner from local university and Advisory Panel consists of five industries representative. The programme have received feedback and views on curriculum proposals.

For University Curriculum Benchmarking report, few local universities have been compared based on the duration of study, industrial training semester, final year project semester and total credits of the programme. From this report, duration of study is between 3.5 to 4 years, the earliest student do their industrial training is in semester 5 to semester 8. There is university allows the students to do their industrial training between FYP1 and FYP2. The benefits of students do their industrial training in final semester is the student can continue work after their industrial training at the same company. This is based on the offer by the company. For final year project the student starts their project as early as semester 6. The range of total credits for the programme is between 121 to 128 credits.

V ANALYSIS OF DATA

This section will reveal the analysis of the results from market and student survey. Other than that, feedback from Industrial Panel also presented in this section.

A. Market Survey

The market survey has three parts namely Part 1: Content of Programme and its relevance to the needs of the organisation and Part 2: Career Opportunities and Part 3: Others.

Part 1: Content of Programme and its relevance to the needs of the organisation

From Part 1, the programme fulfils the basic theories required in the related discipline according to the 73% respondents, whereas 26% of them partially agree and only 1% disagree. 94% agreed the theories used in this programme are relevant to the current situation. Then 95% of respondents agreed the subjects contribute to the strength of the programme. 79% of respondents agreed that the BSE programme covers all relevant subjects. From 6 given criteria stated in the market survey, the fundamental theory is the most fulfil (75%) criteria, followed by the use of ICT (62%), current concept (60%), use of quantitative methods (56%), market/industry relevancy (53%) and the least fulfils legal criteria (49%).

For programme implementation, 98% agreed that four years duration of study is sufficient for the students, and 94% agreed six months duration of practical training is adequate for the students.

Part 2: Career Opportunities

For career opportunities, respondents’ organisation stated than between 1-3 posts in their organisation can be filled by graduates of this programme (75%). Half of the respondents, 50% agreed that Appropriate income for the graduates of this programme is between RM2000 – RM2,500 per month (50%) and 88% agreed that this programme is suitable to be enhanced to a higher level which is Master’s degree (92.1%).

Part 3: Others

The respondents’ organisation have sponsored the student in this field/area (73%). 91% agreed that the
programme able to produce the right graduates for the labour market. The reasons are the fundamental concepts is there such as Java programming, which is part of the programme. Most of the subject enrolled under this programme suit for the IT engineering field.

Another reason is the coming years will need more software skilled employees. Hardware is already good enough, but a lot of software optimisations are required. Hence, people from software background are needed. The maintenance of technical aspects in the organisation is essential to keep the organisation runs smoothly in line with the national agenda or Sarawak itself, moving towards a digital economy. Thus, more systems need to develop and data to be kept. Most of the industries agreed on the new curriculum structure of the new Software Engineering programme.

B. Student Survey

The objective of this survey is to identify current problems with the existing curriculum structure. There are seven measured criteria, namely curriculum structure, course contents, academicians, teaching and learning facilities, assessment method, course delivery and academic advisory. The result showed that the three strengths of the programme are assessment methods, course contents and curriculum structure. The three weaknesses are course delivery, course contents and teaching and learning facilities. These weaknesses because the faculty has a problem with air-conditioning facilities for a few months. For the course contents, it appears as strength and weakness; thus, action is needed to tackle this problem. To improve the programme, the students need more exposure and examples, especially for programming related course. For example, have more lab session and guidance from senior. Course contents listed as the strength and weakness, and need to be improved based on SWEBOK and industry demand. The faculty also, in a process to provide a more conducive learning environment to the students.

C. Industrial Panel Evaluation Feedback

The appointed Industry Advisory Panel (IAP) has held visits and meetings with programme members. The role of an IAP is reviewing the department’s curriculum to maintain industrial relevance, offering advice and assistance on curriculum design, and ensuring that graduates have the necessary skills needed by industries as prospective employers. Based on the Industry Advisor Report, the emphasis is placed on soft skills (communication, interpersonal, leadership, professionalism, teamwork and so on.) As well as expertise in new technologies among students. Curriculum review is required to ensure that the latest soft skills and technology components are incorporated into the courses offered to suit industry needs, for example, Scrum, Project Management Professional (PMP), The 6-Thinking Hats principles, Python programming and IoT Development. The following are examples of new components and technologies incorporated into the courses offered.

Table 1: Latest Components / Technologies and related courses

<table>
<thead>
<tr>
<th>No</th>
<th>Latest Components / Technologies</th>
<th>Courses Related</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Scrum - Project Management/ Group Work</td>
<td>- Software Engineering Lab course</td>
</tr>
<tr>
<td>2.</td>
<td>Project Management Professional (PMP) - Project Management</td>
<td>- Project Management</td>
</tr>
<tr>
<td>3.</td>
<td>The 6 Thinking Hats Principles - Improve communication skills and be more effective in teamwork</td>
<td>- Softskill and Volunteerism</td>
</tr>
<tr>
<td>4.</td>
<td>Python - One of the latest industry needs programming languages</td>
<td>- Object Oriented Software Engineering</td>
</tr>
<tr>
<td>5.</td>
<td>IoT Development - Students can choose to develop an IoT project under the guidance of their supervisor.</td>
<td>Final Year Project</td>
</tr>
</tbody>
</table>

Scrum (Deemer et al., 2012; Schwaber, n.d.; Subramaniam et al., 2017), Project Management Professionals (PMP) (Project Management Professional (PMP)®, n.d.), and 6-Thinking Hats (The De Bono Group LLC, 2014) have been incorporated in the curriculum syllabus as suggested by the IAP. All the components essential for the students to manage projects efficiently, improve communication skills and be more effective in teamwork. Python is one of the latest industry needs programming languages has been taught in Object Oriented Software course. Meanwhile, for Internet of Things (IoT) development, students can choose to develop an IoT project under the guidance of their supervisor.
For University Curriculum Benchmarking report, four local universities have been compared to the existing curriculum. From this report, duration of study is between 3.5 to 4 years, the earliest semester for industrial training is in semester 5 to semester 8. There is a university that allows the students to do their industrial training between FYPI and FYP2. The benefits of students do their industrial training in final semester is the student can continue work after their industrial training at the same company. This is based on the offer by the company. For final year project, the student starts their project as early as semester 6. The range of total credits for the programme is between 121 to 128 credits.

VI RESULT

In order to improve the curriculum structure, the courses need to restructure and updates accordingly. There are four new courses have been introduced as the new curriculum structure of BSE, namely Software Economic, Automata Theory and Formal Language, Software Security Engineering and Software Maintenance and Configuration Management.

A. New Curriculum Structure

Software Economic

Software economic is one of the important course that covers the cost management consideration when working on any ICT projects. It has been reported that most of the projects fail due to financial limitation. As most of the ICT projects do not concern financial sustainability prior beforehand, this course is introduced to fill these gaps. This course introduces mechanism, practices and principals towards financial sustainability study of ICT projects. In the course, the students will cover with state of the art sustainability assessment theory and tool through value-based requirement engineering. The concept and tool that are used in this course is e3value. The benefits of e3value modelling are to view the business model on a value perspective corner. At the same time, e3value capable to visualise the business process model into process flow perspective. It can model an economically independent entity, example; enterprises and end consumers or profit and loss responsible business units. The e3value model consists of some technical terms, example actor, value transaction, value network, value object and others (Gordijn & Akkermans, 2003). The actor refers to the consumer, stakeholders, customers, partners, government and end-users. Each transaction between the actors refers to the value object. The value transactions are playing a role as economic value exchanges in the business model (Jamila Daoudi, 2017). Then, value network able to show relation and transaction among the actors in this business model. The model has the capability to analyse how the network creates and delivers value (Jamila Daoudi, 2017). Furthermore, the model facilitates the users in checking numerical computation involved in the projects (Artur Caetano, 2014). When all the data or value enters into e3value model, the user can simulate the model. The data will produce in the spreadsheet. This model is helpful for the researchers to analyse the financial sustainability of the project (Wim, et al., 2010).

Automata Theory and Formal Language

This course introduces some fundamental concepts in automata theory and formal languages including grammar, finite automata, regular expression, formal language, pushdown automaton, and Turing machine. Finite automata are very useful in the creation of compiler and interpreter techniques, also used in text processing and hardware design. While formal language is very useful in producing a complete and precise model of software specification. Not only do they form basic models of computation, they are also the foundation of many branches of computer science, e.g. compilers, software engineering, concurrent systems, etc.

The properties of these models will be studied, and various rigorous techniques for analysing and comparing them will be discussed by using formalism and examples. Automata Theory course is essential to be taught for undergraduate students because it is a basis for Computer Science foundation as it exposed on how the computer works (ACM, 2015). As for Software Engineering Programme, this course consists of three learning outcomes in which to expose the students on the computing models so that they can explain and justify the powerful computing models to capture general computer (Tecson et al., 2018), as well as based on time and complexity. Due to various acceptance in term of fast understanding of the topics, as well as a slow learner, there is an approach to assist the students in learning this course. One approach is by designing a tool to simulate the expression and algorithms (Ade-Ibijo, 2018). In addition, the latest research and improvement in the area of automata and formal languages will be studied.

Software Security Engineering

Security affects every software component in different types of computing systems. Many vulnerabilities and attacks on those systems are due to security weaknesses in the software itself (Yang et al., 2018). Therefore, incorporating software security into an undergraduate software engineering course is needed in order to produce graduates that fulfill industry needs (Lexter & Jamerson, 2009).

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Course Software Security Engineering has been introduced in order to fulfil the SWEBOK besides meet industry needs. This course provides a foundation of building secure software by applying security principles to the software development lifecycle. CLOs course is created for achieving PLO programme by mastering a range of essential and procedures, including developing and testing software system related practices and processes to solve a broad range of complex problems in software engineering and Relate ideas both in written and oral forms using appropriate and different forms of presentation with confident, accurate and coherent in an appropriate context.

Software Maintenance and Configuration Management

Software Maintenance and Configuration Management course covers two knowledge areas in software engineering practices. This course is designed to meet criteria of 21st-century learning and has deployed the HIEPs element of Collaborative Assignments and Projects (CAS) in teaching and learning in this course. Students are expected to acquire future-ready skills upon completion of this course.

Software maintenance and configuration management is a part of the software life cycle. Previously, software maintenance receives less attention compared to the other phases. However, it has changed recently as most software is developed for long term use. The organisation strive to keep software operating as long as possible (Bourque & Fairley, 2014). In order to maintain the life of the software, few changes need to be done according to the current requirement. Thus software maintenance and conuration required for this purpose. Software configuration management is to control changes of software products and guided by international standards such as IEEE and ISO (Fahmy et al., 2017). A formal definition is to identify and document the functional and physical characteristics of a configuration item, control changes to those characteristics, record and report change processing and implementation status, and verify compliance with specified requirements (ISO/IEC/IEEE 24765:2010). It benefits the project management, development and maintenance activities, quality assurance activities, as well as the customers and end-users (Bourque & Fairley, 2014).

The first learning outcome of this course provides knowledge on software maintenance and configuration tasks, tools and techniques used in the process. The second learning outcome of this course provides the student with problem-solving skill and critical thinking skill to perform impact analysis on the software maintenance and change control task for given scenarios. Whereas the third learning outcome of this course builds a team spirit in students through their collaborate in a team to solve the given project.

VII CONCLUSION

The proposed new curriculum structure for programme Bachelor of Software Engineering is developed based on MQA requirements and in compliance with SWEBOK. The improvements made based on feedback from industry, market survey and the student survey. As a result, four new courses have been introduced to improve the programme curriculum structure, which has been approved by MQA. The programme of Bachelor of Software Engineering will be offered to the new intake of student 2021/2022.

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Perception and Usage of Cloud Storage for E-learning among University of Samarra Staff During The Period of COVID-19 Pandemic: A Pilot Study

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ABSTRACT

Cloud storage is one of the proliferated technology that supports various enterprises. It has been demonstrated as a highly efficient tool in E-learning. However, cloud storage faced several problems like size limitation and negative data repetition. Similarly, the first usage of E-learning has storage issues recorded in University of Samarra (UOS) during the COVID-19 pandemic which forced lots of universities globally to take urgent measures. Many users have complained about facing difficulty to store the cloud storage data. UOS staff faced hardness in data management resulting from oversized, duplicated files that overwhelmed the storage capacity. This research aims at investigating the staff’s perception concerning the usage of cloud storage by surveying the UOS staff’s opinions. A pilot study was conducted on 37 staff who work on E-learning data management by a self-administrated questionnaire using five-point Likert scales. The questionnaire was divided into three sections: cloud storage awareness, current issues, and proposed solutions. As a result, the staff are rather aware of data management as storing and retrieving. The management process was constrained by big, duplicated image files which improperly replaced the text files. The study resulted in high acceptance of utilizing more cloud capabilities and readiness for more training to improve the proficiency of using UOS cloud storage. This study believes that the result will be of considerable benefit for the UOS staff in terms of making cloud storage more reliable and functioning. It could be also a useful guideline utilized by universities in such conditions.

Keywords: Cloud storage usage perception, Cloud-based E-learning, Cloud storage file duplication, Limitation capacity in cloud storage.

I INTRODUCTION

With the beginning of this century, many changes transformed education in a significant way that put teaching and learning in a new shape. Since then, education has been affected by methods, means, and technology (Irgashevich, 2020). The latter forced itself to be the modern solution for education problems, especially during crises such as SARS (Severe Acute Respiratory Syndrome), down to the current pandemic coronavirus COVID-19 (Hoq, 2020). Globally, E-learning plays an important role among education fields, standing on the rapid technology of the internet and developed cloudy storage stations. According to Falkowski-Gilski and Uhl (2020), huge data demands more and more storage components. Besides, the growing number of portable computer devices (i.e., laptops, tablets, mobiles) consume enormous physical capacities to store information unless aided by cloud storage technology, which comes as one of the innovative solutions for this problem. The power of the cloud storage concept is that it provides synchronized, sharable, paperless, collaborative work, and safe data housing for many types of organizations, companies, and users. Moreover, data backup is one of the important cloud storage operations, used to keep a copy in a private place with automatic control set by the own user (Riahi, 2015).

Cloud storage tends to be the best solution for storage limitations. Furthermore, it has elastic purchase options such as capacity-on-demand and other known characteristics, like the capability of using it anytime anywhere, and using multiple devices at once. It also offers monthly and yearly payment method that contains more than one plan for booking a desired capacity (Boza et al. 2017). Cloud storage technology is known as one of the newest developed scientific applications, especially in the information technology domain. It is considered as the essential mainstay for E-learning systems.

Cloud storage is known as cloud computing which is one of the cloud technology implementations that provide virtual computing services utilized by many business fields. So that, several enterprises and institutions whose main priorities are saving time, cost, and effort can make use of the features provided by the cloud storage technology. Side by side, E-learning has a growing relationship with cloud storage since they considerably depend on the internet service. Researchers Mohamed, Shaikha Saleh, Nedaa Baker Al Barghuthi, and Huwida Sädd (2018) find that most E-learning materials are cloud
storage shared sources, establishing new virtual learning spaces, for example, virtual classrooms, schools, and universities as a modern learning style.

Although very useful, cloud storage has countless challenges. Firstly, the users may face lateness, high cost and it demands more effort, contrary to the expected results of its features (Riahi, 2015). Besides, many cases of limited capacity have been overwhelmed by enormous data sizes and wasteful booked size, resulting in duplicated files (He, Qinlu, Bian, Shao, & Zhang, 2020). These cases cause Internet band suffocation, and, consequently, users become unable to access their data store, submit or retrieve information, a case that makes a work setback. So, it is not surprising that users could forget or lose their data. Selvi (2018) investigates the case of data duplication as the same data is stored many times, wasting a great deal of capacity. It is listed as one of the important cloud storage problems, that comes up with different technical issues. Furthermore, due to the operation managed by users, insufficient usage perception can be there as well.

In Iraq, after recording the first COVID-19 case on February 25, 2020, by the Ministry of Health (Ministry of Health, 2020), the central government rapidly embarked on taking alternative solutions for classic education as one of the series of actions to prevent the virus spread. The government lockdown all the educational institutions and forced the (Stay Home) condition against most outdoor life activities (Jebril, 2020). In sequence, they deactivated the universities, schools, and postponed institutions’ works for several months. Accordingly, there were two options for the government to save the educational process; to apply E-learning in such an insufficient time, or to postpone the study indefinitely.

Thus, the decision was made by the government, and electronic exams have been conducted (Elizabeth Noor Coutts et al. 2020). It was the first time for fully applying the E-learning method in education. As quick fixes, some facilities have been allowed to enable students to carry out their exams in this emergent situation. One of these facilities was converting the written students’ answers into image files, which were captured by a student’s mobile device for submission. Instructions have been issued by the Iraqi government emergency team called (crisis cell) and (E-learning team) - related to the Iraqi Ministry of Higher Education and Scientific Research (MHESR), resuming the rest of education year is to be carried out by applying fully E-learning system for all institutions as a mandatory order. So, it is normal that some problems can happen when using E-learning by students and university staff since the new education system was hastily compelled.

Likewise, UOS, one of the Iraqi universities, ranked as a youthful university, which consists of 8205 students distributed to more than 10 colleges over 25 departments (University of Samarra, 2020). It has faced a similar situation during the last academic year and was forced to use the E-learning system for the first time, too. UOS, assigned four staff members, academicians and non-academicians, to be the authorized team for each department of UOS colleges. The main mission of the authorized teams is to design, access and manage the E-learning system, taking into consideration the differences among the colleges and departments to prepare a suitable E-learning system for each one. Once E-learning begins, UOS intensive courses about the new system have been presented, and lots of assisted processes aided the students utilizing new condition chance with the education changes (University of Samarra, 2020).

However, many are complaining that they are unable to open the UOS E-learning system. The university underwent many resubmission cases and observed countless number of duplicated answers, resulting in a huge number of images that overwhelmed the UOS cloud storage capacity. These cases required too long time to manage the storage, and upgrading capacity demands more cost and more effort. More importantly, the authorized staff who were assigned to manage storage got stressed and felt boring every time they access these bloated data. Yet, the situation is worse. The results in some submission cases require using other applications to treat these resubmissions, which lead to inattentiveness and forgetfulness in such cases. Therefore, this study is proposed to investigate the perception of using the cloud storage among the UOS staff, related to its E-learning during the COVID-19 pandemic. It is intended to improve the cloud storage usage. This paper discusses the pilot study outcomes.

II RESEARCH METHODOLOGY

The research methodology adopted in this study is a quantitative approach, as many universities around the world began using the E-learning under the COVID-19 pandemic. A pilot test was chosen to validate data collection by utilizing a survey questionnaire. The methodology was picked on the grounds that it is a valuable methodology and looks to quantify the assessment, used by (Hoq, 2020). The study's fundamental activities included are three, which began with instrument configuration, then followed by the process of data collection and analysis. The further elaboration about this study is mentioned next.

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According to the research methodology, the study discussed the cloud storage perception and features and tried to investigate its current problems related to the E-learning usage. This step requires gathering new limitations during the COVID-19 pandemic, in order to sum up the most important issues for building the main research instrument. According to the research methodology, a survey questionnaire is developed by a self-administrated tool to investigate the UOS staff perception during the period of the COVID-19 pandemic, to collect the research data. The survey tool was appropriate as it returns with many benefits on research, it effectively decreases the cost, and it is easy to analyze (Hoq, 2020). Furthermore, it gives the respondents enough time to respond and confidentially deals with collecting the data. The survey content was developed by adapting from Mohamed, Ku-Mahamud, Ramli and Abdullah (2017). The total survey questions are twenty-seven (27) ones, divided into three partitions: the first part is about the respondents’ demographic information. The second part consists of questions regarding the general concept for the UOS staff of the cloud storage usage in the e-learning. Then, to focus on the COVID-19 pandemic effect, the third part was created to investigate the current usage problems of the cloud storage uses in the UOS E-learning system. The scale used for these questions is the five-point Likert scale. The instrument scale is mentioned by (Sabi et al., 2016).

Regarding the data collection, as a preliminary step, general research data was collected by interviewing the UOS staff to explore the primary information about the cloud storage that supports the UOS E-learning system. The selected staff involves academicians and non-academicians of the UOS for the interview. The interview questions simply discussed the causes of the observed study problems, which primarily result in identifying three main subjects in this research: usage perception, the COVID-19 effects and proposing solutions. Overall, 37 respondents were randomly selected in this study which is considered an acceptable respondents number for pilot research as mentioned by (Abd Latif, Abdullah, & Jan 2016). The whole data collection process involves printed instruments distributed to the research sample as it is quite readable, comfort and easy to respond.

III RESULTS

The result of this study analyzes the obtained data utilizing the descriptive analysis by using the Statistical Package for Social Science software SPSS. SPSS instrument is commonly used in the field of scientific research for analyzing, examining and extracting the results of survey inputs. Thus, the collected data analyzed by this tool is variable, so that the order of the results is presented as follows: Table 1 shows the respondents’ demographic information including the frequented numbers and percentages of four position kinds, classified into two main groups: academicians and non-academicians staff groups. The academicians’ group represent (78%) signifying the majority respondents’ percentage that is almost (65%) of the four positions, while the non-academicians’ group percentage is (21%). It is worth mentioning that all the staff are permanent employees.

Table 1. Respondents’ Demography.

<table>
<thead>
<tr>
<th>Position</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Academicians</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Management and Teaching</td>
<td>5</td>
<td>13.5%</td>
</tr>
<tr>
<td>Teaching Only</td>
<td>24</td>
<td>64.9%</td>
</tr>
<tr>
<td>Non-academicians</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IT Technical</td>
<td>2</td>
<td>5.4%</td>
</tr>
<tr>
<td>Other Employees</td>
<td>6</td>
<td>16.2%</td>
</tr>
<tr>
<td>Total</td>
<td>37</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

Table 2 indicates the respondents’ answers on when they use cloud storage question, choosing one to five times. According to the table, the daily usage represents the most frequented numbers, namely (43.3%), while the teaching position of staff occupies (27.1%) among all users. However, (10.8%) illustrates the technical and other employee positions of the non-academicians’ group who still do not use the cloud storage daily.

Table 2. Respondents’ Cloud Storage Usage.

<table>
<thead>
<tr>
<th>Times of Usage</th>
<th>Academicians</th>
<th>Non-academicians</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daily</td>
<td>(5.4%)</td>
<td>(27.1%)</td>
<td>(43.3%)</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Weekly</td>
<td>(2.7%)</td>
<td>(13.5%)</td>
<td>(16.2%)</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Monthly</td>
<td>(0.0%)</td>
<td>(13.5%)</td>
<td>(16.2%)</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Yearly</td>
<td>(5.4%)</td>
<td>(2.7%)</td>
<td>(8.1%)</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>COVID-19 Period</td>
<td>(0.0%)</td>
<td>(8.1%)</td>
<td>(16.2%)</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Staff Types</td>
<td>(13.5%)</td>
<td>(64.9%)</td>
<td>(100.0%)</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>24</td>
<td>37</td>
</tr>
</tbody>
</table>

Table 2.9
d

Next, respondents give reasons for using cloud storage by answering the questions about their willingness to use the cloud storage in the future. In Figure 1, the result shows that the majority of the respondents (32%) use the cloud storage mainly to store and retrieve information. Besides, the minority...
(5.4%) answer the safety and paperless features for future usage.

Then, a question was asked to the respondents if they know that the UOS cloud storage related to E-learning has limited storage. Figure 2 shows that (73%) of the respondents are aware of that, while (27%) still do not know.

Therewith, the question of which file type stored in the cloud storage coming from the university E-learning system was asked to the respondents. The majority of respondents mentioned that the file type is the image file which consists of 70.3%, while the other types of files represent 29.7% Figure 2 illustrates the above-mentioned results.

Also, UOS E-learning receives submissions of answers (i.e., exams, reports and assignments). During the COVID-19 period, the subject is different. Thus, the result in Figure 3 presents that 54% of the respondents agreed that there are many late submission cases as a statement reviewed in the survey, demonstrating the major responses. Hence, one-tenth (5.4%) of the latter percentage shows disagreement, as they do not face any lateness case of students’ E-learning submissions.

In this study, the main objective is to investigate the UOS staff’s perception of cloud storage usage. In that regard, respondents were required to give their opinions about the cloud storage usage awareness, current usage issues and proposed solutions. Thus, table 3 shows 14 questions classified into three groups to clarifying the three research cores. Firstly, in cloud storage awareness core, the possibility of storing many file types has been emphasized by lots of respondents as it comes the highest agreed opinions among nine statements with mean (4.10) and standard deviation (0.7372). On the other hand, there are mean (3.37) and standard deviation (0.8929) describing the UOS staff response contrast of the neutrality and agreement about knowing the UOS cloud size limits. This contrast interprets that reason
for the limitedness of cloud storage does not come from insufficient capacity, but from big image data. Secondly, the core of the current issues presents an investigation of the new troubles of cloud storage. The UOS staff significantly agree that there are many image file duplication cases during the last UOS final exams, within mean (4.02) and standard deviation (0.7259). Based on that, UOS staff think the UOS cloud storage is been abused by storing lots of image files. Finally, most of the UOS staff believe that there is a need for more training on cloud storage usage for UOS staff, presented by mean (4.54) and standard deviation (0.7300).

Table 3. UOS staff’s perception about cloud storage.

<table>
<thead>
<tr>
<th>No.</th>
<th>Question</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Using UOS E-learning-based cloud storage during the Covid-19 period is useful.</td>
<td>-</td>
<td>-</td>
<td>9</td>
<td>18</td>
<td>10</td>
<td>4.02</td>
<td>0.7259</td>
</tr>
<tr>
<td>2</td>
<td>Cloud storage shares information resources, which makes the UOS E-learning process easier.</td>
<td>-</td>
<td>1</td>
<td>16.2%</td>
<td>62.2%</td>
<td>22</td>
<td>4.00</td>
<td>0.7071</td>
</tr>
<tr>
<td>3</td>
<td>Cloud storage gives me more control over my storage activities.</td>
<td>-</td>
<td>1</td>
<td>10.8%</td>
<td>62.2%</td>
<td>23</td>
<td>4.08</td>
<td>0.6822</td>
</tr>
<tr>
<td>4</td>
<td>Cloud storage addresses learning needs related to E-learning.</td>
<td>-</td>
<td>-</td>
<td>4.0%</td>
<td>20</td>
<td>8</td>
<td>3.97</td>
<td>0.6866</td>
</tr>
<tr>
<td>5</td>
<td>Cloud storage saves me time during my university work.</td>
<td>-</td>
<td>3</td>
<td>8.1%</td>
<td>18.9%</td>
<td>20</td>
<td>3.83</td>
<td>0.8337</td>
</tr>
<tr>
<td>6</td>
<td>Cloud storage reduces university employees’ effort by electronically sharing work.</td>
<td>-</td>
<td>1</td>
<td>13.5%</td>
<td>24</td>
<td>7</td>
<td>4.00</td>
<td>0.6666</td>
</tr>
<tr>
<td>7</td>
<td>Cloud storage saves cost as it saves purchasing more storage equipment in UOS E-learning.</td>
<td>-</td>
<td>2</td>
<td>13.5%</td>
<td>20</td>
<td>10</td>
<td>4.02</td>
<td>0.7988</td>
</tr>
<tr>
<td>8</td>
<td>Cloud storage stores many types of files (i.e., Word, PowerPoint, Pdf).</td>
<td>-</td>
<td>-</td>
<td>8.1%</td>
<td>17</td>
<td>12</td>
<td>4.10</td>
<td>0.7372</td>
</tr>
<tr>
<td>9</td>
<td>Cloud storage has a limited size to use.</td>
<td>2</td>
<td>1</td>
<td>48.6%</td>
<td>13</td>
<td>3</td>
<td>3.37</td>
<td>0.8929</td>
</tr>
<tr>
<td>10</td>
<td>Many late submissions cases are been noted while working on cloud storage in the last university final exams.</td>
<td>-</td>
<td>2</td>
<td>5.4%</td>
<td>10</td>
<td>20</td>
<td>3.75</td>
<td>0.7603</td>
</tr>
<tr>
<td>11</td>
<td>Too many cases of image file duplications are observed during cloud storage works in the last UOS final exams.</td>
<td>-</td>
<td>2</td>
<td>24.3%</td>
<td>18</td>
<td>10</td>
<td>4.02</td>
<td>0.7259</td>
</tr>
<tr>
<td>12</td>
<td>UOS cloud storage is been abused by storing lots of image files that represent the exams’ responses.</td>
<td>1</td>
<td>2.7%</td>
<td>29.7%</td>
<td>17</td>
<td>7</td>
<td>3.75</td>
<td>0.8945</td>
</tr>
<tr>
<td>13</td>
<td>UOS should use all the capabilities of cloud storage.</td>
<td>-</td>
<td>1</td>
<td>2.7%</td>
<td>4</td>
<td>19</td>
<td>4.18</td>
<td>0.7392</td>
</tr>
<tr>
<td>14</td>
<td>The need for more training for UOS staff to improve the cloud storage usage.</td>
<td>-</td>
<td>1</td>
<td>2.7%</td>
<td>10</td>
<td>24</td>
<td>4.54</td>
<td>0.7300</td>
</tr>
</tbody>
</table>

As a whole, the results underline the necessity of correcting the work path and improving the UOS cloud storage usage for the E-learning that could be made by the UOS management, for example, utilizing several text file types (i.e., MS office files, Pdf, and google docs). This process will save capacities, solve the submission lateness problem then it may boost the internet connection, as
suggested by (Harnik, Pinkas, & Shulman-Peleg, 2010). Also, results include utilizing all the cloud storage capabilities demanded by UOS staff, which needs more training to improve the UOS cloud storage usage, toward a successful university E-learning system. All the mentioned outcomes have significant indications that would lead to correct usage perception.

IV DISCUSSION
In the findings, the study reveals many issues in cloud storage usage subject. To some extent, the UOS staff have good knowledge about the cloud storage using in the E-learning. They also show a very positive attitude about the cloud perception points, which defines that there is a relationship between cloud storage and E-learning since the two topics work connectively as well as they use the same technology structure. The cloud storage features awareness has also been highly agreed by the staff, utilized in the relevant E-learning. As the result, the staff emphasize using all the UOS cloud storage capabilities through their experiential usage in UOS E-learning and mostly believe that there will be further improvement in the near future through new training. However, there are still existing problems in cloud storage usage specifically the insufficiency of the UOS cloud storage capacity, too many duplicated files and overwhelming the cloud storage with the misused file type. Similarly, using algorithms to decrease files repetition, Selvi (2018) suggests a solution for the cloud capacity wasting as a cloud usage problem. Also, researchers He et al. (2020) find out a useful framework for decreasing data duplication in cloud storage by using Hadoop technology, while the current research tries to treat the causes of such misusage. On the other hand, researchers Kaseb et al. (2019) resulted in developing a model utilizing such duplicated data in the cloud technology for availability, reliability and reducing the cost of data recovery.

As restrictions, this study faced some limitations such as the general institutions' ban, that has slowed the process of collecting the data. Extraordinary pandemic conditions forced this study to investigate in only one institution with the first time of applying the E-learning among a limited number of respondents, which draws attention that the research outcomes may not be generalized. Therefore, this research must be applied in such an application due to the study result may not apply to a big number of respondents.

V CONCLUSION
The study dialogue highlights the UOS staff opinions, identifying the usage perception deficits. The staff shows a high desire for receiving more training in the near future and utilizing further cloud characteristics, which gives hope of accomplishing fruitful outcomes of UOS E-learning application. Moreover, extraordinary COVID-19 pandemic condition needs investigation on such E-learning system based on cloud storage technology due to the impact of negative usage. This study focuses on the staff usage perception since it was under an emergent situation, and it found out that management misusages are the research issue. After improving staff management work, the study looks forward to suggesting investigating the student perception usage as future work by the UOS management. This pilot research outcomes would be utilized as a guideline for the UOS management. The next step in this study will be conducting the real data collection.

REFERENCES

Developing an Evaluation Framework for Immersive Learning Experiences for Software Engineering Project Course

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ABSTRACT
Most of the principles and concepts that need to be taught in Software Engineering courses are hard to share the realistic experiences because it is difficult to give the student practical exposure to the insight and processes involved. There is a non-existent approach to conveying the concepts of applying Agile Scrum and Team Software Process (TSPi) that involve learner, instructor and business stakeholder. This paper will explain the concept of a framework for efficiently building an immersive learning environment for both learner and instructor of Software Engineering Project course with the involvement of business stakeholder. This provides an opportunity for learning to be more focused on learning design through the prism of immersive environments rather than the collection of information. The online surveys were disseminated to third-year students who took the Software Engineering Laboratory course and the projects' stakeholders. This study aims to gain feedback from both sides on the effectiveness and suitability of the framework and concept in teaching and learning the course. Our experience in the creation, conduct and iteration of the course is outlined in this paper. It ends by assessing the degree to which we were able to achieve the course objectives established by the students and stakeholders.

Keywords: immersive learning, software engineering, experience, knowledge management.

I INTRODUCTION
In Computer Science, especially in Software Engineering courses, students' success and failure depend on the collaboration between the team members. The Software Engineering students must be taught on the theory and technical aspects of the software development discipline and the effectiveness of teamwork and social capabilities.

A significant component in Software Engineering courses is a software project development. The objective is to develop a software product for users or stakeholders who intend to use it regularly. Furthermore, students will learn to solve real industrial problems in the team. The Software Engineering students must not only be taught on the theory and technical aspects of the software development discipline, but also the effectiveness of teamwork and social capabilities.

TME3413 Software Engineering Laboratory (Jali, Masli, Shiang, Bujang, et al., 2017) is a course at the Faculty of Computer Science and Information Technology (FCSIT), UNIMAS. It offers to the third-year students of Software Engineering programme students who have grasped and self-equipped with the fundamentals of programming languages, scripting, software modelling and database management system (DBMS). These skills and knowledge help the students to develop different kind of systems.

II BACKGROUND
In coping with Future Ready Curriculum, a transformative delivery in teaching and learning such as Immersive Learning based on experience for the student to discover and share their experiential learning through hands-on and engagement with the industry and community (MOHE, 2018). Sharples states that Immersive Learning enables individuals to experience a situation as if they were there, using their expertise and tools to solve an issue or learn skills. In a virtual location, creating a feeling of partial immersive learning often involves Augmented Reality (AR) or Virtual Reality (VR) (2019). Applying Software Engineering project development with this learning pedagogy enables the students to experience real-world industry exposure with a real case study, stakeholder and the community. This allows the students to ask, learn strategies for solving problems and gain information by learning.

Immersive Learning Experiences focused on face-to-face teaching and blended learning methods that provide an impactful and meaningful learning experience to the students by allowing them to be actively engaged in tasks or projects that are not restricted to classroom settings (Carroll, 2014). Students will experience communicating with the stakeholders (local entrepreneurs) and building a quality software product that requires understanding. Thus, students will learn to perform user analysis, identify a value proposition, and analyse user experience data. Furthermore, working in a team...
effectively and excellent time management are essential skills to accomplish a common goal (Bruegge et al., 2015; Rodriguez et al., 2015).

Active learning is assessed through students’ oral communication skills. Students are given the opportunities to both discuss and observe their peers. It is also believed that real-world software development project experiences encourage students to enhance their written and oral communication skills (DiYanni et al., 2020; Offutt, 2013). Students will be assisted in developing problem-solving, critical thinking and analytic skills that are all valuable instruments in which students can prepare for better choices, become better students and finally better future employees.

Students have always been exposed to the necessary fundamentals, theories, and concepts in previous courses, but have not been asked to use these skills in real projects exposure settings with actual stakeholders. Assessments mainly solve the case studies taken from the textbooks or capstones projects, and students are not engaged with the real world project and actual clients. This course will help students to experience using Agile software development methods in industrial experience projects. The industries will be among the small and medium-sized local entrepreneur or stakeholders. During the semester, the project team will work together through the full development cycle, from understanding the requirements to delivering a functioning product. It will make a series of presentations and reports of the work to the client and the course coordinator.

III METHODOLOGY APPROACH

This TME3413 – Software Engineering Lab course practices involved the adoption of the Team Software Process (TSPi) (Jali, Shiang, Masli, & Asmadiah, 2019; Over, 2000; Sussy, Calvo-Manzano, Gonzalo, & Toms, 2008) and Agile software methodology for managing software projects in the industry. The Team Software Process (TSPi) provides a series of operational processes to the software engineers, which can help them organise software development projects more efficiently and effectively and improve their projects’ quality and productivity.

Meanwhile, Agile Software development focuses on individual and interaction, working software, stakeholder collaboration, and responding to change. It is an iterative, incremental method in the software development process. Both processes have similarities in terms of assigning roles and responsibilities and defining and discussing risks and issues to remove impediments (Jovanović et al., 2015).

Three important factors influence the software quality and team or organisation performances; Product, Team or People and Technology. Referring to the Figure 1.0, the process is placed at the centre of the triangle connecting these three factors in which the efficiency of the software process is measured via defects, productivity, calendar time, and so forth. Besides, three environmental conditions may influence the quality and performance, which include; Customer/Stakeholder characteristics (communication), Business condition (requirements rules) and Development Environment (Software tools).

Figure 1.0. Software Engineering Lab Project Framework (Jali, Masli, Shiang, Mat, et al., 2017)

A. Product

- The teams were given a list of real world projects and each project involved small-sized business stakeholders.
- The teams also encourage to find their own business stakeholders that suit for the project course.
- Defined their team’s and project goal and project milestones.
- Elicited requirements via conversational, observational, analytical and synthetic methods
- Deliverables include software requirements and design documents (e.g: SRS, SDS, working system, summary test report, user manuals, etc.)
B. Technology

- Integrating software tools and techniques in improving the efficiency of software development process.
- Utilise different tools for project management: TSPi support tool, Trello application, AgroUML, GitHub, Dropbox, so forth.
- Techniques/programming: Unified Modelling Language (UML), Java, PHP, and so forth.

C. Team

- The team formation between 5 to 7 members per group depends on the number of students course’s enrolment.
- Project team emphasis on the roles and responsibilities
- A good collaboration and communication between team members, instructor and clients.

IV IMPLEMENTATION

Since every software project is different, there is no set list of deliverables that every project must provide. Part of the teams’ task is to decide what is needed for this specific project. Typical deliverables include working code, documentation, training materials, test suites, etc.

The three primary criteria for a successful project are satisfying the client's needs, the usability of the product, and maintainability over the life of the product. These are group projects, but the students will also be rewarded individually for extra contributions to the project or fail to provide a fair share of the effort.

The project consists of two phases of a software product. The first phase is exploratory and represents the first attempt at developing the proposed software product. The deliverables for the first phase are reports 1 (revised proposal and SRS) and demo 1. After that, the instructors will provide feedback, and the students should reconsider and possibly revise the project goals before moving on to the second phase. It is acceptable to modify your objective in the middle of the semester, once the teams learn more about the project and better understand what they can accomplish within the semester timeframe. The deliverables for the second phase are report 2 (revised SRS, SDS, Test logs etc...) and demo 2.

This course does not assess on written examination and more on assessing the team’s final product (e.g., design, report, presentation), their group processes (e.g., ability to meet deadlines, contribute fairly, communicate effectively). The course assessments are summarised below:

<table>
<thead>
<tr>
<th>Table 1. Project Deliverables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Deliverables</td>
</tr>
<tr>
<td>Phase 1</td>
</tr>
<tr>
<td>Proposal Presentation</td>
</tr>
<tr>
<td>Initial Report</td>
</tr>
<tr>
<td>Demo 1</td>
</tr>
<tr>
<td>Final Report</td>
</tr>
<tr>
<td>Demo 2</td>
</tr>
<tr>
<td>e-Archive</td>
</tr>
<tr>
<td>Week 5</td>
</tr>
<tr>
<td>Week 10</td>
</tr>
<tr>
<td>Week 10</td>
</tr>
<tr>
<td>Week 13</td>
</tr>
<tr>
<td>Week 14</td>
</tr>
<tr>
<td>Week 15</td>
</tr>
</tbody>
</table>

Table 2. Course Assessment

<table>
<thead>
<tr>
<th>Course Assessments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuous Assessment (70%)</td>
</tr>
<tr>
<td>Project Proposal &amp; Planning</td>
</tr>
<tr>
<td>Design &amp; Implementation Specifications</td>
</tr>
<tr>
<td>Presentation &amp; Peer Evaluation</td>
</tr>
<tr>
<td>Team Evaluation &amp; Feedback</td>
</tr>
</tbody>
</table>

10 15 25 10 10 10 10

This course approaches provide a meaningful learning experience to your students; i. Help students gain a deeper understanding of concepts by seeing their application in complex real-world situations

ii. Involve students in active learning and encourage discussion.

iii. Nurture interpersonal or communication skills

iv. Teach the students how to manage time effectively

V STUDENTS’ ENGAGEMENT/INVOLVEMENT

As a means to support teaching and learning, the Bloom’s Taxonomy (Anderson, Krathwohl, & Bloom, 2001). is used for designing the projects’ learning activities. It consists of a set of three hierarchical models that classify the learning objectives into three learning domains; Cognitive (knowledge), Psychomotor (skills), and Affective (attitudes).

According to Bloom, the Cognitive domain includes six levels of intellectual skills that are arranged into a hierarchy from simple to complex behaviours; knowledge, comprehension, application, analysis, synthesis, and evaluation (Bloom, 1956). In Psychomotor domain, the skills described were those specific to physical movement, coordination and utilising motor skills. The Affective domain involves five areas that deals with emotional factor, also arranged into a hierarchy from simple to complex ways of dealing with things emotionally; receiving, responding, valuing, organising, and characterising (Bloom, 1956) (Krathwohl, Bloom, & Masia, 1964).
Therefore, the projects’ learning activities will enable the students' engagement with team members, instructor and stakeholders in meaningful learning in cognitive, psychomotor and affective learning domains.

a. Cognitive Domain
Solving cases from real clients/stakeholders (with analytically and creatively), applying software methodologies, teams prepare the reporting and deliverables (eg: reports, logs, codes etc..). Conduct the discussion and presentation with the teams, stakeholders and the course’s instructor.

b. Psychomotor Domain
Perform requirement elicitation (interview, survey, observation etc..), using suitable Computer-Aided Software Engineering (CASE) tools for each software development phases (software, hardware, online tools etc..).

c. Affective Domain
Time management in completing the system, communication skills and professionalism acts with teammates and stakeholders, excellent interpersonal skills, constructive feedback, and individual/teams responsibilities.

These domains activities apply to the proposed Software Engineering Project Learning Activities, illustrated in Figure 2.0. This learning activity framework has been practised for TME3413 Software Engineering lab course since 2017.

VI ACHIEVEMENT AND FEEDBACK FROM STUDENTS AND STAKEHOLDERS

A. Course Learning Outcomes (CLO) Achievement
Students who enrolled to TME3413 Software Engineering Laboratory course required to submit their evaluation form on the quality of the course content, teaching and delivery. Based on the students feedback, all the CLOs have been fully achieved (refer to Figure 6.0) and the list of CLOs are as follow:
CLO1: Practice the use of Software Engineering methodology in a team environment using a real-world application.
CLO2: Demonstrate the advantages of using several Computer-Aided Software Engineering Tools (CASE Tools) in major phases of software development.
CLO3: Complete an application solution for an organisation problem in a team.

Since this study was conducted and completed before the COVID-19 pandemic began, the framework has been successfully implemented and the results were presented in this paper. However, in light of the current COVID-19 pandemic situation, some framework components may not be suitable and have to be omitted or replaced with other means. For example, the face-to-face interactions between students, instructors and clients may be impractical due to the constraints caused by the lockdown, like fulfilling the Standard Operating Procedure (SOP), social distancing, students were not allowed to return to the university and other restrictions. Hence, another way to conduct the face-to-face interactions that will still fulfill this framework’s objectives is by using online video conferencing tools like Skype, Microsoft Teams, Zoom Meeting, Google Meet, and other similar tools.
B. Feedback from the Students

The list below are the questions given to the students and their feedbacks.

Question 1: Comments and suggestion for improvement on TME3413: Software Engineering Laboratory course.

“I enjoy learning SE Lab Course. All instruction are clearly stated.”

“The lecturer give us guidance and good explanation to complete the project assigned.”

“Workload is a little heavy but overall interesting course.”

“Great course and lecturer. I really like the design of the course.”

Question 2: Experience with the industrial client.

Share your stories here.

“This is the first time we have the chance to deal with real life which is quite stressful for our team as we worry that we are not able to achieve what the client. Our client is very friendly and after we had showed her our system, she is very satisfied with our work as we had done all the requirement that she mention before we start our project. Is a very great experiences for all of us to deal with the client.”

“Our client which is Mohamad Soleh first impression is he amazed what our system can function just like what he can imagine. Some of our system are include what he did not ask for which he is quite happy that the system will help him a lot. He then suggest some function for our system to make it more reliable than just a simple system. He thanks to us for giving him opportunity to be part of our project and he will support us if we want to improvise this system to another level of difficulty.”

C. Feedback from the stakeholders

The list below are the questions given to the project stakeholder / clients who participate in the students’ projects and their feedbacks. The questions were circulate via online survey direct to the stakeholders.

Question 1: What are the greatest strengths of the system? (Please provide supporting examples)

“Systematic, simple, clear and fulfil what I needed. It provide an announcement corner for me to outdate the information and also a system which I can keep update my location so my customer can actually know where I reach already.”

“We are unable to use the system yet. There are some hiccups during the installation and the team is in the midst of rectifying it. Nevertheless, from the YouTube presentation, it shows that the team has fully understood the user requirement. The system looks very user friendly, simple and easy to understand. Overall all the 4modules meet our expectation.”

Question 2: What are the areas where the students need to make an improvement? (Please provide example and suggestions for improvement)

“The User Manual is well written. Unfortunately, there are issues during the system set-up at the client's office. The student has to ensure that in real working environment that the project can be successfully implemented by the client within the planned timeline.”

“Search Engine Optimisation (SEO) - Get on top of Search Rankings with Google Ads.”

Question 3: Any Other Comments?

“The team is very good and responsible. All the requirement i asked they had done very well. Good Job”

“Overall, I am satisfied with the work done. Especially all the menu bar in admin page. It is very detail especially the sale report which can help me to summary all my sales and convenience for me to check the sales report. Nice!”

“Overall, the team has been very cooperative with our request and has maintained prompt communication throughout the project duration.”

The surveys showed students performed and learned well through the immersive environment in communication, teamwork and problem-solving skills. Positive feedback from students indicated that the course could motivate them to learn and boost their self-confidence to work in a real environment. Stakeholders expressed their satisfaction with the students projects besides giving few suggestions for improvement of the course. Throughout the entire project, communication is one of the essential skills in producing a system and work as a team and dealing with stakeholders. One of the most challenging of this course is that students hardly elicits the exact requirement needed by their stakeholders. Thus, by applying the proposed frameworks practices, students have given a full cooperation during the entire system development process, and manage to overcome all the obstacles in building a reliable yet user-friendly system. Furthermore, students need to learn new technology advancement in order to fulfil stakeholder need and demand.

VII CONCLUSION

This Software Engineering course lets the theoretical principles be shown to bridge the difference between theory and practice; from the classroom to the real
working environment. The students are able to apply the knowledge and content of the course in real-world situations. Therefore, they will find the effectiveness of applying an Agile software methodology and Team Software Process (TSPi) which focuses on the team software development project for undergraduate studies.

The course is able to enhance effective learning through the immersive environment and enable the students to develop key skills such as communication, teamwork and problem resolution. The students will also learn to discover how to effectively communicate and collaborate with development teams to carry out projects from concept to completion. Therefore, by the end of the course, they understood the importance of quality as a guiding principle that should be pervasive throughout a software development organisation. When their project satisfies the stakeholder’s needs and requirements, this will eventually boost the students desire to learn and feel confident in working in the real world environment and therefore ready for their internship programmes in the coming semester.

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REFERENCES


A Systematic Literature Review: The Conceptual of Educational Game Design with Augmented Reality

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ABSTRACT
Augmented Reality enhancements can apply into all senses. The ability into extraordinarily engage sight, hearing, touch, taste and smell. Augmented reality is one technologies revolution, bringing the full power of the creative and adaptive human mind to the digital-physical world. Therefore, this article explains a systematic literature review (SLR) methodology and concept to educational game design in augmented reality applications. The review studies include filtering relevant information on augmented reality and education game design from five databases to answer research questions. A total of 13 published between 2016 to 2020 randomly were used in the analysis. The literature review shows that most authors focusing only on the methodology, genre, tool, classification of augmented reality type, and the device's interface game design and limited on their development model. conclusion, we hope the conceptual of augmented reality in educational game design can be further inspiring and expanded by combining more knowledge and skills.

Keywords: Educational Game design, Augmented reality, and Systematic literature review

I INTRODUCTION
Augmented Reality has emerged as a technology that can overlay images, text, video, and audio components onto existing images or space. That's because augmented reality apps, headsets, and smart glasses hold the promise to add value to virtually every industry - from retail to industrial manufacturing. Augmented reality is already showing the key drivers of the tech economy and the potential to solve some of the biggest problems. (Ayer, S.K., et al, 2016 and Pombo, L., et al, 2019)

Augmented reality was a bit different from virtual reality the user will experience virtual objects that appear in the real world and do not only interact with a virtual object. (Chantzi, A.E., et al 2013) Investigating prior researcher in a field is important, as this reveals the current state of the field and offers guidance to researchers who are seeking suitable topics to explore.

Currently, there are many multimedia and online resources provided in the library, but reviews of research on augmented reality technology are less explored. The objective of this paper is to design the user motivation model by using augmented reality in educational game design. More specifically, the main research question (RQ): How to develop characteristics model to improve user motivation in augmented reality educational game design and why?

It is found that the existing model development criteria to increase motivation are only focused on characteristics, usability, effectiveness and appropriation in technology and model (Samaden, I.S et al.2020, Khan, T., et al. 2019, Tekedere, H., 2016, Li, J., et al 2017, Juan Vargas, C.G 2020) and the criteria of characteristics for model to improve user motivation in augmented reality of educational game design are limited in discussed.

II SYSTEMATIC LITERATURE REVIEW APPROACH
The approach was used Systematic Literature Review (SLR), to search, appraise, synthesize, and analyze all the studies relevant to a specific field of research. The methodology utilized is described by Kitchenham in “systematic approaches to success literature review” (Kitchenham, B., et al 2009). The planning defines the scope, searching, screening, data extraction, synthesis analyzing, and writing was seven steps utilized the SLR.

A. The planning for searching
In this phase, available online scientific databases to search for the literature. Therefore, Researchgate.net, ACM digital library, IEEE Xplore, Science Direct, and Google Scholar was five (5) relevant literature databases have been selected.

B. The scope defining
The PICO framework (Problem or Population, Intervention, Comparison or control, Outcomes - Outcomes should be measurable as the best evidence comes from rigorous studies with statistically significant findings) to define the scope in properly formulated answering research questions. For this study, P – identify the characteristic features of the

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http://www.kmice.cms.net.my/
internal interface concept Augmented Reality in educational game design. I. validation by experts surveys and questioner, observe, read the document. C. characteristic features of the external interface AR educational game design and O-new model.

C. The searching
The keywords used to search and find the relevant contents in a paper’s title and content is “Augmented reality educational game design,” Augmented reality and educational game design” OR “Educational game design and Augmented reality” since the word ‘augmented reality’ and ‘mixed reality is interchangeable.

D. The screening
Documents are screened to narrow down the documents to a final number of documents that are relevant for answering the research questions. Articles published from 2016-2020 are taken into consideration for inclusion in the search criteria. The exclusion criteria were: studies that are not related to the augmented reality as in technological perspective; Augmented Reality, and educational game design, educational game design. (Figure. 1)

The process for selections involved skimming the title abstract and result; skimming the introduction and conclusions; skimming full text; exclude duplicates; and quality as-Quality Assessment (QA). In this review, we developed three QA criteria to assess the quality of each study as presented below:

QA1: that the topic addressed in the paper related? 
QA2: that the research methodology described in the paper? 
QA3: that the data collection method described in the paper?

Each publication was assessed according to the ratio scale: Yes = 1 point, No = 0 point, and Partially = 0.5 point. The total quality score for each selected study was measured between 0 (very poor) and 4 (very good). Finally, 10 selected papers were retrieved and chosen which was related to Augmented Reality and educational game design setting.

E. The Data Analysis
After reviewing the final selected papers, categorization was made to identify the type of potential educational game design in AR. (Figure 1)

III RESULT
The search process provided a total of 13 primary studies. The following sections summarize the results of SLR according to the research question designed based on primary studies identified. Most related articles were retrieved from these databases because these databases published articles that are related to computers and education.

Based on this study, the number of articles published increased from 2016 to 2020. The drastic increase may have been caused by technological advances. However, in 2017, 2018, and 2020 there is an increased every year of publications related to the use of augmented Reality for educational game design.

Results indicated that the most discussed potential on augmented reality with education game design is in eight (8) following categories. (Table 1) shows the results from the SLR studies, which are the identified categories of concept and tool in augmented reality education game design about 2016-2020.

A. Reading Materials
Information can come from virtually anywhere. Look at the table below examining different sources of information.

B. Distinguishing Features
A textbook is an organized body of material useful for the formal study of a subject area. A good textbook is distinguished by:

- A discrete, well-bounded scope
- Use of examples and problems
- An internally consistent style
- A structure that makes sense
C. Academic Journals

An academic is providing good quality research articles, a peer-reviewed periodical that focuses on a narrow field of study. Academic journals serve as forums for the introduction and presentation for scrutiny of new research, and the critique of existing research to give inspiration to another researcher. In this case, in addition to searching through journal writing and proceeding, researchers also obtain information through related journals, books, news, and magazines.

Augmented reality is taking digital or computer-generated information, whether it be images, audio, video, and touch or haptic sensations, and overlaying them over in a real-time environment. augmented reality technology can be used to enhance all five senses, but its most common present-day use is visual. While, augmented reality devices can be broadly categorized into four types: head-up-display (HUD), holographic display, smart glasses optical see-through a display, and handheld/smartphone-based.

The augmented reality educational game design model has attracted users to share knowledge more engaging way, based on the previous researcher, mostly has focused on the exploration of model design to enable model production to meet target groups, such as tool, the edutainment gameplay genre, kindness, dan effectiveness

Results and discussion for his section the results reviewing and analyzing 13 published articles from 2016-2020 choose by randomly, that were related to Augmented Reality in education. In (Table 1), was a summary of the literature review.

V CONCLUSION

The conclusion for a previous review article from 2016 until 2020 explains a method review studies following a predefined procedure on educational game design in augmented reality application. Based on (Table 1), the concept of educational game design with Augmented Reality there come out with many concepts, example: simulation game technologies, virtual objects such as story animations, game-based learning and storytelling, combination with non-digital and digital elements, focusing on their interface design field, combination with diversity of fields, and combine with augmented reality with virtual reality.

Findings from this research showed us that more researches, teachers, students, and learning materials should be developed by using augmented reality and implemented in learning. To develop augmented reality first the technology and required 3D models should be prepared and the framework also should be considered accordingly and the augmented reality techniques in education, the exploration of different types of augmented reality, and the combination with the Al-Quran ayah concept still need to be explored. It to create a balance between the knowledge of the world and the knowledge of the hereafter.

ACKNOWLEDGMENT

We would like to express our gratitude to the Universiti Teknikal Malaysia Melaka (UTeM), Universiti Sultan Zainal Abidin (UniSZA), Universiti Teknologi MARA (UiTM), and Ministry of Higher Education (MOHE), for the support and scholarship sponsorship in this research.
Table 1. Summary of Literature Review

<table>
<thead>
<tr>
<th>Reference</th>
<th>number of samples</th>
<th>methodology</th>
<th>Genre</th>
<th>Classification</th>
<th>Devices</th>
<th>Concept and tool</th>
<th>Learner Outcome(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Augmented Reality Gaming in Sustainable Design Education (Ayer, S.K et al 2016) (Paper 1)</td>
<td>34 architectural engineering students, 47 architecture students, and 27 civil engineering students were given the same design activity using augmented reality 65 students completed a similar design activity using only blank sheets of paper, and another group of 23 students used a paper-based approximation of the computerized eco Campus.</td>
<td>simulation technologies</td>
<td>Action-game</td>
<td>Interaction simulation game technologies</td>
<td>ecoCampus mobile computing system</td>
<td>simulation game technologies would influence students’ design processes during the activity: eco Campus</td>
<td>students in all disciplines who used eco Campus were able to break the tendency toward design fixation. Students were also able to use the application to assess their designs and generate additional concepts with better overall performance across all disciplines compared with the students who used paper-based formats.</td>
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<tr>
<td>Educational magic toys developed with augmented reality technology for early childhood education. (Yilmaz, R.M. 2016) (Paper 2)</td>
<td>Mix method was used and the sample consisted of 30 teachers and 33 children aged 5 to 6 in early childhood education</td>
<td>magic toys (EMT) Mix method</td>
<td>Idle games</td>
<td>Interaction virtual objects such as story animations, 3D objects, and flash animations appear on the toys.</td>
<td>Educational magic toys (EMT) mobile computing system</td>
<td>EMT because virtual objects such as story animations, 3D objects, and flash animations appear on the toys. EMT has included puzzles, flashcards, and match cards to teach animals, fruits, vegetables, vehicles, objects, professions, colors, numbers, and shapes for average 5 to 6 age children in Early Childhood Education</td>
<td>Shaping children's experience, enhancing their imagination, affecting their behaviors, toys have great importance that these toys can be effectively used in early childhood education. However, collaborative and interactive learning with these toys should be provided. Moreover, this study will provide an important contribution to present a new educational AR application, and fill the gap in the educational technology field.</td>
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<tr>
<td>Science spots AR: A Platform for science learning games with Augmented Reality. (Laine, T.H. et al 2016) (Paper 3)</td>
<td>Geometry game prototype, and (3) mixed-method formative evaluation of Leometry with 61 Korean 5th-grade elementary school children.</td>
<td>Leometry game the Van Hiele model</td>
<td>Sport game</td>
<td>Interaction Game-based learning and storytelling</td>
<td>Mobilephone Science Spots AR (SSAR)</td>
<td>Game-based learning and storytelling are prominent methods Leometry game, which contains geometry problems based on the Van Hiele model. Concept and architecture of Science Spots AR, (2) design and implementation of the Leometry game prototype, and (3) mixed-method formative evaluation of Leometry elementary school children.</td>
<td>Three aspects of SSAR through Leometry: (1) features, (2) storytelling approach, and (3) impact. The formative evaluation results suggest that the Korean children appreciated the game’s features and its storytelling approach, and their answers regarding the overall impact were encouraging. The results also indicated that AR can be a powerful motivator, and other research has shown its potential in education (see Background).</td>
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<tr>
<td>A design-based approach to augmented reality location-based activities: Investigating immersion in relation to student learning. (Georgiou, Y., and. Kyza, E.A 2017)(Paper 4)</td>
<td>11th-grade students, comprised of two design iterations (n1=18, n2=10);</td>
<td>A design-based approach to augmented reality location-based activities</td>
<td>Adventure game</td>
<td>Tracking AR Application</td>
<td>Tablet. Global Positioning System (GPS), and AR application</td>
<td>Augmented Reality (AR) location-based learning activities are argued to promote students’ immersion, and the facility are learning.</td>
<td>Indicate that the students who participated in the second iteration reported being more immersed in the augmented reality activity, provided explanations of higher quality, and managed to solve the problem-based case.</td>
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<td>Title</td>
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<td>Augmented Reality in ubiquitous game with Application of the</td>
<td>(Paper 9)</td>
<td>Idle game</td>
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<td>The interactive</td>
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<td>Primary Education</td>
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<td>to strengthen the educational processes of appropriation of the traditions, and values of the Nasa culture. the process of design of the ARBG, the evaluation in the classroom, and the results.</td>
<td>positive results</td>
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<td>CoDesigning Game-Based learning with Augmented Reality with Teachers</td>
<td>(Co-CreaRGL)</td>
<td>PLEX framework</td>
<td>Adventure game</td>
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<td>(Training, Iterative Design and Classroom Evaluation)</td>
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<td>SEE ME ROAR</td>
<td>mobile game</td>
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<td>geo-located augmented reality (AR)</td>
<td>designed and made a prototype of SEE ME ROAR, an AR-based social learning game. The game is focused on helping primary school students engage in mathematics learning and interact with their classmates.</td>
<td>researcher plan to follow a practice-led approach to develop the game and instructional design, where the base prototype is modified to include these new levels.</td>
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<td>The tracking</td>
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<td>to explore the candidate teachers’ opinions about using augmented reality (AR) in classrooms. marker-based mobile augmented reality application has been developed and computer hardware devices are used as teaching material.</td>
<td>to obtain a deeper understanding concerning the motivations underlying Pokémon Go use and to create a measure that assesses these motivations.</td>
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<td>Augmented Reality Experience: Initial Perceptions of Higher Education Students.</td>
<td>(Sural, I., 2018) (Paper 8)</td>
<td>Adventure-games</td>
<td>marker-based mobile augmented reality application has been developed and computer hardware devices are used as teaching material.</td>
<td>very excited about using augmented reality.</td>
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<td>Descriptive research</td>
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<td>Augmented Reality gamification for human anatomy</td>
<td>(A. Argo el. al 2019) (Paper 9)</td>
<td>interactive exercises like quizzes and simulations to enable users to have a fellfield learning experience on the 3D human organ model enriched with dynamic virtual content. three main modules: server, content designer, and a mobile AR interface.</td>
<td>mobile AR interface. &quot;education tags&quot; introduction of game design elements to support university medical students in their learning activities during a human anatomy laboratory. the designed consist of three main modules: server, content designer and a mobile AR interface. &quot;education tags&quot;</td>
<td>the gamification process can substantially improve the learning experience of the students.</td>
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<td>Application of the ubiquitous game with augmented reality in Primary Education</td>
<td>A quasi-experimental study was carried out with 91 sixth-grade primary school students;</td>
<td>augmented reality application “WallaMe”</td>
<td>mobile phones</td>
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<td>Adventure game</td>
<td>to analyze the impact that the integration of ubiquitous game approaches augmented reality has on learning.</td>
<td>the experimental group obtained statistically significant improvements in the academic.</td>
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<td>Title</td>
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<td>Methodology</td>
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<td>The experimental group: 34 girls and 35 boys; The control group had 13 girls and 9 boys. The control group was formed of 22 students in a class that studied the same unit but using a textbook and “traditional” forms of teaching.</td>
<td>Sáez-López, J-M., el al 2019 (paper 10)</td>
<td>academic performance, student skills in searching for, and analyzing, information, level of fun, and collaboration established among the students.</td>
<td>augmented reality application “WallaMe” academic performance, student skills in searching for, and analyzing, information, level of fun and collaboration established among the students. performance of the subject, motivation, in the search for, and analysis of, information, level of fun and collaboration.</td>
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<td>Hybrid Board Game Design Guidelines</td>
<td>Ville, K., and Janne, P., 2019 (Paper 11)</td>
<td>Hybrid board games combine non-digital and digital elements to introduce a new kind of game experience.</td>
<td>Mix Hybrid board games combine non-digital and digital elements to introduce a new kind of game experience. combine non-digital and digital elements to introduce a new kind of game experience. These guidelines are the result of an iterative process of workshop, with industry experts and academic researchers, supported by developer interviews and player surveys. They are presented as starting points for hybrid board game design and aim to help the designers to avoid common pitfalls and evaluate different trade-offs.</td>
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<td>Augmented Piano in Augmented Reality</td>
<td>Santin, G., 2020 (Paper 12)</td>
<td>Augmented Instruments and Hyper instruments</td>
<td>To show some examples of different designs of AR piano augmentation from the composition Studi sulla realtà nuova. Interface Studi sulla realtà nuova</td>
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<td>EmoFindAR: Evaluation of a mobile multiplayer augmented reality game for primary school children</td>
<td>Lopez-Faican, L., and Jaen, J., 2020 (Paper 13)</td>
<td>mobile augmented reality without markers</td>
<td>mobile augmented reality without markers as the technology to implement a multiplayer game scenario that can be used to improve socialization, communication skills, and emotional intelligence in primary school children. study addresses the usability of two gameplay styles, and their impact on users’ communication, and motivation: competitive vs collaborative play. EmoFindAR both game modes are intrinsically satisfactory for children triggering positive emotions such as enthusiasm, enjoyment, and curiosity that improve the participants’ mood and help increase the degree of involvement. Moreover, we observed that the collaborative game version has a greater impact on emotional affection, social interaction, and interest.</td>
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REFERENCES


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Automated Fish Egg Counting System using Image Processing

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²Department of Data Science Universiti Malaysia Kelantan, City Campus, 16100 Kota Bharu, Kelantan, Malaysia, {nooraini.y@umk.edu.my}

ABSTRACT

The fish industry is a source of income for fish breeders. Fish egg selection is one of the important aspects in determining the quantity of fish eggs. The quantity of fish eggs purchased from practitioner may be insufficient due to undetected poor quality of fish eggs. Hence, this study focuses on automated fish egg counting system using image processing method utilizing k-means algorithm. The image of fish egg are captured and processed to calculate the total number of fish egg automatically. The results demonstrate potential use of the proposed automated counting system with accuracy up to 99.41%. Furthermore, with the proposed automated counting, the manual counting time can be reduced to an average time of 1.29 seconds. This could benefit the fish breeding industry in screening good quality of eggs automatically.

Keywords: automated counting system, image processing, fish egg, k-means algorithm.

1 INTRODUCTION

The fisheries sector plays a major role in Malaysia's economy, as a source of income and employment. It is also one of the foreign exchange markets. Fish is normally consumed by races in Malaysia and plays a crucial role as a source of protein in daily diet. Based on the Third National Agricultural Policy (NAP 3), the fish demand and fishery products are expected to increase substantially due to high population growth and increased per capita GDP (GDP) (Othman, 2010). Supply of fish from domestic suppliers may not raise the expected amount for consumption. Therefore, both fish imports and fish prices are expected to increase.

Aquaculture in Malaysia has been one of the top 15 producers in the world, with a cumulative output of 521,000 tonnes (FAO, 2016). As a global producer of fisheries sector, it is important to ascertain the framework and the current challenges faced by the business. In 2013, the fisheries sector contributed 1.1% of the world's production, with contribution of 0.4% in aquaculture (Chan, 2017). Aquaculture contributes 8.9 per cent of the overall national gross domestic product (GDP), supplying Malaysians with an unprecedented 1,753,900 million jobs (Fathi, 2018). It shows that the sector offers national food security and acts as the potential contributor in alleviating hunger and poverty around the world (Allison, 2011).

Fish breeding is one of the key areas in the fisheries sector. It is a complex process that involves careful preparation and monitoring procedure. The most essential aspect in fish breeding is to maintain optimum egg quality. A systematic standard egg selection procedure has yet to be implemented in which egg suppliers capture the image of eggs and manually count the quantity of egg production. For manual counting process, the fish egg was counted manually one by one. Since counting the number of fish by hand is difficult and also the possibility of error is high, a system based on the image processing in different places and conditions was designed (Zion et al., 2006).

Recent years, many techniques for automated counting system using image processing with varies domain are proposed, but it is lack of in fish egg domain field. During the process of preparing this project, we only found the latest study in fish egg domain proposed by (Huang et.al, 2016; Westling, et.al, 2014). The method used for the counting process, also varies from each other. Blob analysis, connected components analysis, statistical area measurements, Otsu's method and watershed method are widely applied in the previous research for counting process (Fabric et. al, 2013; Xiaomin and Feihong, 2013).

Counting of fish egg is important especially in hatchery due to the production of eggs in a fish population is a fundamental parameter in fisheries management and quality control (Far Eastern Agriculture, 2016). In view of the aforementioned facts, to automate the counting process using image processing technique would reduce the time consumption, minimize the exposure to unhealthy situation and ensure accurate estimation of fish eggs. The above literatures showed that little research was done for fish egg management in fisheries industry based on quantity and quality especially in Malaysia.
In this study, an automated fish egg counting system is proposed using image processing algorithm in MATLAB software. The method consists of three main steps: fish egg image acquisition, image segmentation, and counting process. First, a digital camera is used to capture the color image of fish egg samples. Next, remove all the unwanted background and remaining the region of interest (ROI) in grey images form. Lastly, to isolate overlapping eggs so that accurate counting process can be conducted.

Hence, this project is implemented to ease the fish breeders in terms of counting a total number of fish eggs automatically by capturing the fish images only.

II METHODOLOGY

The study’s approach followed the methodology which are detailed as follows.

A. Image Acquisition

Image acquisition is the creation of a digitally encoded representation of the visual characteristics of an object, such as a physical scene or the interior structure of an object (Tambouli, 2020). This process is important to capture a clear and sharp image. For this process, a valuable input must be included where the image captured needs to be clear and sharp in order for MATLAB application to identify the shape of an image. A digital camera with the following specifications is used to digitize the fish egg: Sony α6000 with 16mm-50 mm lens, 4000X4000 image size for optimum detection of fish eggs, and camera flash is turned off. The total images captured are 22 images with different numbers of fish eggs. Figure 2 provides the examples of fish eggs. The image height of the camera and basin, containing fish eggs, vary from 0.75 meter up to 1 meter depending on the amount and condition of fish eggs. A basin with black color as shown in Figure 1 is used for convenient image acquisition.

![Figure 1. Apparatus setting for image acquisition process](image1.png)

The process of capturing the fish egg image is supposed to be done by the same person in order to avoid any misconduct of the setting. After all the fish egg images have been captured, the images that are clear and sharp are uploaded to MATLAB application to proceed to the next step. Figure 2 shows several samples of the images.

![Figure 2. The sample image of fish egg](image2.png)

B. Image Processing

The next process of the system is image in which it determines how the image is processed in order to count the total fish egg images. In this process, there are two sub-processes that need to undergo before the counting process, which are image segmentation and morphological operation.

**Image Segmentation (k-means algorithm).** Image segmentation is the division of an image into various categories. It divides an image into a number of discrete regions, so that the pixels in each region have high similarity and high contrast between regions. There are several methods that are often used by researchers in image segmentation such as thresholding based, edge based and clustering based. In the process of image segmentation, k-means clustering algorithm will be applied in order to choose which image suits more to proceed to counting process. k-means clustering algorithm is an unsupervised algorithm and it is used to segment the interest area from the background. The algorithm partitions the given data into k-clusters or parts based on the k-centroids. In this process the k in the k-means algorithm will be determined and set into k=4. Figure 3 shows the resulted image on every k cluster and k=4 is chosen as the most suitable image to be counted in the next process. After the k have been set, the image will undergo erosion and dilation process (morphological operation).

![Figure 3. The resulted image of k-means algorithm](image3.png)
Morphological Operation. Morphological operations apply a structuring element to an image input, thus creating an image output of the same size. The values for each pixel in the output image are based on a comparison of the corresponding pixel in the input image to its neighbors in a morphological process. There are two processes in morphological operation that are being used in this process which are erosion and dilation.

Erosion. Morphological erosion removes islands and small objects so that only substantive objects remain. In this process, erosion is applied in order to reduce boundaries and increase the size of space between each of the eggs so the eggs will not be overlapped. Figure 4 shows the resulted image after being eroded.

![Figure 4. The resulted image when erosion is applied](image)

Dilation. Morphological dilation makes objects more visible and fills in small holes in objects. This process is applied in the system in order to add more pixels in each of the eggs to make it clearer and visible so that the counting process would be easier. Figure 5 shows the resulted image after being dilated.

![Figure 5. The resulted image when dilation is applied](image)

C. Counting Process
The final step in automated counting system for fish egg is the counting process. In this process, the counting is performed using `bwconncomp` function in MATLAB. This function is used to return the connected components (CC) found in the binary image of fish egg (BW) in order to analyze the wanted region to be counted.

The counting process requires an adequate output for image segmentation or else the counting process is inaccurate. Figure 6 shows the process of the system.

![Figure 6. Counting process of fish egg by using image processing method](image)
The user could fill in the detail of the fish egg and upload the image by clicking on the ‘Upload’ button, followed by the ‘Count’ button to count the number of fish eggs as shown in Figure 8. The result will be displayed in the textbox given as well as the image of the fish egg that have been converted into binary image (black & white).

![Figure 8. Upload image](image)

After the user finished uploading the image, the result can be counted by clicking the ‘Count’ button. A binary image will be produced as well as the total number of fish eggs in the space provided as shown in Figure 9.

![Figure 9. Counting image](image)

After completing all the processes, the user could click ‘Save’ button to save the image counted with the result or the user can click on ‘Reset’ button to enter a new image and all the images will be reset.

### IV RESULTS OF AUTOMATED COUNTING SYSTEM FOR FISH EGG (ACSFE)

#### A. System Result

For the system result, the automated counting process has been analyzed by doing comparison to manual counting process. All 22 images were counted and the average duration recorded by using the Eq. (1) below:

\[
t_{\text{avg}} = \frac{\sum_{i=1}^{n} t_i}{n}
\]

where \( t_i \) and \( n \) represent the counting time for \( i \)-th image and total samples, respectively. Table 2 shows the result of the manual counting process.

#### Table 2. Result of Manual Counting Process of Fish Egg

<table>
<thead>
<tr>
<th>Image No.</th>
<th>No of eggs count</th>
<th>Counting Time, ( t ) (sec)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>214</td>
<td>277.0</td>
</tr>
<tr>
<td>2</td>
<td>132</td>
<td>145.0</td>
</tr>
<tr>
<td>3</td>
<td>142</td>
<td>153.0</td>
</tr>
<tr>
<td>4</td>
<td>159</td>
<td>224.0</td>
</tr>
<tr>
<td>5</td>
<td>162</td>
<td>273.0</td>
</tr>
<tr>
<td>6</td>
<td>194</td>
<td>152.0</td>
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<tr>
<td>7</td>
<td>159</td>
<td>203.0</td>
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<td>8</td>
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<td>212.0</td>
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<td>9</td>
<td>158</td>
<td>238.0</td>
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<tr>
<td>10</td>
<td>160</td>
<td>251.0</td>
</tr>
<tr>
<td>11</td>
<td>260</td>
<td>274.0</td>
</tr>
<tr>
<td>12</td>
<td>73</td>
<td>57.0</td>
</tr>
<tr>
<td>13</td>
<td>169</td>
<td>198.0</td>
</tr>
<tr>
<td>14</td>
<td>259</td>
<td>183.0</td>
</tr>
<tr>
<td>15</td>
<td>104</td>
<td>119.0</td>
</tr>
<tr>
<td>16</td>
<td>328</td>
<td>287.0</td>
</tr>
<tr>
<td>17</td>
<td>170</td>
<td>154.0</td>
</tr>
<tr>
<td>18</td>
<td>110</td>
<td>100.0</td>
</tr>
<tr>
<td>19</td>
<td>263</td>
<td>234.0</td>
</tr>
<tr>
<td>20</td>
<td>169</td>
<td>150.0</td>
</tr>
<tr>
<td>21</td>
<td>169</td>
<td>136.0</td>
</tr>
<tr>
<td>22</td>
<td>205</td>
<td>194.0</td>
</tr>
</tbody>
</table>

**Average duration** \( t_{\text{avg}} \) \( = 191.54 \) sec

Based on the data collected for the manual counting process, the time taken for the manual counting process are considered as long by averaging time of 03:19 minutes for all 22 image sample.

Table 3 shows the result of automated counting of fish egg for 22 images.

#### Table 3. Result for Automated Counting

<table>
<thead>
<tr>
<th>Image No.</th>
<th>Manual Counting</th>
<th>Automated Counting</th>
<th>Accuracy (%)</th>
<th>Counting Time, ( t ) (sec)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>214</td>
<td>202</td>
<td>94.39</td>
<td>1.71</td>
</tr>
<tr>
<td>2</td>
<td>132</td>
<td>132</td>
<td>100</td>
<td>1.14</td>
</tr>
</tbody>
</table>
Based on Table 3, the time to process the image for the automatic counting process is faster compared to the manual counting process by an average of 1.282727 seconds for all 22 sample images. The gap between automatic and manual counting is very wide for this project, and it can be assumed that the automated counting method is faster compared to the manual counting process for fish eggs, because the average accuracy of this project can also be as high as 99.41%.

**B. Evaluation Result**

To test the usefulness of the system, a usability evaluation has been conducted comprising 10 respondents selected among the postgraduate students and lecturers at one of the public university in the northern of Malaysia, with expertise and experience in image processing area.

The instruments used for the evaluation were the ACSFE system and a post-task questionnaire. The post task questionnaire was prepared using online Google Form, which consists of two sections. Section A consists of demographic questions while Section B contains questions related to respondents' opinions on the usability of ACSFE in a five-point Likert scale where one represents strongly disagree, and five represents strongly agree. The respondents followed the step-by-step procedure before answering the evaluation. The steps are as follows:

1) Read the information sheet and sign the consent form

2) Interact with the function of ACSFE based on the information sheet

3) Answer the post-task questionnaire

As for the demographic information, 70% of the respondents are Image Processing Experts, while 30% are Academia Researchers. Most of the respondents are male 70% of the total respondents, while 30% of the respondents are female. The age group of the respondents are 10%, 30%, 40% and 20% with age being classified into 21-25, 26-35, 36-45, and above 46, respectively. Most of the respondents (i.e. 70%) did not know about any system that can automatically count fish eggs while another 30% are not sure with the statement.

Section B of ACSFE measures the respondents' perception towards ACSFE usefulness and ease of use. It also measured the respondents' satisfaction towards ACSFE. Tables 4, 5, and 6 reported the frequency and average of the responses. The respondents rated at least “Agree” to the three aspects of the usability. None of the respondents disagreed with only a few rated as “Neutral”.

<table>
<thead>
<tr>
<th>Image No.</th>
<th>Manual Counting</th>
<th>Automated Counting</th>
<th>Accuracy (%)</th>
<th>Counting Time, $t$ (sec)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>142</td>
<td>145</td>
<td>97.93</td>
<td>1.52</td>
</tr>
<tr>
<td>4</td>
<td>159</td>
<td>157</td>
<td>98.74</td>
<td>1.19</td>
</tr>
<tr>
<td>5</td>
<td>162</td>
<td>145</td>
<td>89.51</td>
<td>1.22</td>
</tr>
<tr>
<td>6</td>
<td>194</td>
<td>189</td>
<td>97.42</td>
<td>1.32</td>
</tr>
<tr>
<td>7</td>
<td>159</td>
<td>153</td>
<td>96.22</td>
<td>1.12</td>
</tr>
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<td>8</td>
<td>156</td>
<td>117</td>
<td>75</td>
<td>1.25</td>
</tr>
<tr>
<td>9</td>
<td>158</td>
<td>116</td>
<td>73.42</td>
<td>1.40</td>
</tr>
<tr>
<td>10</td>
<td>160</td>
<td>154</td>
<td>96.25</td>
<td>1.23</td>
</tr>
<tr>
<td>11</td>
<td>260</td>
<td>229</td>
<td>88.07</td>
<td>1.34</td>
</tr>
<tr>
<td>12</td>
<td>73</td>
<td>68</td>
<td>93.15</td>
<td>1.05</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Image No.</th>
<th>Manual Counting</th>
<th>Automated Counting</th>
<th>Accuracy (%)</th>
<th>Counting Time, $t$ (sec)</th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
<td>169</td>
<td>168</td>
<td>99.41</td>
<td>1.21</td>
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<tr>
<td>14</td>
<td>259</td>
<td>233</td>
<td>89.96</td>
<td>1.45</td>
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<td>100</td>
<td>1.10</td>
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<tr>
<td>16</td>
<td>328</td>
<td>302</td>
<td>92.07</td>
<td>1.53</td>
</tr>
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<td>17</td>
<td>170</td>
<td>164</td>
<td>96.47</td>
<td>1.21</td>
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<td>18</td>
<td>110</td>
<td>102</td>
<td>92.72</td>
<td>1.15</td>
</tr>
<tr>
<td>19</td>
<td>263</td>
<td>216</td>
<td>82.13</td>
<td>1.33</td>
</tr>
<tr>
<td>20</td>
<td>169</td>
<td>141</td>
<td>83.43</td>
<td>1.20</td>
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<tr>
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<td>169</td>
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<td>97.63</td>
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<td>22</td>
<td>205</td>
<td>193</td>
<td>94.15</td>
<td>1.30</td>
</tr>
</tbody>
</table>

Table 4. The Respondents’ Responses on the Usefulness of ACSFE
ACSFE was considered to be effective and easy to use based on the results of the evaluation. In addition, the respondents’ reported that they were satisfied with the features of the app that facilitate their needs with the system. The respondents also professed that ACSFE could help them in counting the number of fish eggs faster than manual counting and the results also have high accuracy. The respondents indicated that ACSFE was easy to use without the need for written guidance about the user interface, and the respondents can easily remember how to use the system. In addition, the respondents were pleased with the system’s functionality, and expected to suggest the system to others.

**V CONCLUSION AND FUTURE WORKS**

As a conclusion, this paper presents an automated way to count the number of fish eggs by using image processing method which is k-means algorithm. This system demonstrates potential to automatically count the number of fish eggs rather than using manual counting that consumes a lot of time. The result of the system also indicates significance with a high accuracy up to 99.41% which is reliable to be used. ACSFE could increase the fishery companies’ efficiency by providing exceptionally fast and high average counting accuracy compared to the conventional manual counting process.

Furthermore, this system is simple and user friendly. For future works, the system can be improved in terms of security features where the user can be able to sign in and register to use the system. Besides, for future updates, users who already have an account to the system may experience more features of the system in terms of choosing a good quality of fish egg and also improve the counting process of the fish egg. Finally, process steps for automatic counting of a total number of fish eggs defined and empirical tested in the research finding would be replicating as a knowledge transfer process for future study in fish eggs domain. Suggestion for future research to design
and develops highly accurate system with more contrast fish egg image which builds upon earlier findings of this study.

ACKNOWLEDGMENT

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REFERENCES


Knowledge Sharing on the Acceptance of Smart Waste Management System: Moderating Effects of Local Cultures

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ABSTRACT

Smart cities utilize information and communication technologies (ICTs) to increase operational efficiency and effectiveness and share information with the public with the aim of improving government services, citizen welfare, and overall quality of urban life. Based on previous studies, the results of the implementation of ICTs are different from one city to another. It was found that in some cities, the implementation was successful, while in others, it was not as successful. This phenomenon often raises the question as to what the main cause of success or failure is, of the implementation and acceptance of technology in society. Various factors can influence success in the adoption of technology. The issue of waste management is one the biggest challenges to local authorities of both small and large cities. It is an important question that needs to be investigated in academic research, regarding the potential of smart cities in remediating environmental problems in general and waste management. In this paper, we focus on governance in using the Smart Waste Management System (SWMS) for waste management. The successes of Smart Waste Management System (SWMS) may be attributed to many factors. We are concerned with cultural roles, mainly on what we term as “local culture” (LC) elements of SWMS acceptance. The main focus of this paper is based on Hofstede’s Onion Model and adopted in the proposed model: Knowledge Culture, Basic Assumption Culture, and Beliefs Culture.

Keywords: Local cultures, smart city technologies, moderating, technology acceptance.

1 INTRODUCTION

The European Commission defines smart cities as places where traditional networks and services are made more efficient with the use of digital and telecommunication technologies for the benefit of its inhabitants and businesses. It clearly indicates that the smart cities use information and communication technologies (ICTs) to increase operational efficiency and effectiveness, and to disseminate information to the public with the aim of improving government services, citizen welfare and overall quality of urban life. In this paper, we refer to the ICTs artifacts used by smart cities as Smart Cities Technologies (SCTs for short). With the advent of the 4th Industrial Revolution (4IR), harnessing the potential technologies of 4IR will require governments of the cities to integrate new innovation and technology-related concepts, to allow more effective, improved, higher-quality public services, and greater infrastructure robustness. Many studies have focused on the technology infrastructure and the importance of new SCTs in relation to modern infrastructure in cities (Kummitta, 2018). They have focused on how smart communities could be smarter, and cities could be designed to implement SCTs. Waste generation is a concern for modern societies due to both, the service cost of waste collection, and the environmental issues of landfills. The IoT seems a promising solution for handling waste collection and recovery operations in smart cities (Zanella et al., 2014).

However, with respect to these SCTs, issues related to their failure or success at the technology acceptance level are still crucial, and these issues are commonly discussed topics in research, discussions on which are ongoing in current literature. SCTs solutions must be holistic enough so that they can engage people and are sustainable economically, environmentally, socially, culturally, and ethically. For example, there are internal and external determinants related to smart cities studied in (Myeong et al., 2018). The government perception that efforts to accept SCTs must be able to address all stakeholders, has had a direct or indirect impact towards SCTs. Hence, the level of SCTs acceptance at the organizational level is always influenced by the perception of all stakeholders. For instance, stakeholders’ local perception towards SCTs has to be carefully tackled with a holistic approach which is not only limited to giving a full emphasis on SCTs from a technological aspect. In fact, local urban identity, culture, and knowledge ecosystems continue to shape innovative capacity and technological acceptance despite global exchange in talent, trade, and technology. There are many studies such as (Sun et al., 2018; Baptista &
Oliveira, 2015; Goularte & Zilber, 2018; Ozbilen 2017) which elaborate on the role of cultures in technology acceptance. Most studies are regarding the dimension of the national culture model (Hofstede, 2011) such as power distance, individualism versus collectivism, masculinity versus femininity, uncertainty avoidance, and long-term orientation. Hofstede's cultural dimension is a general aspect of culture which is used to understand the differences in culture across countries and is not specific to locality culture. There are a few studies (Ucar, 2018; Cui et al., 2017; Pannilage, 2016; Gabriel, 2015) focused on the constructs that are related to what is referred to as a local culture. Although there is no standard definition of local culture, the term “local” can be understood as configurations of people as well as their practices and experiences that exist under the nation-state (Gabriel, 2015). By "culture" it refers to a collective minded programming where there are distinguishing factors in patterns of thought, feelings, and actions between experts in a society or a human group and another community or other human groups (Hofstede 2011). Hence, "local culture" would be understood as the way people live where all aspects of human thought or beliefs and behavior are inherited from one generation to another through the process of learning in that particular locality or area.

Therefore, this study attempts to explore whether local cultural factors would cause urban failure in the context of the intention to use SWMS from an organizational perspective. It would be able to address two important points regarding SCTs which this paper attempts to investigate further. First, although smart cities are on the rise, it is crucial to understand why the same initiatives succeed in some places but not in others. Is this failure due to a specific aspect of a cultural issue like local cultural factors? Second, taking a local culture perspective would be a promising theoretical lens that could yield new insights into the local success of SWMS. The composition of this paper is as follows. We start looking at the background of this paper. Next we describe a theoretical foundation and also establish our proposed research model. Subsequently we briefly give a research direction to be taken from this paper and discuss the main contribution of this paper in relation to our proposed model. Finally, we conclude the research in progress work and provide an explanation on what is next for future work.

II BACKGROUND

A. Smart City and The Fourth Industrial Revolution (4IR)

A rapid urban development process and the provision of various services to the community should be placed on the main agenda of transformation in steps towards moving on to a smart city. There is still no standard for defining a smart city (Anthopoulos & Fitsilis, 2013). But it can still be seen and measured from the efficiency of management and the improvement of the quality of township and the livelihoods of a city. It is evident that most researchers have emphasized the term smart city since 1998 (Bastelaer, 1998), where more recent studies focus on the relationship between smart city components (Giovannella, 2013; Giffinger, 2007). The 4IR posed many challenges to public administration in developing countries, where human and material resources were inadequate to bring about significant technological advancements, despite the increasing benefits, as a result of efficiency and effectiveness in service delivery. The 4IR technologies will effectively enable the SCTs and play a part in making their acceptance and subsequently, adoption level, a complex endeavor.

B. The Role of Local Government, Cultures and Technology Acceptance Issues in Smart Cities

The development and management of a city center is a complicated and challenging task for a local authority which aims to ensure quality of life to the population by providing the best services. Therefore, a local authority should also be prepared to transform the city management operations to become more efficient and effective, in line with the smart city goals. The government must be able take decisions in favor of accepting the SCTs (in this paper the focus is on SWMS). However, this is a very challenging task, since the SWMS level of acceptance is always influenced by multiple factors and perspectives. Culture plays an important role not only in terms of cultural influence, but also in bringing economic and technological developments, and furthering the ideology of the developed countries on a global level. Studies of cultural factors on technology adoption have also been widely applied in previous studies.

Referring to Table 1, the two main components of the previous study were, the basic theory used, and the cultural factors that were focused on the study. In terms of the theory used, previous studies have used TAM and UTAUT in studying technological adoption, most of which have used the TAM theory as the basic theory. On the other hand, the second component is a cultural factor which in the previous studies focused more on Hofstede's cultural
dimension model. Studies have revealed different user experiences related to the success of modern technologies that use different cultural values, and levels of technology acceptance, as determinants of consumer recognition and response to new technologies (Yoo et al., 2011). Issues on technology acceptance in smart cities are crucial and unique. Technology acceptance models can be classified into different categories as argued by Hsiao and Yang (2011). These categories are: 1) Psychological approach which focuses on ease of use; 2) A social or commercial approach; and 3) A task-related, information systems approach. For entities as complex as smart cities, the integration of all three approaches is a necessity (Yigitcanlar et al., 2018).

<table>
<thead>
<tr>
<th>Table 1. Studies on the role of culture on technology acceptance.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sun et al. (2018) - Impact of cultural values on technology acceptance and technology readiness</strong></td>
</tr>
<tr>
<td>Cultural Factors: Collectivism, Long-term Orientation, Masculinity</td>
</tr>
<tr>
<td><strong>Theory Use:</strong> Hofstedé's national culture, TAM</td>
</tr>
<tr>
<td><strong>Acceptance Factors:</strong> Discomfort, Perceived Ease of Use, Perceived Usefulness</td>
</tr>
<tr>
<td><strong>Domain Context:</strong> Hotel Management</td>
</tr>
<tr>
<td><strong>Baptista and Oliveira (2015) - Understanding mobile banking: The unified theory of acceptance and use of technology combined with cultural moderators</strong></td>
</tr>
<tr>
<td>Cultural Factors: Collectivism, Femininity, Individualism, Long-term Orientation, Masculinity, Power Distance, Short-term Orientation, Uncertainty Avoidance</td>
</tr>
<tr>
<td><strong>Theory Use:</strong> Hofstedé's cultural dimension, UTAUT 2</td>
</tr>
<tr>
<td><strong>Acceptance Factors:</strong> Effort Expectancy, Facilitating Condition, Habit, Hedonic Motivation, Performance Expectancy, Price Value, Social Influence</td>
</tr>
<tr>
<td><strong>Domain Context:</strong> Mobile Banking</td>
</tr>
<tr>
<td><strong>Al-Jumily and Hussain (2014) - The impact of cultural factors on technology acceptance: A technology acceptance model across Eastern and Western cultures</strong></td>
</tr>
<tr>
<td>Cultural Factors: Collectivism, Individualism, Power Distance, Uncertainty Avoidance</td>
</tr>
<tr>
<td><strong>Theory Use:</strong> Hofstedé's cultural dimension, TAM</td>
</tr>
<tr>
<td><strong>Acceptance Factors:</strong> Facilitating Conditions, Perceived Ease of Use, Perceived Usefulness, Political Factors, Social Factors</td>
</tr>
<tr>
<td><strong>Domain Context:</strong> Education</td>
</tr>
<tr>
<td><strong>Lin (2014) - An investigation of the effects of cultural differences on physicians’ perceptions of information technology acceptance as</strong></td>
</tr>
<tr>
<td>Cultural Factors: Collectivism, Femininity, High Context, Individualism, Low Context, Masculinity</td>
</tr>
</tbody>
</table>

C. Smart Waste Management System (SWMS)

Smart waste management system (SWMS) is a solution to manage and improve cities governance in terms of waste collection systems using ICT technology. Local authorities have an opportunity on access networks to support all types of city management and maintenance services which require data connection (Gutierrez et al., 2015). SWMS is currently the best and most trending solution (Mahajan et al., 2017) which helps Local Authorities monitor real time waste management data such as collection data. Therefore, SWMS provide an accurate reports, increase the efficiency of the system and make good governance.

III THEORETICAL FOUNDATION AND RESEARCH MODEL

A. Theoretical Foundation of Technology Acceptance

There are several commonly used theories for predicting and describing behavior related to the usage and acceptance of technology. Therefore, some basic theories have been used such as TRA (Azjen & Fishbein, 1980), IDT (Rogers, 1983), TPB (Azjen, 1991), TAM (Davis, 1989), TOE (Tornatzky &
Fleischer, 1990), UTAUT (Venkatesh et al., 2003), and TAM 3 (Venkatesh & Bala, 2008). The application of these basic theories can also be seen from two aspects of the research paradigm as described by Porter and Donthu (2006). The first paradigm defines a specific system and focuses on how the characteristics of technology influence one's perception of technology. The TAM has become one of the most widely used models (Porter & Donthu, 2006). There are two main constructs in TAM that influenced the use of technology, namely, perceived usefulness and perceived ease of use. However, El-Gohary (2012), argues that the above model is appropriate to investigate the use of technology at the individual level. TAM's main focus is on technology-related neglect of social and psychological parameters (Venkatesh & Bala, 2008), that limits its explanatory and predictive utility, and thus demands integration with other frameworks (Awa et al., 2015). The second paradigm focuses more on the hidden personality dimensions in explaining the acceptance and adoption of new technologies. However, in this study, authors prefer to focus on the acceptance of technology at the organizational level, taking into account not only technology, but also other holistic aspects such as culture, in particular. In terms of paradigm, this study is more likely to be the second paradigm.

B. The Technology-Organization-Environment (TOE) Framework

The Technology-Organization-Environment (TOE) framework by (Tornatzky & Fleischer, 1990) further explains the acceptance of technology from the perspective used by organizations (Table 2). These are, 1) the technological context, 2) the organizational context, and 3) the environmental context. The technological context describes the technology acceptance that depends on the pool of technologies inside and outside the organization. The organizational context refers to the characteristics and resources of an organization including the firm's business scope, firm size, top management support, organizational structure, human resource, number of slack resources, and linkages among employees. The environmental context relates to the structure and size of the industry, the firm's competitor, the regulatory environment, and the macroeconomic context.

The TOE framework is more holistic, large-scale, and industry-friendly (Wen & Chen, 2010); it has a strong empirical support in the field of information systems where it is superior to other used frameworks, as argued in (Yoon & George, 2013), and meets contemporary scientific demands as explained in (Jacobsson & Linderoth, 2010) for more social interactive systems that address deterministic system problems. Therefore, TOE is the preferred choice taken in this study for several important reasons: a) this theory has a solid foundation; b) consistent empirical support; and c) has the potential to be used in technology acceptance and adoption at an organizational level.

<table>
<thead>
<tr>
<th>Technology</th>
<th>Statement</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Perceived Usefulness</td>
<td>Perceptions of the system's ability to improve subsequent work performance.</td>
</tr>
<tr>
<td>2. Security Concern</td>
<td>Perceptions of information security in using the system to improve subsequent work performance.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Organization</th>
<th>Statement</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Top Management Support</td>
<td>Support and involvement of top management on the use of the Smart Waste Management System</td>
</tr>
<tr>
<td>2. Organizational Readiness</td>
<td>Focus on the strength of the organization in using the resources accordingly.</td>
</tr>
<tr>
<td>(Size)+(Human, technical and financial resources)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Environment</th>
<th>Statement</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Costumer Readiness</td>
<td>Customer readiness for using the technology will affect adoption of the Smart Waste Management System, which depends on the relationship between organization and customer.</td>
</tr>
<tr>
<td>2. Government Regulatory</td>
<td>Government strategies or initiatives that encourage consumers to accept the Smart Waste Management System</td>
</tr>
</tbody>
</table>

C. Culture

There are many cultural differences that exist between different countries, which influence the ability of multinational organizations to embrace and use technology (Straub, Keil & Brenner, 1997). Akhtar (2018) argues that cultural factors need to be included in the acceptance model. It refers to the use of information systems influenced by culture (Im et al., 2011). The cultural dimensions of countries have been widely used to distinguish between them (Hofstede, 2011). A study by Blut et al. (2016) confirms that cultural dimensions change the effectiveness of acceptance factors in the use of technology in different countries. Therefore, cultural factors act as important moderators in technology adoption (Baptista & Oliveira, 2015; Srite & Karahanna, 2006). There are several studies that have modeled Hofstede's cultural dimension as a moderator.
(e.g. Goularte, 2018; Khan et al., 2017). Although Hofstede's model is generally accepted as the most comprehensive national cultural framework, its validity and limitations have been criticized by some researchers (Baptista & Oliveira, 2015).

D. Research Model and Hypotheses

Despite the popularity of the Hofstede's cultural dimension model and its high praise, it has been criticized for focusing only on values that clearly ignore other important cultural layers such as practices, traditions, cultural artifacts, and more (Taras, 2017). Whereby his conceptual Onion Model of Culture is different from the cultural dimension model, which has rarely been challenged (Richter, 2016).

Relatively, local culture research on technology acceptance and adoption has received little attention in previous studies. In this paper, the proposed model incorporates with three antecedents of acceptance as manifested in (i) local knowledge culture, (ii) local basic assumption culture, and (iii) local beliefs culture, owing to the varied influences exerted by this local culture on the intention to use the SWMS (see Figure 1).

These antecedents of acceptance will have to be treated as moderating variables affecting the relationship between TOE factors on SCTs acceptance. There is a need to balance between the need to adapt to local practices and customs, and the need to standardize best practices across national boundaries (Friedman, 2007), in order to use the technology.

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Currently there is no standard definition for local knowledge culture. Local Knowledge Culture is depicted to influence TOE Frameworks among members of the local society, whether that technology is useful or not to them. And the knowledge about that technology in terms of its usage, its benefits and usability, will be shareable to the facets of the local society. When the technology is introduced and brought into an area where most of the people are less exposed to current technology, it will lead to the rejection and possibly the failure of the technology. This is due to the lack of knowledge related to SWMS. Therefore, the hypotheses of this study of local knowledge culture are:

- **H1a**: There is a significant impact of local knowledge culture as a moderator between perceived usefulness and the intention to use SWMS.
- **H1b**: There is a significant impact of local knowledge culture as a moderator between security concern and the intention to use SWMS.
- **H1c**: There is a significant impact of local knowledge culture as a moderator between top management support and the intention to use SWMS.
- **H1d**: There is a significant impact of local knowledge culture as a moderator between organizational readiness and the intention to use SWMS.
- **H1e**: There is a significant impact of local knowledge culture as a moderator between customer readiness and the intention to use SWMS.
- **H1f**: There is a significant impact of local knowledge culture as a moderator between government regulatory and the intention to use SWMS.

**Local Basic Assumptions Culture**

Basic Assumptions which are been ignored within a society and create patterns of cognition, perceptions and feelings displayed by the members of the group (Schein, 2010). Basic Assumptions of a particular culture tends to prescribe the ways its members perceive, believe, think, and evaluate the world, self, and others (Asma, 2000). These basic assumptions need to be understood because they provide the basis to the differences in thinking and acting. Failure to look at these basic assumptions can cause people from one culture to evaluate people from another
culture by using their own cultural assumptions. In this research study, basic assumptions among the society in the local area can be an indicator of whether the society is ready to accept SWMS or not. Therefore this study leads to see whether:

H2a: There is a significant impact of local basic assumptions culture as a moderator between perceived usefulness and the intention to use SWMS.

H2b: There is a significant impact of local basic assumptions culture as a moderator between security concern and the intention to use SWMS.

H2c: There is a significant impact of local basic assumptions culture as a moderator between top management support and the intention to use SWMS.

H2d: There is a significant impact of local basic assumptions culture as a moderator between organizational readiness and the intention to use SWMS.

H2e: There is a significant impact of local basic assumptions culture as a moderator between customer readiness and the intention to use SWMS.

H2f: There is a significant impact of local basic assumptions culture as a moderator between government regulatory and the intention to use SWMS.

IV RESEARCH DIRECTION AND CONTRIBUTION

We have chosen our samples from 7 local authorities in Terengganu State, Malaysia, which involve as many as 700 stakeholders as respondents (e.g., vendors, contractors, communities, and staff). The target for the samples is to have at least 100 respondents from each local authority who will be using or have been using SCTs such as SmartBins, smart parking and more. Our data collection instruments will focus on local cultural elements (knowledge, basic assumption and beliefs) on the intention to use SWMS through a questionnaire. We will formulate close-ended, multiple-choice questions to reflect our research questions, so that the answers will satisfy our research objectives. The measuring items or indicators will measure each hypothesis using a Likert scale ranging from 1 to 5. The findings from this study are expected to contribute to empirical research on local cultural factors that influence the technology, organization and environment of technological decisions by local communities. These contributions would be explored from the government's perspective, given the importance of local cultural factors in bringing new technologies to the people and ensuring that they use them. This study is designed to enable the government to formulate policies, plans and target appropriate factors to support the adoption of new technologies in society.

V CONCLUSION

This paper presents a research in progress work on proposing a research model describing the phenomenon of moderating effects of local cultures on SWMS acceptance. The model describes how the

Local Beliefs Culture

Inspired from Hofstede's Onion Model, local beliefs culture was proposed based on values and rituals which can be explain in two perspectives: 1) social beliefs; and 2) religious beliefs. Social beliefs are the tenets or convictions that people hold to be true where individuals in a society have specific beliefs, but they also share collective values. Religious beliefs are the collection of cultural systems, belief systems, and worldviews that relate humanity to spirituality and sometimes to moral values. Beliefs are also the main driver for the construction of any person's general view of the world and the whole core community has in common (Richter, 2016). Due to reflections, which directly are influenced through several factors, beliefs might differ in detail, on the level of both sub societieS and individuals. The local societies which have strong beliefs are expected to have an influence on the technology in terms of social and religious beliefs, and hence conflicts on the usage of SWMS. This study suggests finding whether:

H2a: There is a significant impact of local beliefs culture as a moderator between perceived usefulness and the intention to use SWMS.

H2b: There is a significant impact of local beliefs culture as a moderator between security concern and the intention to use SWMS.

H2c: There is a significant impact of local beliefs culture as a moderator between top management support and the intention to use SWMS.

H2d: There is a significant impact of local beliefs culture as a moderator between organizational readiness and the intention to use SWMS.

H2e: There is a significant impact of local beliefs culture as a moderator between customer readiness and the intention to use SWMS.

H2f: There is a significant impact of local beliefs culture as a moderator between government regulatory and the intention to use SWMS.
role of local cultural factors would moderate the relationships between technology and the intention to use the technology among the local society and its stakeholders, which would lead to its acceptance. The model brings the heterogeneous nature of local culture elements (knowledge, basic assumptions and beliefs) into the research matters on moderating SWMS acceptance.

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ABSTRACT
Non-Functional Requirements (NFRs) are very important since they play a significant role for the system’s behavior. Unfortunately, in Agile methods, the NFRs are overlooked until the later steps of software development. The negligence of NFRs elicitation is happened due to lack of standardized guidelines that can be referred by the software practitioners. Moreover, empirical studies on the current practices of NFRs elicitation in Agile software development organizations, specifically focused on security requirements and knowledge required are still limited. To the best of our knowledge, the study also has never been done before in Jordan context. Therefore, this study was conducted to address the abovementioned lacking issues. The study was conducted using quantitative approach. The questionnaire was distributed through online and face-to-face communication. The data was analyzed using descriptive statistical analysis. Hence, this paper presents the results from the pilot study that involves 34 software practitioners in Jordan. The items of questionnaire were highly reliable to be utilized for more analysis. The findings highlighted the current practices for NFRs elicitation specifically focused on the security requirements elicitation and the required knowledge for NFRs elicitation which are useful for formulating guideline for NFRs elicitation.

Keywords: Agile requirements engineering, Non-functional requirements, NFR elicitation guideline, Required knowledge, Security requirement.

I INTRODUCTION
Agile software development (ASD) methods have been developed and evolved since the early 1990s. Basically, ASD focused on shorter software development lifecycle with iterative and incremental process. Due to that, Agile methods have been widely used in business sectors as they are able to deliver the software product faster. Unfortunately, requirements are still relatively unstable (Alam et al., 2017).

Requirements are the groundwork of all software products and it seeks to guarantee that customer demands are rightly understood (Heikinlää et al., 2015). Requirements engineering (RE) is one of the key software processes which determines how to gather, document and review requirements (Pohl & Rupp, 2015).

In the classical approach such as waterfall method, the requirements are explained perfectly and in-detail before proceeding to design and development. Nevertheless, in agile methods such as SCRUM, eXtreme Programming (XP), Dynamic Systems Development Method (DSDM), or hybrid methods, the strategy of software development is different. The requirements are mostly explained in a simple manner via user stories and these documents will be used to start and produce the sprints (Asghar et al., 2016).

On top of that, security is a critical non-functional requirement (NFR) that needs consideration during software development. However, developing secure software is not a trivial task as it requires to take into account the security requirements from elicitation stage (Villamizar, Kalinowski. Viana, & Fernández, 2018). Yet, in majority of software projects, security is often dealt with in retrospective when the system has already been designed and put into operation (Rindell et al., 2019; Villamizar et al., 2018).

Later, when this NFR was neglected, several risks might be introduced that requires additional effort and cost to solve the problems. For example, the U.S. Army has spent almost $3 billion on a broken system and less efficient (Silva et al., 2016; Maiti, 2016). Recently, an Indonesian airplane was crashed and killed 189 people. The specialists confirmed that the main reason for the tragedy was because of inefficiency and unreliability of the automated system, which led to the crash of the airplane (Wojcik, 2019; Gruenberg, 2019).

Regardless of NFRs importance, they are only stated in an unofficial form in agile methods (Shahid & Tasneem, 2017; Bormane et al., 2016). For example, the requirements in SCRUM are captured on 3x5 index cards with each requirement specified in 3 to 5 sentences, which is inadequate to capture the detailed NFRs (Maiti, 2016). Even though developer and customer work together to elicit the requirements in agile methods yet, it is very difficult to gather all the requirements from a single person such as Product Owner (PO) in SCRUM (Maiti, 2016; Eberlein & Leite, 2002) as the customer does not has good knowledge on the requirement elicitation practices.
Hence, having a good knowledge and understanding among the practitioners are important in helping the elicitation of NFRs (Pakki, Roy, & Kavuri, 2016; Too, Hassan, Din, & Azim, 2013). Consequently, determining the required knowledge for performing NFRs elicitation will help the practitioners to understand more on what should be taken into account during elicitation stage and what are the role of practitioners (Pakki et al., 2016; Too et al., 2013). Additionally, Younas et al. (2017) and Rojo and Oliveros (2014) reported, the main problem in the area of agile requirements elicitation is the lack of guidelines for NFRs elicitation. In general, the guideline is defined as a set of practices, disciplined activities that provide steps of instructions which help to form an opinion and support decision making concerning a course of action (Shurrab, 2016; Ramachandran, 2012).

Moreover, even though NFRs elicitation is considered as important, yet report that discusses on the empirical evidence of the current practices of NFRs elicitation in agile software development companies is still lacking especially those related to the current practices of security requirements elicitation (Villamizar et al., 2018; Curcio et al., 2018; Wagner, Fernández, Kalinowski, & Felderer, 2018). There are studies such as Curcio et al. (2018) and Wagner et al. (2018) which highlight that the current practices of NFRs elicitation are still ambiguous in agile RE and need further investigation via empirical studies. Therefore, a study was conducted to investigate the current practices and required knowledge for NFRs elicitation among Jordanian Agile software practitioners. It can be argued that the outcomes of this study will help Jordanian software companies deal with emerging challenges while eliciting the NFRs. This paper reports the outcomes from the pilot study. The NFRs elicitation focuses on the security requirements. Besides, this study also investigates the required knowledge of elicitation and the opinion of practitioners on the importance and the benefit of NFRs elicitation guidelines in Agile context.

The paper is organized as follows: Section 2 provides literature reviews, Section 3 elaborates the research method of the study, and Section 4 presents the findings and discussion. Finally, Section 5 provides the conclusion and future work.

II LITERATURE REVIEW

There are studies which investigated the practices of agile RE by a comprehensive literature review to determine the practices such as Alam et al., (2017), Inayat et al. (2015) and Elghariani and Kama (2016). Alam et al., (2017) presented fourteen practices of agile RE and also the issues and challenges that practitioners face in the implementation of these practices. Inayat et al. (2015) presented seventeen practices which explain how agile methods can deal with the requirements. Moreover, Elghariani and Kama (2016) provided almost similar findings to Inayat et al. (2015). However, these studies focused on the agile RE in general with less attention to NFRs elicitation and particularly security requirements elicitation practices or required knowledge for elicitation.

Moreover, Wagner et al. (2017) contributed to empirical knowledge of the state of practices and contemporary problems in agile requirements elicitation. They conducted an international survey in North America, South America, Central Europe, and Northern Europe on agile practices and problems. The study provides some useful findings related to how requirements are elicited and documented, and on common agile RE problems. However, the survey focused on FRs elicitation with less emphasis on NFRs elicitation.

Pakki et al. (2016) conducted an online survey in the United States to collect data about RE challenges and knowledge of stakeholders in agile and traditional methods. The study tried to identify the challenges faced by organizations in handling NFRs. Nevertheless, the study focused on the RE process in general with less concentration related to current practices and required knowledge for NFRs elicitation, especially security requirements elicitation practices. Furthermore, Kotze (2017) conducted a survey among employees at software development organizations in South Africa about the knowledge of stakeholders for FRs elicitation in traditional methods. Similarly, the study did not take into consideration the current practices and required knowledge for agile NFRs elicitation. More recently, Ochodek and Kopczyńska (2018) conducted an online survey through social network groups to gather information about agile RE practices and the importance of these practices. The study determined the perceived importance of agile RE practices and created a seven-tier ranking of the practices. Nevertheless, the survey concentrated on the RE process in general with less attention paid to NFRs elicitation practices and required knowledge for practitioners, and particularly security requirements elicitation.

It appears that most of the existing studies focused on agile RE in general with minimal attention to current practices and required knowledge for NFRs elicitation, especially security requirements elicitation practices. Also, there are studies which focused on traditional methods or FRs elicitation, however, these studies did not take into account the agile NFRs elicitation.

Besides that, most of the existing studies were conducted in North America, South America, and Europe, and limited studies from Asian countries.
(Inayat et al., 2015). Jordan is one of the Asian countries, which has an increase in the software development sector due to the incentive measures followed by the Jordanian government (Yaseen, Dingley, & Adams, 2016). Based on the list of companies from Jordanian Ministry of Trade and Industry and the Jordan Business Directory Website, there are more than 880 companies that applied Agile practices in software development, which made Jordan a suitable environment for conducting such studies. Therefore, this study investigated the current practices and the required knowledge of NFRs elicitation in Jordan's Agile software development companies. Also, the opinion of practitioners on the importance of NFRs elicitation guidelines in Agile context is gathered through this study.

III RESEARCH METHOD

This study adopted the quantitative method and the data of the pilot test was collected by utilizing a survey. The reason for selecting this method because it is a useful method to measure the opinion of respondents (Umezawa et al., 2015; Cooper & Schindler, 2011). There are three main activities involved, started with questionnaire construction, data collection, and data analysis. These activities are elaborated next.

A. Questionnaire Construction

The questionnaire consists of five main sections namely: 1) demographic information, 2) the current practices for NFRs elicitation, 3) the current practices for security requirements elicitation, 4) the required knowledge of practitioners for NFRs elicitation, and 5) implementation of NFRs elicitation guideline. These sections consist of 46 questions with sub-questions, that included multiple-choice and Five Point Likert scale questions (Salleh, Mat, & Othman, 2019; Jørgensen et al., 2019).

The demographic section aims to assess the qualification of respondents such as the current position and years of experience. The questions of the section were derived from different studies such as Mohamed (2015), Baharom (2006), and Tarawneh (2016). The second section of the questionnaire consists of 17 questions such as NFRs elicitation techniques, software types, historical data, detach user stories, NFRs sources, and NFRs validation. The questions of this section were derived from studies such as Estdale and Georgiadou (2018), Mairiza et al. (2010), Afreen, Nida, Khatoon, and Sadiq (2016), Maiti, (2016), and Domah and Mitropoulos (2015).

In section three, the question is regarding the current practices for security requirements elicitation which consists 10 questions such as responsibility of elicitation of the security requirements from the customer, eliciting and documenting security requirements explicitly, the notation used to represent the security requirements, and the importance of considering security requirements. The questions of this section were derived from studies such as Estdale and Georgiadou, (2018), Mohamed (2015), Hussain and Mkpojiogu (2015).

Section four which is the required knowledge of practitioners for NFRs elicitation contains 7 questions related to the domain, communication, and system of NFRs elicitation in Agile context. The questions of this section were derived from studies such as Pakki et al. (2016), Too, Hassan, Din, Ghan and Abd (2013), Kotze (2017), Serna et al. (2017). In section five the questions are about the implementation of NFRs elicitation guideline which contains 4 questions that aim to find the opinion of practitioners on the importance and the benefit of NFRs elicitation guidelines in Agile context. This section also aims to specify the name and elements of guidelines for NFRs used by respondents. Moreover, the questions of this section were derived from studies such as Younas et al. (2017) and Silva et al. (2016).

B. Data Collection

The pilot test was conducted among 34 Agile software practitioners in Jordan. This number of respondents is appropriate since the pilot group size between 25 to 100 is a sufficient sample as suggested by Cooper and Schindler (2011). The questionnaire was shared through online interviews and face-to-face communication, which involved agile practitioners such as Product Owner (PO), programmers, team leader, and security advisor. The names of potential Agile software practitioners were obtained from 1) the list of companies from Jordanian Ministry of Trade and Industry, and the Jordan Business Directory Website, 2) the government and private organizations attained by the Internet and social media, and 3) communicate with friends who have relation in the Agile software industry.

C. Data Analysis

The collected data was analyzed using descriptive data analysis. For this purpose, the Statistical Package for Social Science (SPSS) ver. 14.0 software was utilized. The main purpose of using SPSS is to focus on describing the respondents’ opinions or the frequency of certain events to occur (Oppenheim, 1992). Besides, the Cronbach’s alpha was utilized in order to evaluate the consistency of internal in the components of the questionnaire (Azman et al., 2019).

IV FINDINGS AND DISCUSSION

The questionnaire was validated by performing a pilot test to detect the respondents’ understandability of the questions. Besides, it also ensures the validity of the questionnaire, completeness of the included items, readability, and estimate the time taken to answer the
questionnaire (Umezawa et al., 2015; Cooper & Schindler, 2011). More importantly, the pilot test assists in avoiding the ambiguities, obstacles, or mistakes that might arise when answering the questionnaire. The following sub sections discusses the outcome of the analysis.

A. Demographic Information

To understand the respondents’ background, they were asked to indicate their position in the company and years of experience in software development. Table 1 portrays the frequency and percentages of respondents according to their positions and experiences. Most of the respondents are PO (35%) and security advisor (29%), followed by programmers (15%), and team leaders (9%). Indeed, majority of the practitioners who participated in this pilot study have more than 6 years in Agile software development.

B. The current practices of NFRs elicitation

In this section the respondents were asked about the responsible person who performs the elicitation of NFRs in their organizations. Figure 1 shows that the majority of respondents answered PO (91%), followed by Team Leader (3%), Programmer (3%), and Project Manager (3%).

Moreover, the respondents were asked about the application domains that they developed and applied NFRs elicitation. They were permitted to select more than one answer. Majority of the respondents answered Mobile application (77%) and Web application (75%), followed Telecommunication Services (55%), E-learning (37%), E-banking (36), and E-commerce (25%). In addition, the respondents were asked about the types of system that they applied NFRs elicitation. They were permitted to select more than one answer. The respondents answered Real-time systems (83.5%), Information systems (76%), Safety-critical systems (74.4%), and Controlled systems (72.7%).

Moreover, the respondents were asked whether they verify the NFRs after elicitation. Unfortunately, 77% of them, do not perform the validation. Besides, majority of the respondents (80.3%) answered the PO has the responsibility to validate NFRs after elicitation. On another side, the respondents were asked about the validation methods used for NFRs. Majority of the respondents validate NFRs with their customers 64%, while 30% use GQM. The rest 6% use expert review.

Furthermore, the respondents were asked to rank the degree of acceptance performing of NFRs elicitation practices in their companies. Therefore, Five Likert scales ranging from Strongly Disagree (value 1) to Strongly Agree (value 5) were used to describe the degree of acceptance for applying these practices. The mean score was calculated and choosing the convenient interval that represent the actual mean in order to acquire the results. To represent all levels of acceptance required an appropriate interval scale. Table 2 presents the degree of acceptance for scales representation for every practice.

Table 1. Respondents’ Experience and Position.

<table>
<thead>
<tr>
<th>Positions</th>
<th>1-5 years</th>
<th>6-10 years</th>
<th>11-20 years</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>PO</td>
<td>0 (0%)</td>
<td>9 (26%)</td>
<td>3 (9%)</td>
<td>12 (35%)</td>
</tr>
<tr>
<td>Security Advisor</td>
<td>0 (0%)</td>
<td>8 (23%)</td>
<td>2 (6%)</td>
<td>10 (29%)</td>
</tr>
<tr>
<td>Programmers</td>
<td>0 (0%)</td>
<td>5 (9%)</td>
<td>0 (0%)</td>
<td>5 (15%)</td>
</tr>
<tr>
<td>Team Leader</td>
<td>0 (0%)</td>
<td>2 (6%)</td>
<td>1 (3%)</td>
<td>3 (9%)</td>
</tr>
<tr>
<td>Project Manager</td>
<td>0 (0%)</td>
<td>2 (6%)</td>
<td>0 (0%)</td>
<td>2 (6%)</td>
</tr>
<tr>
<td>System Analyst</td>
<td>0 (0%)</td>
<td>2 (6%)</td>
<td>0 (0%)</td>
<td>2 (6%)</td>
</tr>
<tr>
<td>Total</td>
<td>2</td>
<td>26</td>
<td>6</td>
<td>34</td>
</tr>
</tbody>
</table>

Figure 1. The responsible person who performs the elicitation of NFRs.

Table 2. The Mean Values for NFRs Elicitation Practices.

<table>
<thead>
<tr>
<th>NFRs Elicitation Practices</th>
<th>Mean value</th>
<th>Degree of acceptance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identifying the application domain and type of system at the beginning of the project.</td>
<td>3.53</td>
<td>Agree</td>
</tr>
<tr>
<td>Focusing on face-to-face communication to elicit the NFRs.</td>
<td>4.67</td>
<td>Strongly Agree</td>
</tr>
<tr>
<td>Encouraging customer participation through natural language.</td>
<td>4.34</td>
<td>Strongly Agree</td>
</tr>
<tr>
<td>Using the historical data to defining and eliciting the NFRs.</td>
<td>4.34</td>
<td>Strongly Agree</td>
</tr>
<tr>
<td>A list of questions are prepared to extract the NFRs from the customer.</td>
<td>3.52</td>
<td>Agree</td>
</tr>
<tr>
<td>Separating the NFRs with detaching story cards.</td>
<td>4.57</td>
<td>Strongly Agree</td>
</tr>
<tr>
<td>The validation of NFRs in natural language with the customer.</td>
<td>3.53</td>
<td>Agree</td>
</tr>
<tr>
<td>The validation of NFRs by third party.</td>
<td>2.31</td>
<td>Disagree</td>
</tr>
<tr>
<td>Using a check-list table in case of changing requirements.</td>
<td>2.23</td>
<td>Disagree</td>
</tr>
</tbody>
</table>
C. The current practices of security requirements elicitation

In this section, the respondents were asked about the responsible person who perform the elicitation of security requirements. For eliciting the security requirements and documentation explicitly, 77.3% of respondents answered they are eliciting and documenting security requirements explicitly. Besides, the respondents who are dealing with security requirements were asked about who performs the elicitation of security requirements in their organizations. The majority of respondents answered PO with 73%, followed by Security advisor (12%), Team Leader (6%), Project Manager (6%), programmer (3%), System Analyst (3%), and the remaining 3% chose no specific person.

In another side, 61.6% of respondents do not use any specific notation, 5% of respondents do not document the security requirements. 20.4% uses Misuser stories to represent the security requirements, 7% use Misuse case, 3% uses Attack tree, and 3% uses Abuse case. On top of that, the respondents were asked to rank the degree of performing these practices inside their companies. Table 3 presents the degree of acceptance for scales representation for security requirements practice.

D. The required knowledge of NFRs elicitation

The respondents were asked about the required knowledge of NFRs elicitation in order to decide the required knowledge needed to elicit NFRs in Agile context. Table 4 shows the mean values of required knowledge and the degree of acceptance.

Table 3. The Mean Values for Security Requirements Elicitation Practices.

<table>
<thead>
<tr>
<th>Security Requirements Elicitation Practices</th>
<th>Mean value</th>
<th>Degree of acceptance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eliciting security requirements separately.</td>
<td>2.31</td>
<td>Disagree</td>
</tr>
<tr>
<td>Documenting security requirements in a particular notation.</td>
<td>4.32</td>
<td>Strongly Agree</td>
</tr>
<tr>
<td>Utilizing the common attacks that occurred previously to elicit the requirements security.</td>
<td>4.47</td>
<td>Strongly Agree</td>
</tr>
<tr>
<td>Considering attackers’ perspective while eliciting security requirements.</td>
<td>4.33</td>
<td>Strongly Agree</td>
</tr>
<tr>
<td>Reaching a common understanding about the security needs.</td>
<td>3.52</td>
<td>Agree</td>
</tr>
</tbody>
</table>

Table 4. The Mean Values for Required Knowledge of NFRs Elicitation.

<table>
<thead>
<tr>
<th>The Required Knowledge of NFRs Elicitation</th>
<th>Mean value</th>
<th>Degree of acceptance</th>
</tr>
</thead>
<tbody>
<tr>
<td>The practitioners requires domain knowledge of various sources such as standards and norms or relevant bibliographic reference to identify the NFRs.</td>
<td>4.35</td>
<td>Strongly Agree</td>
</tr>
<tr>
<td>Training the person(s) responsible for eliciting NFRs by specialists/experts.</td>
<td>3.42</td>
<td>Agree</td>
</tr>
<tr>
<td>Awareness of the customer background (profile)</td>
<td>3.63</td>
<td>Agree</td>
</tr>
<tr>
<td>NFRs are easily missed because of the unsuccessful communication knowledge.</td>
<td>2.11</td>
<td>Disagree</td>
</tr>
<tr>
<td>The deficiency for the system knowledge will lead to the omission of necessary and important NFRs.</td>
<td>2.11</td>
<td>Disagree</td>
</tr>
<tr>
<td>The practitioners who perform the elicitation need to have a knowledge of notations.</td>
<td>4.35</td>
<td>Strongly Agree</td>
</tr>
</tbody>
</table>

V CONCLUSION AND FUTURE WORK

This paper reports the result from a pilot study which aims to validate the questionnaire related to the current NFRs practices especially security requirements in Agile context. Besides, it also investigates the required knowledge for NFRs elicitation. The pilot study was conducted among Agile software practitioners in Jordan. The outcome of the study reveals the current practices and required knowledge for NFRs elicitation. The Cronbach’s alpha values were above 0.7 for each item of the questionnaire. Thus, the questionnaire items are highly reliable to be utilized for more analysis. Besides, there are suggestions of improvement from the respondents during the pilot test. Among them are they mentioned that the questionnaire takes too long, having long and complex sentences, and the sequence of questions is not commensurate with the objectives. These suggestions are taken into account in order to improve the questionnaire. The next stage for this study will be collecting the real data.

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Personal Knowledge Acquisition: Do Educators Acquire New Knowledge during the Movement Control Order?

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ABSTRACT

The pandemic COVID-19 leads to the online teaching and assessment methods to be adopted by the education institutions in Malaysia. In response to this, questions are raised in terms of whether educators can acquire new knowledge, what new knowledge they gained, and whether demographic profile matters. Online survey was conducted where 151 responses from educators in Malaysia were analyzed. Result shows that majority of the respondents admitted of gaining new knowledge during the MCO period. Furthermore, personal knowledge acquisition does differ in terms of gender, academic qualification, and years of experience. As for what knowledge they gained, thematic content analysis showed that educators learned technical, non-technical, and spiritual knowledge. This research could contribute to the knowledge management process of education institution in Malaysia.

Keywords: COVID-19 pandemic, knowledge management, education, training and development, adversarial

I INTRODUCTION

During the peak time of Covid-19 pandemic, it can be seen that education institutions around the world were closed down. In 18 March 2020, Malaysian government took the same action, disrupting teaching and learning in all types of education institutions – universities, colleges, schools, and kindergarten (Perutusan Khas, 2020). The movement control order (MCO) that led to the closing down of education institutions did not only affect the students’ learning, but also the educators’ teaching and assessments processes.
need to have the knowledge in conducting the remote assessment (Guangul et al, 2020).

In other words, in response to the changes from offline to online pedagogy, it is expected that educators must acquire new knowledge to help them with the whole new teaching and assessment process – is this true? And if educators gained the new knowledge, what are they? In addition, according to Carley (1986), individual knowledge acquisition is rather limited. Hence, another question raised – is there any different between the demographic profile of educators and the acquisition approach of new knowledge during the MCO? Based on these questions, a small research was conducted and this paper is prepared to present the research findings.

II LITERATURE REVIEW

A. Personal Knowledge Acquisition
Knowledge acquisition is a part of knowledge management process, where individuals gain knowledge either through observation, reading or practices. Knowledge acquisition is important as it provides the foundation to respond to the changes in the environment (Khan et al., 2020). As for educators, knowledge acquisition is important because the new knowledge gained enable them to cope with the changes in the teaching and learning environment. That is, by acquiring new knowledge the educators are able to know the various tools and platforms for online classes, how to manage the online interaction with students, and how to conduct online assessment. Overall, new knowledge is crucial for educators to strengthen their capability.

Knowledge gained however can be grouped into two basic types – explicit and tacit (Becerra-Fernandez & Sabherwal, 2010). Explicit knowledge is knowledge that can be put into words, documented and shared. For example, the characteristics of a good educator. Tacit knowledge on the other hand is not easily put into words, documented and shared because it involves intuition and experiences. For example, being an effective educator that able to adapt to students’ diverse background and teaching context requires years of interactions, practices, learning from mistakes, and skills.

These mixtures of being an effective educator involve ambiguous relationship and thus are not easy to explain.

B. Demographic Profile and Knowledge Acquisition
Past studies have been conducted to determine the role of demographic profile on personal knowledge acquisition. But, the findings were contradictory. For example, a study conducted by Jansen et al. (2010) revealed older people had problem with recording of information. Since memory correlates with knowledge (DeMarie-Dreblow, 1991), the study implies that age played a role in knowledge acquisition process. Later, Pacharapha & Rachim (2012) found that whether individuals are expert or novice did contribute to the knowledge acquisition.

However, there are studies that found individual factors did not influence knowledge acquisition. For example, Rotgans & Schmidt (2016) concluded that individual’s interest was not a significant predictor of knowledge acquisition.

III METHODOLOGY
The research objectives were to determine whether educators gained new knowledge during MCO, whether online resources and tools are beneficial, and whether there is any different between the demographic profile of educators and the acquisition of new knowledge during the MCO. This research paper would also like to identify what new knowledge have been acquired by educators in Malaysia. Therefore, the respondents for this research paper were lecturers, teachers, and tutors who worked in the various types of academic institution including public and private universities, colleges, schools and even kindergarten.

Data was collected in May 2020 through online questionnaire, where a total of 151 responses were collected. In the online survey questionnaire, besides their demographic profiles, respondents were asked on whether they have gained new knowledge during the Covid 19 - MCO period to strengthen their capability as lecturers, teachers or tutors, and
whether online resources and tools available aided their online classes. The questionnaire was in categorical format. Hence, descriptive statistics were mainly used to analyze the data.

In order to know what kind of new knowledges gained by educators during the Covid 19-MCO period, an open-ended question (i.e. “what new knowledge have you gained during the MCO period?”) was asked. Responses were examined using content analysis, and grouped using thematic method.

IV FINDINGS

A. Demographic Profiles
Table 1 show the frequency of gender, qualification and years of experience of respondents. Results show that majority of the respondents were female (83.4%), hold master degree (58.9%), and have been educators for more than 10 years (70.1%).

<table>
<thead>
<tr>
<th>Table 1. Demographic Profiles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
</tr>
<tr>
<td>Female</td>
</tr>
<tr>
<td>Male</td>
</tr>
<tr>
<td>Qualification</td>
</tr>
<tr>
<td>Certificate</td>
</tr>
<tr>
<td>Adv diploma/Diploma</td>
</tr>
<tr>
<td>Bachelor</td>
</tr>
<tr>
<td>Professional</td>
</tr>
<tr>
<td>Master</td>
</tr>
<tr>
<td>PhD/DBA</td>
</tr>
<tr>
<td>Years of experience</td>
</tr>
<tr>
<td>10-14 years</td>
</tr>
<tr>
<td>15-19 years</td>
</tr>
<tr>
<td>20-24 years</td>
</tr>
<tr>
<td>25-30 years</td>
</tr>
<tr>
<td>5-9 years</td>
</tr>
<tr>
<td>Less than 5 years</td>
</tr>
<tr>
<td>More than 30 years</td>
</tr>
</tbody>
</table>

B. Knowledge Acquisition during MCO
Table 2 shows the frequency of educators that gained new knowledge during MCO. The result shows majority of the respondents acknowledged that they had gained new knowledge (92.1%), there was still 7.9% perceived that they did not acquire new knowledge.

<table>
<thead>
<tr>
<th>Table 2. Knowledge Acquisition</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
</tr>
<tr>
<td>Yes</td>
</tr>
<tr>
<td>No</td>
</tr>
</tbody>
</table>

C. Difference between Gender and Knowledge Acquisition
The chi-square test shows significant relationship between gender and knowledge acquisition, $X^2 (1, N=151) = 16.5, p = 0.000$. Cross tabulation analysis shows that 58.3% respondents who perceived they did not gain new knowledge were male; whereas 87.1% respondents who answer “yes” were female. Comparing between male and female, 28% males (7 out of 25) and 4% females (5 out of 126) said “no”. The details of cross tabulation result are shown in Table 3.

<table>
<thead>
<tr>
<th>Table 3. Gender and Knowledge Acquisition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gain New Knowledge</td>
</tr>
<tr>
<td>No</td>
</tr>
<tr>
<td>N</td>
</tr>
<tr>
<td>Male</td>
</tr>
<tr>
<td>Female</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>

| Chi-square | 16.5 |
| df          | 1    |
| Sig (p) value | .000 |

D. Difference between Qualification and Knowledge Acquisition
The chi-square test shows significant relationship between academic qualification and knowledge acquisition, $X^2 (5, N=151) = 12.5, p = 0.029$. Across qualification, all certificate holders felt he or she did not gain new knowledge. On the other hand, all diploma and professional certificate holders believed that they acquired new knowledge. As for bachelor, master and doctorate degree holders, majority of them learned new knowledge. The details of cross tabulation result are shown in Table 4.

<table>
<thead>
<tr>
<th>Table 4. Qualification and Knowledge Acquisition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gain New Knowledge</td>
</tr>
<tr>
<td>No</td>
</tr>
<tr>
<td>N</td>
</tr>
<tr>
<td>Cert</td>
</tr>
<tr>
<td>Adv dip/Diploma</td>
</tr>
<tr>
<td>Bach</td>
</tr>
</tbody>
</table>

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http://www.kmice.cms.net.my/
E. Difference between Years of Experience and Knowledge Acquisition

The chi-square test shows significant relationship between years of experience and knowledge acquisition. However, the significant value is at 10%, making the relations almost insignificant, \( \chi^2 (6, N=151) = 11.5, p = 0.073 \). By comparing the distribution of “yes” and “no” answer, majority of the respondents from each category (except group of less than 5 years) concurred that they acquired new knowledge during the MCO period. As for respondents that came from less than 5-years’ experience as educators, 30% said “no” and 70% said “yes” to the question of gaining new knowledge. There is an interesting finding when readers or researchers look at the composition of “no” answer; where 25% have experience less than 5 years, and 33.3% have experience between 10 and 14 years. The details of cross tabulation result are shown in Table 5.

<table>
<thead>
<tr>
<th>Gain New Knowledge</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>No</td>
</tr>
<tr>
<td>N</td>
<td>%</td>
</tr>
<tr>
<td>&lt;5y</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>25.0</td>
</tr>
<tr>
<td>5-9y</td>
<td>1</td>
</tr>
<tr>
<td>10-14y</td>
<td>4</td>
</tr>
<tr>
<td>15-19y</td>
<td>3</td>
</tr>
<tr>
<td>20-24y</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Chi-square 11.5

|                     |       |
|                     | df 6  |
|                     | Sig (p) value .073 |

F. Types of New Knowledge Acquired

Based on the content analysis, responses from the open-ended question about “what new knowledge acquired...?” can be categorized into three themes:

1. Technical knowledge

During MCO, educators learn about digital platforms, software, gadgets and other hardware that enhance online teaching and assessments such as WebEx, Google Meet, Zoom, and even internet infrastructure.

According to one of the respondents, “belajar buat tandatangan digital” (learn of how to make digital signature) is one of the new knowledges that she gained. Another respondent said that she learned on how to make online documentations.

2. Non-technical knowledge

During online classes throughout MCO period, respondents also gained knowledge on how to deal with their students that came from diverse background because communication through physical and online interactions are not the same. And respondents agreed that they became more patience and had higher sense of empathy. Thus, they learned on managing their emotion better.

One of the respondents stated that “masa tu, saya belajar bagaimana deal dengan pelajar OCD dan ADHD” (during that time, I learned on how to deal with students with ‘obsessive-compulsive disorder’ and ‘attention deficit hyperactivity disorder’).

3. Spiritual knowledge

It seemed that two respondents had learned unique new knowledge as compared to other respondents. One of them discovered that he still has lots of things to learn in order to become a better educator (self-awareness). Another one had learned on...
how to appreciate his family relationship during MCO period, and thus gained new knowledge about the value of family relationship.

V DISCUSSION AND CONCLUSION

Result shows that there are differences between demographic profiles and acquiring new knowledge during Covid 19 - MCO period. In this case - gender, academic qualification, and years of experience as educators played an important role in acquiring knowledge.

Gender. More males did not gain new knowledge. This may be due to the nature of males who are interested in understanding how things work, and knowing general knowledge since early age (Baron-Cohen, 2003; Su et al., 2009). Since internet of things and technology fall under those particular interests, it is postulated that male educators have already equipped with the necessary digital skill before MCO period.

Qualification. Only educator with certificate qualification did not gain new knowledge, compared to other group where majority acquired new knowledge. However, since there is only one respondent out of 151 with certificate, deduction on finding is difficult. If the respondent work in higher education institution, the reason may be because his or her teaching responsibility did not require much of high-level knowledge. If the respondent teach technical content, maybe there is not much materials and tools available during MCO to help him or her. Consequently, he or she felt that no new knowledge was acquired.

Years of experience. Interestingly, among those who answer “no”, albeit 8%, majority of the respondents either work less than 5 years, or between 10-14 years. Based on situational leadership theory, this may be because of the willingness and ability level of the respondents (Hersey and Blanchard, 1977). For those who were less than 5 years’ experience, they may be incapable to learn new knowledge as they are still lacking the necessary knowledge and skills to search for new knowledge, and did not know what to do. As for those who have been educators for 10 to 14 years, while capable, they may be at a situation of complacency and unwilling to acquire new knowledge.

In term of the kind of new knowledge gained, analysis showed that educators acquired technical, non-technical and even spiritual knowledge. Some of these knowledges such as the type of media and solutions to help teaching and assessment are considered as explicit knowledge as they can easily learned and shared. But knowledge such as identifying the right mix and mode of hardware, solutions, and channels; and metacognitive knowledge such as discovering oneself position and values, requires experimentations and reflections. These knowledges are tacit in nature, which will be difficult to be learned by others.

Nevertheless, majority of the respondent gained new knowledge. Adversarial growth theory proposes that individuals grow and develop themselves to cope with adversity event (Linley, 2004). Research findings concurred with the theory where educators strived to gain new knowledge to be better educators in responding towards adversity situation – the turnaround of teaching and assessment processes from physical to online during the MCO period.

Knowledge acquisition is just a part of the knowledge management process. Hence this research is merely an exploratory study and the preliminary stage of knowledge management process for the education institution in Malaysia during Covid 19 pandemic and new norms practices. Future research may focus to expand into retaining and dissemination of personal knowledge, which could complement education institutions’ knowledge management practices.

REFERENCES

Route Planning Mobile Application in Transportation Management

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ABSTRACT
Finding the shortest yet most efficient route to travel through a given list of specific destinations is a well-known challenge known as Travelling Salesman Problem (TSP). E-hailing or ride-hailing services are services that enable users to gain short-term access to transportation modes on an as-needed basis through online-enabled platforms such as Grab, Uber, etc. This study aims at providing a route planning mobile application for drivers to determine an optimal means of traveling between two or more given locations. In “Share your Ride” mobile application, the route search is optimized based on the shortest distance traveled. Usability of the proposed route planner mobile application is presented to provide insights on the possibility of using it in daily routine. This will help in managing knowledge particularly in transportation and logistic management.

Keywords: route planner, e-hailing, transportation management, mobile application.

I INTRODUCTION
Ride-hailing services or e-hailing are services that connect passengers and local drivers through an online-enabled platform for transportation purposes. Ride-hailing services are a comfortable method for door-to-door transport recently as they are cheaper compared to licensed taxicabs. In some countries, ride-hailing services are regulated in the same way as regular taxicabs (Ride Hailing Services, n.d.). There are more than 23 e-hailing apps available in Malaysia nowadays and E-hailing is now a part of a wider development in the economy towards a so-called “sharing economy”. “Sharing economy” is where private citizens are able to share their assets and services over a platform that efficiently connects users and providers ( Tirachini, 2020; Todd et al., 2018).

An example of ride-hailing services will be Grab. Grab Holdings Inc. is a company formerly known as GrabTaxi and MyTeksi. Grab is a transportation network company based in Singapore which not only offers transportation but food delivery and digital payments as well through their mobile app. Grab was originally founded in Malaysia but moved to Singapore later as it’s headquarter. Grab now operates in most of the Southeast Asian countries. Grab Holdings Inc. is the region’s first company to be valued at over US$10 billion. In 2016, Grab opened a major development center and office in Seattle to serve as a tech hub to attract talent in the United States (Grab (Company), n.d.).

Taxis and private hire cars are assigned by the Grab app to nearby commuters through a location-sharing system. Grab provides smartphones for their drivers each time they enter a new market. This allows every driver to have access to the platform and those drivers are allowed to pay daily installments for the phone. Grab earns its profit through part of the booking fees. Grab also teaches taxi drivers that work alongside them on using their smartphones as well as how to operate the Grab mobile app. Grab has also tried to reach out to as many markets as they could such as large cities and smaller cities (Grab (Company), n.d.).

To improve the services of e-hailing, various functions can be incorporated to add competitiveness, and this includes a route planner. A route planner is a specialized search engine used to find an optimal means of traveling between two or more given locations. In transportation management (Bast et al., 2016; Lovelace & Ellison, 2019), route search may be optimized on different criteria, such as shortest time taken, shortest distance traveled, etc. (Journey_planner, n.d.). With the implementation of the route planner into a ride-hailing application, drivers can know the best route for fetching their passengers. This will help drivers to save travel costs for fetching passengers as the shortest possible route can be determined.

The rest of this paper is organized as follows; related studies are presented in section II while the methodology of the study is as in section III. Section IV includes a discussion on evaluation of the developed “Share your Ride” mobile application, section V concludes the study with some insight for future work.

II RELATED STUDIES
Travelling Salesman Problem (TSP) is a well-known algorithmic problem in computer science and operations research. TSP revolves around finding the best possible route (shortest distance or lowest travel costs) to travel through a given list of specific destinations with each destination traveled at least once during the trip. This problem mimics the route planning issues that arise in the e-hailing services. Various machine learning algorithms have been deployed in solving TSP. Among others is the Genetic Algorithm (Mirjalili, 2019; Okwu & Tartibu, 2021).
which is a metaheuristic that was inspired by Charles Darwin’s theory of natural evolution (Ruse, 1975). GA is used to generate high quality solutions to problems such as TSP through operators such as Crossover, Mutation, and Selection.

Many related studies have used genetic algorithm (GA) based techniques for route planning problems (Ahn & Ramakrishna, 2002; Chakraborty, 2004; Inagaki et al., 1999; Kanoh & Nakamura, 2000; Nanayakkara et al., 2007). For example, a study in 2007 (Nanayakkara et al., 2007) proposed a hybrid GA algorithm for large urban street networks such as Singapore. Prior to that, Chang and Ramakrishna (2002) proposed an algorithm that utilizes genetic algorithm operators such as crossover and mutation to improve the quality of a solution. Chakraborty (2004) proposed a GA based algorithm in her paper that has a novel fitness function to avoid overlapping of multiple routes. Furthermore, Kanoh and Nakamura (2000) proposed a solution that uses crossover and viral infection to determine the optimal combination that will generate an alternative route in the shortest time when traffic congestion changes during driving. Lastly, Inagaki, Haseyama, and Kitajima (1999) discussed the genetic algorithm approach for the Vehicle Routing Problem (VRP) in their paper. All algorithms from these papers were on actual road maps and were proven effective.

Similar to the reported work, this study employs the shortest distance metric in determining a suitable route for e-hailing drivers. Route search is deployed to present the driver with the sequence of locations for picking up/dropping off his passengers. Such an approach contributes a simple way to solve day-to-day problems and drive the quality of services in transportation management. Deploying knowledge management in public transportation has shown to be promising as it allows companies to reach a competitive advantage (Durst & Evangelista, 2018; Raymundo et al., 2014). In the current era, businesses are seeking new approaches for better leveraging the resources available to gain efficiencies and deliver value to the traveling public. Hence the use of knowledge management that many public and private sector organizations have applied to improve performance, create a culture that enables innovation, and reduce disruptions associated with workforce transitions. While there are many examples of successful KM programs, KM needs to be enriched.

III METHODOLOGY

The realization of the “Share your Ride” mobile application study is based on the Software Development Life Cycle (SDLC). The SDLC model that was deployed was the Iterative SDLC. There are four phases involved in the model: planning, analysis, design, and implementation.

In the planning phase, a problem was identified in the current ride-hailing services where drivers are having problems finding the best route to fetch their passengers. At this stage, a plan was proposed to develop a system that can help drivers to determine the best route to fetch their passengers. In the second phase (i.e. analysis), user requirements were documented, focusing on the functional and non-functional requirements for the route planner. The requirements were gathered by analyzing several ride-hailing systems which include Uber, Grab, Mula, etc. A use case analysis, process modeling, and data modeling were then produced at this stage. In the design phase, sketches of the user interface are made available via the Android Studio Integrated Development Environment (IDE). This is followed by a low-fidelity prototype that was used to refine the functional and non-functional requirements. The prototype is then shown to selected users for suggestions of improvement. Upon completing the prototype, a user acceptance study was undertaken to evaluate the acceptance of the route planner application. A group of users that are of roles driver and passenger were recruited to evaluate the mobile application.

Table 1 shows the list of requirements and their respective priorities for the Share Your Ride application that was gathered from the requirements gathering process.

<table>
<thead>
<tr>
<th>ID</th>
<th>Requirement Description</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>SRP_01</td>
<td>Make Ride Booking</td>
<td></td>
</tr>
<tr>
<td>SRP_01_0</td>
<td>Passengers can provide input and select their desired destination to complete the booking.</td>
<td>M</td>
</tr>
<tr>
<td>SRP_01_2</td>
<td>System will prompt error messages if the passenger's location is not found.</td>
<td>D</td>
</tr>
<tr>
<td>SRP_01_3</td>
<td>System will prompt error messages if the passenger did not fill in the destination field.</td>
<td>D</td>
</tr>
<tr>
<td>SRP_01_4</td>
<td>Passengers can cancel a booking at any time by clicking the ‘Cancel’ button.</td>
<td>O</td>
</tr>
<tr>
<td>SRP_02</td>
<td>Generate List of Booking</td>
<td></td>
</tr>
<tr>
<td>SRP_02_0</td>
<td>System is able to generate a list of ride-booking from passengers that have confirmed booking every two minutes.</td>
<td>M</td>
</tr>
<tr>
<td>SRP_03</td>
<td>Create subgroup from List of Booking</td>
<td></td>
</tr>
<tr>
<td>SRP_03_0</td>
<td>System will calculate the distance between each passenger.</td>
<td>M</td>
</tr>
<tr>
<td>SRP_03_0</td>
<td>System can create a subgroup of passengers from a list of bookings based on the destination that the passengers have booked.</td>
<td>M</td>
</tr>
<tr>
<td>---------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>---</td>
</tr>
<tr>
<td>SRP_04_0</td>
<td>System can calculate the distance between the driver and each passenger from the subgroup.</td>
<td>M</td>
</tr>
<tr>
<td>SRP_04_0</td>
<td>System can calculate every possible route for the driver to fetch their passenger.</td>
<td>M</td>
</tr>
<tr>
<td>SRP_04_0</td>
<td>System can select the best route for the driver to fetch their passenger.</td>
<td>M</td>
</tr>
<tr>
<td>SRP_05_0</td>
<td>Passengers are needed to insert a username, password, e-mail, phone number, and security question to complete the registration.</td>
<td>M</td>
</tr>
<tr>
<td>SRP_05_0</td>
<td>System should have a check button to check the availability of the username.</td>
<td>O</td>
</tr>
<tr>
<td>SRP_05_0</td>
<td>System will send one verification mail to the passenger that just registered.</td>
<td>M</td>
</tr>
<tr>
<td>SRP_05_0</td>
<td>System will prompt error messages if the passenger did not fill in details on fields that are mandatory (marked with asterisks *).</td>
<td>D</td>
</tr>
<tr>
<td>SRP_05_0</td>
<td>System will prompt an error message if the username has already been taken by another passenger/driver.</td>
<td>D</td>
</tr>
<tr>
<td>SRP_05_0</td>
<td>Passengers can cancel the registration at any time by clicking the ‘Cancel’ button.</td>
<td>O</td>
</tr>
<tr>
<td>SRP_06_0</td>
<td>Drivers are needed to insert username, password, e-mail, phone number, security question and provide information in regard to their vehicle to complete the registration.</td>
<td>M</td>
</tr>
<tr>
<td>SRP_06_0</td>
<td>System should have a check button to check the availability of the username.</td>
<td>M</td>
</tr>
<tr>
<td>SRP_06_0</td>
<td>System will send one verification mail to the driver that just registered.</td>
<td>M</td>
</tr>
<tr>
<td>SRP_06_0</td>
<td>System will prompt error messages if the driver did not fill in details on fields that are mandatory (marked with asterisks *).</td>
<td>D</td>
</tr>
<tr>
<td>SRP_06_0</td>
<td>System will prompt an error message if the username has already been taken by another passenger/driver.</td>
<td>D</td>
</tr>
<tr>
<td>SRP_07_0</td>
<td>Drivers can cancel the registration at any time by clicking the ‘Cancel’ button.</td>
<td>O</td>
</tr>
<tr>
<td>SRP_07_0</td>
<td>Drivers and passengers are required to fill in their username and password to log into the system.</td>
<td>M</td>
</tr>
<tr>
<td>SRP_07_0</td>
<td>Drivers and passengers can request a password reset if they forget their password. (Security question will be asked to confirm the identity of the user and verification code will be sent to user’s email)</td>
<td>M</td>
</tr>
<tr>
<td>SRP_07_0</td>
<td>System will prompt error messages such as “Username/Password does not match” and “Username does not exist” if the user inputs a wrong username/password combination.</td>
<td>M</td>
</tr>
<tr>
<td>SRP_07_0</td>
<td>Drivers and passengers can cancel by logging into the system by clicking the ‘Cancel’ button.</td>
<td>O</td>
</tr>
<tr>
<td>SRP_08_0</td>
<td>Passengers can change their password, telephone number, security question upon using the system.</td>
<td>M</td>
</tr>
<tr>
<td>SRP_08_0</td>
<td>Passengers can delete their account if they wished to.</td>
<td>O</td>
</tr>
<tr>
<td>SRP_08_0</td>
<td>System will verify and prompt an error message if the passenger did not enter the correct existing password while changing their account password.</td>
<td>O</td>
</tr>
<tr>
<td>SRP_08_0</td>
<td>System will verify and prompt an error message if passengers entered a new password that is similar to the existing password while changing their account password.</td>
<td>O</td>
</tr>
<tr>
<td>SRP_08_0</td>
<td>System will verify and prompt an error message if passengers entered a new telephone number that is similar to the existing telephone number while changing their account password.</td>
<td>O</td>
</tr>
<tr>
<td>SRP_08_0</td>
<td>Passengers are able to cancel changing user information at any time by clicking the ‘Cancel’ button.</td>
<td>O</td>
</tr>
<tr>
<td>SRP_09_0</td>
<td>Drivers are able to change their password, telephone number,</td>
<td>M</td>
</tr>
</tbody>
</table>
security question upon using the system.

SRP_09_02 Drivers are able to delete their account if they wished to. O

SRP_09_03 Drivers are able to update the information about their vehicle in case there are changes. O

SRP_09_04 System will verify and prompt an error message if the driver did not enter the correct existing password while changing their account password. D

SRP_09_05 System will verify and prompt an error message if the driver entered a new password that is similar to the existing password while changing their account password. D

SRP_09_06 System will verify and prompt an error message if the driver entered a new telephone number that is similar to the existing telephone number while changing their account password. D

A prototype of the Share Your Ride mobile application was developed with the gathered requirements while using Firebase as the application database. Some snapshot of the Share Your Ride application is illustrated in Figure 1, 2, 3, and 4.

Figure 1. Login Interface (Left) And Ride Booking Interface (Right)

Figure 2. Driver Main Interface Before Selecting A Location (Left) And After Selecting A Location (Right)

Figure 3. User Profile Interface (Left) And Manage User Information Interface (Right)
IV EVALUATION OF SHARE YOUR RIDE MOBILE APPLICATION

Evaluation Setting

A usability evaluation was conducted to test how well users can learn and use the system and also their satisfaction level while using the system. The purpose of the evaluation is also to gather respondents’ feedback on the usefulness, ease-of-use, and also satisfaction of the system called “Share Your Ride” Route Planner (SRP). To perform the evaluation, the Share Your Ride application and a post-task questionnaire have been used. There are 30 respondents involved in this usability evaluation and all the respondents participated voluntarily. The respondents involved are users with or without experience in using a Route Planning System. The respondents participated in this evaluation through remote testing which was performed online. Respondents were given an invitation email along with Google Form URL to participate in the evaluation. The post-task questionnaire is the method used to conduct a usability evaluation of this system. The post-task questionnaire consists of two sections, sections A and B. The demography and background information of the respondents were included in section A while respondents’ opinion on the usability of the mobile application is investigated through section B.

Respondents’ Demographic Information

User acceptance of the application begins with Section A which reveals a user’s demography profile. The majority of the respondents are drivers which scale up to 53% of the respondents. 47% of the respondents chose to evaluate the system as a passenger. Most of the respondents are Male which is 57% and this is expected as they are ones mostly involved as drivers in e-hailing services. The respondents of the evaluation consist of people ranging from age 16 to 46 and above. Most of the respondents are age 21-25 which is made up of 30% of the respondents. This is followed by a group age 46 and above (i.e 23% of the respondents). The age group 26-35 is ranked third while group 36-45 years as the fourth group. The age group 16-20 is the one of least number of respondents. Even though all the respondents use the Internet daily, not all have been using e-hailing services. A total of 33% of respondents use e-hailing every week followed by a monthly basis with 27% of the respondents. There are 23% of the respondents who use e-hailing occasionally. On the other hand, only 17% of respondents use e-hailing on daily basis.

In terms of the number of e-hailing systems that have been used by respondents, most of the respondents (73%) used 2 or fewer systems. The remaining respondents have used at least 3 e-hailing systems. Nearly half of the respondents (i.e 12/30) have heard about route planner while the remaining are either have not heard of it or unsure about it. Nevertheless, 16 out of 30 respondents agree that they think a route planning system is necessary for drivers nowadays. Besides, most of the respondents (i.e 26/30) wanted to have a system that plans the traveling route for them.

Usability of Share Your Ride Mobile Application

The respondents’ responses in Section B of the post-task questionnaire were analyzed to evaluate the usability of the Share Your Ride application. This section measures respondents’ thoughts on the usefulness, ease of use of Share Your Ride, and their satisfaction with the application. Tables 2, 3, and 4 show the responses of the respondents towards the usefulness, ease of use, and satisfaction of Share Your Ride, respectively. The ratings deployed in the tables are represented using abbreviations where “SD” represents Strongly Disagree, “D” for Disagree, “N” for Neutral, “A” for Agree, and “SA” for Strongly Agree.

<table>
<thead>
<tr>
<th>Items</th>
<th>SD</th>
<th>D</th>
<th>N</th>
<th>A</th>
<th>SA</th>
</tr>
</thead>
<tbody>
<tr>
<td>SRP enhances my effectiveness to complete all tasks</td>
<td>0</td>
<td>0</td>
<td>12</td>
<td>7</td>
<td>11</td>
</tr>
<tr>
<td>SRP gives me greater control over my work.</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>14</td>
<td>11</td>
</tr>
</tbody>
</table>
The outcome of the application evaluation suggested that the Share Your Ride mobile application is useful, easy to use and respondents are satisfied with the application. Most of the respondents agree that Share Your Ride is easy to use and flexible that it could help them to find the best route to fetch their passengers and meet their needs. In terms of ease of use, respondents responded that Share Your Ride is easy to learn without any written instructions and they can easily remember how to use the app. Lastly, respondents are satisfied with Share Your Ride and would recommend the application to others.

V CONCLUSION

With the advancement of technology nowadays, mobile application is preferred by most of the people as it is very convenient without needing to bring a laptop with them all the time to have access to the application. This paper described the design and development of the Share Your Ride application that helps drivers to plan the best route to fetch their passengers. Based on the results from the evaluation, it is learned that the application is well accepted by the users, particularly the drivers. Drivers thought that the application is useful in their e-hailing services. The application of shortest distance helps the e-hailing company to ease their drivers in managing passengers. Knowledge management generates some kind of benefit to business organizations, putting them in more favorable positions in terms of profitability and competitiveness.

Nevertheless, there is a need to improve on the ease of use of the Share Your Ride application in order to attract users of different age groups. A better user interface design is required to improve the user experience. In addition, to facilitate drivers during an emergency or unexpected scenario, there is a need to incorporate a re-routing function that provides alternatives routes to be taken by drivers. This would be much useful in the event of an accident or land collision.

REFERENCES


Table 3. Respondents’ Response On The Ease of Use of SRP

<table>
<thead>
<tr>
<th>Items</th>
<th>SD</th>
<th>D</th>
<th>N</th>
<th>A</th>
<th>SA</th>
</tr>
</thead>
<tbody>
<tr>
<td>SRP is easy to use.</td>
<td>0</td>
<td>11</td>
<td>5</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>SRP is user friendly</td>
<td>0</td>
<td>9</td>
<td>14</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>SRP is flexible.</td>
<td>0</td>
<td>13</td>
<td>9</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>It is easy to learn how to use SRP.</td>
<td>0</td>
<td>6</td>
<td>16</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>I can use SRP without written instructions.</td>
<td>0</td>
<td>7</td>
<td>13</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>I can easily remember how to use SRP.</td>
<td>0</td>
<td>11</td>
<td>11</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>I have not noticed any inconsistencies as I use SRP.</td>
<td>0</td>
<td>5</td>
<td>17</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>I can recover from mistakes quickly and easily when using SRP.</td>
<td>0</td>
<td>7</td>
<td>12</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>I can use SRP successfully every time.</td>
<td>0</td>
<td>7</td>
<td>14</td>
<td>9</td>
<td></td>
</tr>
</tbody>
</table>

Table 4. Respondents’ Response on The Satisfaction of SRP

<table>
<thead>
<tr>
<th>Items</th>
<th>SD</th>
<th>D</th>
<th>N</th>
<th>A</th>
<th>SA</th>
</tr>
</thead>
<tbody>
<tr>
<td>I am satisfied with SRP.</td>
<td>0</td>
<td>8</td>
<td>6</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>I would recommend SRP to my friend.</td>
<td>0</td>
<td>9</td>
<td>14</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>SRP works the way I want it to work.</td>
<td>0</td>
<td>6</td>
<td>17</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>I feel I need to have SRP.</td>
<td>0</td>
<td>4</td>
<td>16</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>SRP is wonderful and pleasant to use.</td>
<td>0</td>
<td>8</td>
<td>11</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Overall, I am satisfied with the ease of completing the task using SRP.</td>
<td>0</td>
<td>5</td>
<td>15</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Overall, I am satisfied with the amount of time it took to complete a task in SRP.</td>
<td>0</td>
<td>7</td>
<td>10</td>
<td>12</td>
<td></td>
</tr>
</tbody>
</table>


Defining Core Knowledge Elements of Adaptive Augmented Reality (A²R) through Conceptual Model Analysis

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ABSTRACT
In this paper, a number of past studies on Adaptive Augmented Reality are scrutinized in order to define the core knowledge elements of adaptive concept. Through model analysis, where four past models were considered; components of such concept were gathered and proposed as a formal definition. Such components were included in a heritage tourism app running on mobile devices. Findings indicated that such core elements are indeed accepted as necessary in defining adaptive augmented reality concept. A Usability test was administered to all the respondents in order to record the app perceived effectiveness, efficiency, learnability, satisfaction and error. The overall score gets a high mean, where all five attributes gathered positive responses from users.

Keywords: knowledge element, augmented reality, adaptive, conceptual model.

I INTRODUCTION

The use of Augmented Reality (AR) technologies as a distinctive information dissemination environment is vindicated in the study by Osadchyi et. al. (2020). Such technologies have been employed for inspiring museums with an adapted visiting experience and digital content tailored to the historical and cultural context of the museums and heritage sites. Various interaction approaches, such as sensor-based, device-based, collaborative, or hybrid interaction, have also been engaged by these immersive reality technologies to enable interaction with the virtual environments. However, the utilization of these technologies and interaction approaches is not often supported by applicable guidelines that can assist AR apps developers and cultural heritage workers to predetermine their relevance to accomplish the intended objectives of the AR applications. Therefore, we review the current literatures and eventually define the core elements of A²R.

II PAST STUDIES

A. Augmented Reality
AR provides an overlay of virtual content (text, audio, video, 3D object) on real world view (through a monitor, mobile phone, and head-mounted display) without replacing the real environment. (Azuma, R., Baillot, Y., Behringer, R., Feiner, S., Juliur, S., & MacIntyre, 2001; Milgram, Takemura, Utsumi, & Kishino, 1994) Milgram identified AR as a sub-class of Mix reality in the Reality-Virtual Continuum. While Azuma et al. (2001) defined AR system with three characteristics: 1. real and virtual object merged in a real environment, 2. Interactive and real-time, 3. Alignment of the virtual and real object. By agreeing to Azuma; Hollerer and Feiner (2004) also define an AR system as “one that combines real and computer-generated information in a real environment, interactively and in real-time, and that aligns virtual objects with physical ones.” On the other hand, the definition is given by Dudzik (2018), AR is “an interactive, real-time direct or indirect view of a physical environment that has been enhanced by the superimposing of computer-generated sensory information, such as images, sounds, videos, and haptics.” These definitions have pointing AR to some similar key term such as, interactive, real-time, and integrating with virtual content to enhance the real environment.

In the early days, AR was bulky as a ‘see through’ Head Mounted Display (HMD) had to be attached to desktop computer or laptop to operate (Milgram et al., 1994). With the advancement in technology, the size of the AR devices became smaller and more mobile such as mobile phone and google glass. AR was introduced in military and aviation manufacturing long before it came available to the public user. Due to the advancement in mobile technology, AR has been applied in various fields such as marketing, education, medical, manufacturing, entertainment, tourism and others (Mekni & Lemieux, 2014). Museum and heritage is another field taking advantage of this edge cutting technology, for examples, “Svevo Tour” is an AR project to promote famous Italian novelist, Italo Svevo (Fenu & Pittarello, 2018). AR again taking a leap when “Adaptive” is encapsulated in this technology.

B. Adaptive Augmented Reality
Adaptive augmented reality (A²R) is the latest concept of the augmented reality that responds and adapts to a real-time context and the characteristics of the user (Damala et al., 2012; Tenemaza, de Antonio, & Ramirez, 2015). AAR concept is said to provide adaptation of 3D augmented reality and better
engagement to the users (Damala & Stojanovic, 2012). These could help, for instance, the museum visitors, to be more immersed in the exhibition or artifact based on their emotional experience.

There have been a few studies recently that relate to A2R in various fields, including cultural heritage, disabilities, and elderly. The latest study of A2R in helping people with mild intellectual disability in Ecuador (Tenemaza, De Antonio, Ramirez, Vela, & Rosero, 2016). The newly explored concept has been used to locate the patient when they are lost and help them return home. The app developed to benefit both the patient and the caretaker because it also acknowledges the caretaker when the patient is lost. This noble application is an expansion of the researcher’s previous work (Tenemaza et al., 2015). In another study related to the elderly using the application of A2R is in helping them living alone in doing a daily chore (Hervás, Bravo, Fontecha, & Villarreal, 2013).

This concept of A2R is based on user, environment and platform. These three pillars can foster functional ability, ease of use and portability of new augmented reality applications. Damala et.al (2013) describe in their paper three applications showing the adaptation of augmentation based on three variables: the scene illumination, the distance to the target and the ambient noise. This research was aimed at enhancing information presented to visitors based on their psychological state. They employed within the context of the creation of an AR guide for a museum visit. The interest of the visitor is monitored using physiological sensors so that the multimedia content delivered to the visitor’s see-through AR display with which he can interact through gesture interaction can be adapted according to his engagement and interests. Their work has been a major breakthrough for adaptive augmented reality as applied to the heritage field.

These studies without doubt have contributed to the A2R field. However, a formal definition in the form of local user, context, interaction and environment models to assist the creation of such assisted technology has yet to be proposed (Tenemaza, de Antonio, & Ramirez, 2015). Looking at all the advancement and changes that are happening in the heritage field abroad, and noticing that in Malaysia there is still a major gap and lack of development in this area, it is time a study should be proposed to lessen this gap in the local context.

III A2R CONCEPTUAL MODELS

A number of AR conceptual models and frameworks have been proposed, mainly related to a number of attributes which are enjoyable informal learning, adaptive multimodal interaction, immersive experiences, value creation, user experience and acceptance.

As discussed earlier, applications of AR have grown into various fields. Traditionally, AR was associated with domains of architecture, however now this has expanded to the field of heritage too. For instance, Pendit and Zaibon (2014) built a model as a guideline to develop a mobile AR application for experiencing non-formal enjoyable learning while visiting cultural heritage site. However, this model was not produced for adaptivity in mind. The model was proposed after reviewing an existing model and realized that the previous model do not include the element of enjoyable informal learning. So, they incorporated learning theories toward AR application components (such as media elements, activity, navigation, social interaction, games and presentation style) and mobile technology component to holistically visualize the concept of enjoyable informal learning in mobile augmented reality model.

Damala & Stojanovic (2012) in their article, built a theoretical framework where they provided together with an overview of a system architecture and coined the term A2R. In another article, Damala and team targeted at the ways through which A2R could be employed in museum and gallery settings as an interactive Multimedia explanation medium, guiding the museum visitors. A2R provides visual and acoustic augmentations that complement the artefacts or site viewed by a heritage visitor. The crucial goal is to “make every heritage visit unique, by fitting a visit with contents that are inclined to increase the affective impact of the augmented museum visiting experience and hence encourage intrinsic and self-motivated learning” (Damala & Stojanovic, 2012).

A. A2R Museum Visit Augmentation Model

Figure 1. A2R Museum Augmentation Model by Damala & Stojanovic (2012)

A theoretical framework was developed together with an overview of the system architecture. The authors focused on the interdisciplinary, collaborative and content-informed methodology to identify the
motivations and needs of the cultural heritage professionals as to the potential of the A²R for the museum visit. Figure 1 could be considered among the earliest conceptual model for A²R.

**B. Adaptive Multimodal Interaction in Mobile Augmented Reality Framework**

The conceptual framework for Adaptive Multimodal Interfaces in Mobile Augmented Reality is a framework that provides a guideline to apply adaptive multimodal interaction in mobile AR (Abidin, Arshad, & Shukri, 2017). The framework has three main components: inputs modalities, multimodal adaptation module, and AR module; based on components of previous models related to adaptive interfaces, multimodal interfaces and augmented reality. From this model, the adaptation in the AR system could happen based on three input modalities: user input, Environmental changes, and mobile device changes. The input is processed in the adaptive module before the adaptive information sends to the AR controller module to proceed with the displays of relevance AR content on the AR camera view. The three components in this framework will be considered in the adaptive augmented reality conceptual model even though it lacks empirical evidence (Figure 2).

**C. Adaptive Augmented Reality Model**

Tenemaza, et al. (2015) proposed a detailed definition of the content of the User Model required for A²R systems (Figure 3). They explored the state of the art ontologies for user modelling, and proposed a set of significant user characteristics to be modelled. They also presented an initial architectural model for such systems.

**D. Context-awareness Adaptive AR Model**

Hervás et al. (2013) suggested a model for supporting daily user needs using simple interactions with the environment through an augmented-reality perspective that applies proactive adaptation through knowledge representation using ontologies. The proposed architecture (i- ARA) model uses principles of context-awareness and user personalization (refer to Figure 4).

**IV DEFINING A²R CORE ELEMENTS**

Four relevant past models (refer to Figure 1 to 4) were studied. The main aim is to put forward a concrete definition of A²R for the purpose of this research.

It is clear that, in each of the AR models, user profile, media, interaction, environment data and device components are included as elements (refer to Table 1). In the proposed models described earlier, all of them include the User Profile and Environment elements as their adaptive augmented reality components. User’s information (such as age, gender, height) and physiological state are retrieved to determine the characteristics of the users or their interest. The augmented content is usually based on the characteristics selected and related to the multimedia contents (images, videos, animations, text, audio comments, sounds, and 3D objects). The interaction can happen through gesture, speech, touch and gaze based on the device used to interact with the content. Most models take advantage of the sensors available on the device. For example, sensor devices are used to determine changes in user’s interest through the audio, visual and biosensing data in ARiSENSE, so that relevant content will be displayed to the users (Damala & Stojanovic, 2012). While for mobile phone, information from sensor (camera, GPS, compass and etc.) were utilized to adapt useful
In all models presented in Table 1, it is clear that environment (EV) and user personalization (UP) are the core components in adaptive apps.

EV ties to changes in context of contents being displayed; such as the visual, audio and interaction elements. UP deals mostly with the user model; sensing users’ bio to adapt to EV and scenarios that have been planned. Age, gender, height are instances of bio where adaptivity could be applied. Other components (OC) depend on service or device layers. If the augmented app is targeted for mobile device, then perhaps cloud network model should be included.

We hereby proposed that the core elements of:

\[ A^2R = \{EV, UP, OC\} \]

where

\[ EV = \{\text{medium, media, interaction, context}\} \]

\[ UP = \{\text{bio data such as age, gender, height, etc.}\} \]

\[ OC = \{\text{service, networked, devices}\} \]

& whenever sensors are available, the UP adaptive component makes use of such sensors.

& context in EV refers to how creative the storytelling is applied.

### A. Applying Core Elements in a Tourism Apps Prototype Development

A major difference between native mobile application and augmented reality, according to interaction design foundation, is its physical environment where digital elements to appear over real and allow interaction between user and the artefacts. AR used to direct people’s attention through AR features and interactivity. Fundamentally, AR is a computer technology that uses cameras to capture and display real-world environments, objects, or images, and juxtaposes digital information onto reality in real-time. The latest technology trend that emerged is the augmented reality assisted tourism application. Consumer behavior is shifting, and technologies are undeniable revolutionized and enhance the tourist experience at visited places where valuable and additional knowledge obtained easily through AR apps. AR apps alter and enhance people’s perceptions of their physical surrounding when seen through a particular device.

The user model approach uses specific algorithm that collect real time user data for user recognition method. Here, the height measurement was used as the adaptive criteria to differentiate kids and adults. The estimated adult height for this study refers to a study conducted by Ipsos (2019) suggesting that the ideal height for Malaysians men is between 178cm to 185cm, while ideal height for women was 155cm to 163cm. Researchers take into account the range between the height of males and females is estimated at 159cm to 181cm. Children in this study were defined as individual ages under 12 years old. From the past studies, kids’ heights are set to below 4.75 feet (Bong, et al., 2012).

For this purpose, users are required to locate the ground or floor surface using AR camera and the apps will measure user height at the background. The A^2R app system will then measure user height from floor surface to mobile device Y height using device sensor and proposes personalize experience divided into two categories, kids and adults.

The storytelling method is best suit to deliver Information and to shape new narrative experiences characterized by the use of rich media. This type of interaction model is expected to transform visitor experience, communicates messages and improve user engagement via A^2R tour. A good story helps the visitor to interpret an artwork in the context of the life of the artist or the social and political context in which the artwork was created. In the study described here, two different narrative paths are shown depending on the height and age of the users.

To develop a prototype consisting of all the core elements described (refer to Fig 5), the Mobile apps
Development Lifecycles by Sharp, Rogers & Preece (2011) was adopted. To ensure an effective mobile AR application development, careful planning was overseen. A functional prototype makes it easy for the user to understand the functionality and features of the application being developed.

In total, 21 respondents participated in this study where 8 are females and 13 males. 71.4% of the respondents are in the 19 – 24 years old group. Students made up 76.2%, employed users are 9.5%, and young kids are 14.3%. Data show that all of the respondents are using android devices.

A Usability test was administered to all the respondents in order to record the app perceived effectiveness, efficiency, learnability, satisfaction and error (Table 2).

Table 2. Findings on Perceived effectiveness, efficiency, learnability, satisfaction and errors.

<table>
<thead>
<tr>
<th>No</th>
<th>Items</th>
<th>Min</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.</td>
<td>Effectiveness</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>I am satisfied with the arrangement of the features and the layout of the screen.</td>
<td>4.35</td>
</tr>
<tr>
<td>2</td>
<td>I can easily rotate the device in portrait or landscape orientation while using this app.</td>
<td>4.36</td>
</tr>
<tr>
<td>3</td>
<td>The navigation is clear and easy to follow.</td>
<td>4.48</td>
</tr>
<tr>
<td>B.</td>
<td>Efficiency</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>The app is able to load the 3D images of the artifacts quickly.</td>
<td>4.10</td>
</tr>
<tr>
<td>5</td>
<td>It takes only a while for the mobile sensor to surface detect any object.</td>
<td>4.35</td>
</tr>
<tr>
<td>6</td>
<td>The menu buttons are user friendly in size.</td>
<td>4.52</td>
</tr>
<tr>
<td>7</td>
<td>The instructions are concise and able to direct users to the intended use or function.</td>
<td>4.35</td>
</tr>
<tr>
<td>C.</td>
<td>Learnability</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>The screen features are not cluttered and spaced out efficiently.</td>
<td>4.29</td>
</tr>
<tr>
<td>9</td>
<td>The features are comprehensive with clear graphics, videos, audios and 3D elements.</td>
<td>4.52</td>
</tr>
<tr>
<td>10</td>
<td>The storytelling is relevant with pre-history facts.</td>
<td>5.00</td>
</tr>
<tr>
<td>D.</td>
<td>Satisfaction</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>This app is suitable for users as an alternative way to exploring the rich heritage using advance technology.</td>
<td>4.57</td>
</tr>
<tr>
<td>12</td>
<td>This app allows the users to actively interact with the artifacts in different ways.</td>
<td>4.38</td>
</tr>
<tr>
<td>E.</td>
<td>Error</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>This app performs favourably on my mobile device.</td>
<td>4.52</td>
</tr>
<tr>
<td>14</td>
<td>The time taken to carry out certain functions is optimised if no error message detected.</td>
<td>4.35</td>
</tr>
</tbody>
</table>

From the results in Fig 6, the overall score gets a high mean of above 4 (score 5 is max). All five attributes gathered positive responses from the users. Users are satisfied with the arrangement of the features and the layout of the app screen. By using minimal interface design makes the navigation clear and easy to follow. Efficiency attribute is high noting that the time taken to display info on artefacts and record mobile censor data, execute menu button and instruction are fast. Respondents also agree that the learnability attribute, clear screen optimization and the storytelling are engaging. All the features relevant with the prehistory facts and are comprehensive with clear graphics, videos, audios and 3D elements. The attractiveness attributes measure the apps suitability as an alternative way to exploring the rich heritage using advance technology. The app allows the users to actively interact with the artifacts in different ways. Respondents also agree that the app is compatible with their smartphones devices, which allow them to carry out certain functions if no error message is detected.

V CONCLUSION

A2R is a technology that can support users in their daily life with useful information for their activities which is really adapted to the user’s characteristics, to the environment where the activity is taking place, and to the current context. Cultural Heritage are among of the context to benefit from this technology. A2R is able to enhance the visitors experience by providing useful information based on visitors’ profile during their visits to the museum. The best example is depicted in the ARSENSE project (Damala et al., 2012), where the main objective of the study was to enhance visiting experience by providing augmented contents based on their interest. Another success examples of AR application in heritage domain is “Svevo Tour” as the elderly visitors are emotionally engaged with the contents (Fenu & Pittarello, 2018). This article is aimed at summarizing and defining the core components of A2R. Through model analysis, components of such concept were gathered and proposed as a formal definition. In conclusion, any adaptive augmented reality application should include an adaptation module where user personalization plays an essential role in showcasing the adaptive element.
ACKNOWLEDGEMENT

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E-Waste Recycling Awareness in Young Adults in Malaysia: An Interactive Courseware

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ABSTRACT
E-waste is becoming one of the fastest-growing waste globally with an estimation of 1.11 million metric tonnes in 2020 due to the rapid growth of electronic and electrical waste. Improper recycling of e-waste will expose the hazardous compounds contained in e-waste such as lead, mercury which harmful to human health resulting in serious illness. However, e-waste is crucial not only because of the hazardous effect of the chemical waste but also the potential for wealth creation from the proper extraction of precious materials such as silver, gold. This paper describes the requirement design and strategies for an interactive courseware to educate the youth on e-waste information and the proper way to discard them. This courseware development is guided by the Rapid Application Development (RAD) methodology. A post-study survey is conducted to get the user’s feedback on E-waste interactive courseware.

Keywords: household e-waste, electronic waste recycling, awareness, courseware.

I INTRODUCTION
Electronic waste, or e-waste refers to all items of electrical and electronic equipment including its parts that have been discarded as waste (Balde et al., 2017). It includes a wide range of products which consist of almost any household or business item with circuitry or electrical components with power or battery supply. In certain regions of the globe, E-waste is also known as e-scrap. There are six e-waste categories; temperature exchange equipment, Screens, monitors, lamps, large equipment, small equipment and small IT and telecommunication equipment (Balde et al., 2015). E-waste, when not treated properly can brings harms to health since e-waste contains hazardous components, including contaminating air, water, and soil, and putting people’s health at risk such as detrimental to human health affecting the system in the human bodies such as endocrine system, reproductive system and nervous system (Srivastava & Phatak, 2020).

Most of e-waste contains heavy metals, polycyclic aromatic hydrocarbons, polychlorinated biphenyls, and brominated flame retardants (Rawat, Verma, & Singh, 2020). However, e-waste is a diamond in disguise. It contains intrinsic value of critical and precious metals inside such as gold, silver, copper and can be recovered using wet chemical processes and electrolysis, recycling of e-waste is becoming an attractive and lucrative business opportunity (Tengku-Hamzah, Tengku, Adeline, 2011) that can contribute to Malaysian economic growth with creation of many new industries such as jewelry, pharmaceuticals and electronic and electrical industries. Department of Environment (DoE) Malaysia stated that the real facts and figures of household e-waste cannot be captured correctly since the discarded e-waste was not done through proper channels. Moreover, based on studies conducted in selected areas, the quantity of household e-waste generated is estimated to reach 53 million pieces in 2020 – 3.5 times higher than in 1995 (Department of Environment Malaysia, 2015). Yet, the awareness level among the citizens is still low about e-waste dangers and recycling activities.

Briefly, this paper presents the study that aims to develop an interactive courseware for e-waste recycling among young adults. This paper contributes to the current e-waste literature by providing the requirements analysis and design strategies for developing an interactive courseware for e-waste recycling. The phases of this application development are spelled out that can be used by others who have similar interest in developing interactive courseware for e-waste recycling. This paper is organized in the following manner. Section II of this paper reviews the background of the study. Then, in Section III the adopted methodology is elaborated in detail, describing the requirements and design of the application. Finally, the paper ends with discussion and future work.

II BACKGROUND OF THE STUDY
Electronic waste or e-waste are known as discarded electrical devices, a type of scheduled waste that hazardous and harmful to human and environment but also a type of waste that can be managed to be a luxurious resource. Globally, some countries have become hazardous dump yards of e-waste especially developing countries such as China, India other developing countries that export their huge number...
of wastes to other country (Perkins et al, 2014). The current incident of closure of 111 schools and toxic reported incidents reflects an example of disastrous scenario if e-waste not being handled appropriately (Free Malaysia Today, 2019).

With the increasing concerns one-waste, many countries have starting to establish vibrant national e-waste recycling schemes (ScienceDaily, 2010) and Malaysia has prepared the mechanism such as legal structure, organization, system for sustainable collection and environmentally sound recycling of household e-waste (Masrom, 2017).

In the discarded electronic appliances, there are many valuable materials such as gold, copper, silver that can be extracted from the motherboard or circuit board and potentially recyclable. From precious raw materials that can generate wealth, e-waste also contains toxic materials that are harmful to human health and the environment. Each computer or television display monitor contains an average of 2-4kg of lead while there are 70% of the heavy metals such as mercury and cadmium also found in landfills come from discarded electronic devices (Hawari & H. Hassan, 2010). These heavy metals and other hazardous substances can be a threat to the public health and cause environmental problems. Improper recycling of the hazardous compounds will be detrimental to human health affecting system in human body such as endocrine system, reproductive system and nervous system (Pinto, 2008). Currently, most of the electronic devices end up in landfill sites with no proper treatment because of the lack of segregation mechanism. Furthermore, over that 90% of these wastes were sending to the landfill while in other countries, a large fraction of these wastes from households ends up in the waste incinerators (Pinto, 2008).

Therefore, DoE had created an official household e-waste management portal to share many usable information of e-waste recycling in videos and pictures on the website but level of awareness is still low (Department of Environment Malaysia, 2015). It is due to website is a one-way communication to public that can be quite a challenge to gain young adults, age 15-30 years’ attention. Most of the young adults possessed several e-waste items but lack of information on the process of their recycle and disposal of the items. Malaysians internet user’s demographic as of July 2018 shows that the young adult that age below 20 and 20-29 years had the majority in total of 38.1% (SKMM Internet User, 2018) which means that they own at least one electronic devices to get access to the internet. Thus, it is important to create awareness among the young adults through an interactive courseware that is suitable for this group.

III METHODOLOGY

The interactive courseware was developed following the Rapid Application Development (RAD) methodology proposed by Martin (Martin, 1991). RAD is an adaptive software development approach which involves prototyping and the requirements for the systems of apps. RAD consists of 4 phases which is requirement planning, user design, construction and cutover. These phases help to ensure the project completed as planned. The flow of the phases is illustrated in Figure 1.

![Figure 1. The phases of RAD.](Image)

This project started off with Requirement Planning Phase. Requirement Planning is the initial stage of RAD methodology model and it is meant to set the goals the elaboration including project scope and boundaries. During this stage, the project goal and the expectation was determined. User requirement was gathered from all the stakeholders involved including young adults via in depth interviews and online surveys.

In the User Design Phase, user feedbacks were gathered and the courseware architecture was developed well. During this stage, the development of user design through various prototype iterations to ensure requirement is related to the project. Interface sketches and database designs are generated using techniques such as storyboards and Unified Modelling Language (UML) models of system analysis and design. In the Rapid Construction Phase, Adobe Flash was used to develop the courseware. The project was linked to database for storing the name of the user and the total score of the Awareness Test. Lastly, during the cutover stage, the courseware was developed and involved in courseware and user testing. This project able to get 32 user testing feedbacks for initial evaluation of E-Waste Recycling Awareness.

IV DEVELOPMENT OF E-WASTE RECYCLING AWARENESS COURSEWARE

This section describes the design and development of the E-Waste Recycling Awareness interactive courseware. The section is divided into two subsections: (A) the requirements analysis and (B) the prototype development.
A. The Requirements Analysis
The E-Waste Recycling Awareness is an interactive courseware specifically tailored to young adult who age range between 15-30 years to raise their awareness of e-waste recycling. The requirements gathered are analyzed and categorized as functional requirements and non-functional requirements for the courseware. The high level of the functional requirements for this courseware is embedded in several scene which are:

- Start Courseware
- Choose Menu
- Play “Awareness Test”

Table 1. List of requirements for e-waste recycling awareness

<table>
<thead>
<tr>
<th>No</th>
<th>Requirement ID</th>
<th>Requirement Description</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>A01</td>
<td>Start Courseware</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>A02</td>
<td>Choose Menu</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>A03</td>
<td>Play “Awareness Test”</td>
<td></td>
</tr>
</tbody>
</table>

The high-level functional requirements shown in Table 1 represented in the main pages that included several scenes of the courseware. In this study, StarUML tool was used to visualize and model the requirements of the courseware. Among the analysis UML model developed are use case, activity diagram and sequence diagrams. Figure 2 illustrates the use case diagram and the communications between the use cases and the actor. Three main use cases of E-Waste Recycling Awareness are “Start Courseware”, “Choose Menu” and “Play “awareness test”.

For every single use case identified in the use case diagram, a use case specification is produced. Use case specification to detail out every single step of the functions involved in the use case. Use case specification is vital to ensure all the requirements are captured correctly including all the basic flows, alternative flows and also exceptional flows. After the requirement analysis is done, the application is further continued with UML analysis and design model. UML is used to produce activity diagram for the big picture of e-waste recycling awareness courseware, followed by analysis of sequence diagram that evolved into design sequence diagram and class diagram.

The purpose of the sequence diagram was to show in timely manner the object interaction through the passing of messages between the objects involved to perform the functionalities of e-waste recycling mobile application for the basic flows, exceptional flows and alternative flows. The messages passed between the object will become the operations or methods for the related objects. A sequence diagram is produced based on each of the use case specification prepared earlier. Figure 3 shows the sequence diagram of basic flow of Start Courseware page and Figure 4 Sequence Diagram of Choose Menu page.

B. E-Waste Recycling Awareness Courseware
A prototype of the courseware was then developed to represents the requirements explained in the previous subsection. Adobe Flash was used to develop the prototype of E-Waste Recycling Awareness for creating multimedia content and animation can result in designs where browsers can immerse in an interactive experience. ActionScript 3.0 is the programming language of Adobe Flash that is in model of object-oriented programming while XXAMP is used for database and the data is stored in mySQL for storing the name of user and total score in Awareness Test page. Screenshots in Figures 5, 6, 7 and 8 show the selected interfaces of E-Waste Recycling Awareness.
V EVALUATION OF E-WASTE RECYCLING AWARENESS COURSEWARE

A. The Evaluation Setting
A usability evaluation was conducted on 32 respondents who are in between 15-30 years of age. The respondents were approached face to face and through online and participated in the study on a voluntary basis. The instruments used for the evaluation were the E-Waste Recycling swf file and
a post-task questionnaire. The post-task questionnaire consists of 4 sections which are demographic information, screen, action and navigation and overall performance that was adopted from (Elissavet & Economides, 2003). The five-point Likert scale is used to indicate extent for each question (Preedy & Watson, 2010). The respondents performed the following instructions for the evaluation: (1) read the consent form, (2) interacted with E-Waste Recycling Awareness and completed the E-Waste Recycling Awareness Test, and (3) answered the post-task questionnaire.

B. The Respondents' Demographic Information

From the demographic information revealed that 50% of the respondents is female. 94% of respondents are young adults who is between 15 to 30 years older. All respondents are Malaysians from three major races of Malay, Chinese and Indian. Most are the respondents (81%) stated they have the experience to use mobile application ICT more than 3 years. There are majority 53% of the respondents used 9 hours and above for their daily usage of ICT devices.

C. The Usability of E-Waste Recycling Awareness

Section B to Section D captured the respondents’ perception towards E-Waste Recycling Awareness in terms of usability, deliverable level of awareness and satisfaction. The frequency and percentage of the responses as shown in Fig 9, 10, and 11 From the responses, the respondents generally rated four or five of the post-task scales. Some of the respondents rated neural and only a few rated Disagree.

From the results of the evaluation showed that E-Waste Recycling Awareness is easy to use and majority of the respondents are satisfied with it. They are overall content with the courseware as well. Analysis of the respondents’ responses shows that most of the respondents agree that the courseware is understandable and the content delivered is clear. Most of the respondents stated that E-Waste Recycling Awareness was ease to use and works interactively and attractively.

VI DISCUSSION AND FUTURE WORK

This paper presented the development of e-waste recycling courseware that is interactive to create awareness for young adults. This application tried to utilizes the advantage of mobile technology to educate people on e-waste recycling. It also opens up opportunities to provide information to people on how generate income from the recycling of e-waste, to ease the work of e-waste collectors and to save the environment from hazardous chemicals from the e-waste if they are not disposed properly. In the future, we would like to further enhance the courseware for other age and targeted groups such as kids and rural people.
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ABSTRACT
Global growth in the usage of internet has led to the expansion of Internet Banking. Acceptance of IB among banking users has improved due to the suitability offered. However, a few associated Internet networking risks have increased the possibility of encountering phishing attacks. Phishing attack refers to the most defiant security threats that are often perpetuated by conning user’s information, whereby personal information is inadvertently disclosed, sensitive information is deleted, and other related resources are destroyed. To handle the challenge of phishing attacks, knowledge management can be used as a strategy in improving existing products and services, especially in producing essential innovations that may secure the role of banks. Such technological innovations lead to the strengthening of Knowledge Management (KM) in improving performance with the linking of individuals, procedures, and knowledge. To become more efficacious in the era of the knowledge age, organizations need to understand and implement various strategic management techniques. Hence, the paper tries to clarify the role of KM in strengthening its usage in the area of internet banking in fighting against phishing attacks. Once users become more familiar with technology, they tend to have higher anticipations towards technology.

Keywords: Internet Banking, Phishing Attacks, Knowledge Management.

I  INTRODUCTION
Technology has been seen to be the basic and significant part of financial success. In the last 20 years, the development of technology in business has impacted individuals in a way due to its various benefits (Khedmatgozar & Shahnazi, 2018). Development of technology has several inferences unto the banking sector. Reputation of the banking sector in today's financial growth and expansion cannot be undermined globally. Today the use of internet proposes to banking sector varied range of applications technologies like internet banking which are used in keeping up with the users, in reducing transaction costs, and quicken banking transactions. Besides, the acceptance and approachability of the internet have been a significant factor as it delivers the support for internet banking services to take place (Usman, 2018). Thus, banks worldwide have moved speedily to the era of technological changes whereby customers are exposed to internet banking platforms (Mann, 2017; Chauhan & Choudhary, 2016). Nevertheless, as people are more starting to regularly depend on such online transactions especially during the Covid-19 pandemic, numerous scams, and swindling activities are mushrooming including phishing attacks (Stafford, 2020; Aboubucker & Bao, 2018).

Even though internet banking has extensively been adopted in many advanced countries, users in the developing countries are slower than anticipated (Akgül, 2018; Kamwibua, 2017; Aribake, 2015) because of a low level of trust in the online transaction platform especially on the insecurity or lack of confidence (Viswanadham, 2017; Kaaabachi, Ben Mrad, & Petrescu, 2017). Though all transactions requires some degree of trust, those that are approved within the uncertain and impersonal conditions of the internet need considerable points of trust due to the high level of risk generally allied with online transactions (Viswanadham, 2017; Gao & Waechter, 2017). Thus, banking institutions must pay proper consideration in defending their user’s information from unlawful individuals who might be requesting various confidential details for deceitful purposes.

Such technological innovations lead to the strengthening of Knowledge Management (KM) in improving performance via the connection of individuals, procedures, and knowledge. This is viewed as appropriate since knowledge has been recognized as a valuable commodity that is embedded in products especially high-technology products and services (Apak, Tuncer, Atay & Koşan, 2012). To be successful in today’s challenging organizational environment, companies need to learn from their past errors and not reinvent the wheel again and again. This paper is organized to explain the role of KM in strengthening its usage in the area of internet banking in fighting against phishing attacks.
II LITERATURE REVIEW

A. Phishing Attack

Phishing has been a web security threat that has fascinated the consideration of both academicians and company researchers that can be regulated by firewalls or any form of encryption software (Jain & Gupta, 2017). Thakur and Kaur, (2016) emphasized that phishing was first mentioned on the Internet via a set of hackers in the year 1996, who stole America Online (AOL) accounts by deceiving ignorant AOL users into unveiling their passwords (Carella, Kotsoev, & Truta, 2017). Phishing has severely grown-finely becoming a real threat to security globally and a money-spinning criminal business model (Gupta, Agrawal, & Yamaguchi, 2016). Based on the report by the international anti-phishing working group, released in the year 2016, that year was considered as the worst year in history for phishing scams having 1,220,523 as total figure recorded in the year 2015 (Pymnts, 2017).

Phishing attack has been seen to be a critical risk in an online domain, being a crime whereby a perpetrator sends some designed fake websites that appear to come from a trusted brand or organization in a way of targeting or tricking online users to disclose sensitive info and to gain entrée to their details, such as an address, credit card, username and phone number (Jain, & Gupta, 2016). Federal law enforcement associates of United State have acknowledged phishing attack as a crime involving several individuals that form a professional criminal network such as money laundering (Baykan, & Güne, 2018; Nero, Wardman, Copes & Warner, 2011). Phishing has become a relatively simple way of exploiting not only the average internet banking users but also the institutions that offer the services (Dixit, 2016; Mann, 2017). Therefore, banking institutions need to always install security modules such as anti-virus and keyboard protection on user’s devices.

B. Knowledge Management

The purpose of KM is to accomplish knowledge more efficiently and competently. Knowledge advances individual’s capacity in meeting their needs and extends the diversity of choices open to them in all areas of their lives. Besides, KM can be the next source of competitive advantage as it has become a mainstream priority for companies of all sizes (Ragsdell, 2009). Similarly, the rapid advancement of internet infrastructure has increased the efficiency of KM. Both knowledge sharing as well as re-use need to be encouraged and recognized at the individual user’s level as well as the banking level. KM must be an eye-opener to attain planned business objectives. For instance, the failure of imposing new technical infrastructures that are either unsuitable to respective work environments, or where users are not willing to share knowledge is an ample indication in strengthening KM in organizations (Mills & Smith, 2011). Nevertheless, establishments are gaining skills and competence in managing inner knowledge and smearing it on the attainment of the organizational goals and observing in the direction for fresh bases of knowledge that are not essentially found within the restrictions of the establishment (Rashed, 2016). Hence, there is a need for having KM creativity to become a solution for such problems, which brings together users, processes, and technology that can support organizations to accomplish their goals and visions.

Administrative knowledge is not envisioned in replacing specific knowledge but to match it via making it stronger, more coherent, and more broadly applicable. Moreover, the success of any organization gradually depends on its capacity to analyse, allocate, sustain, yield, and gather knowledge. KM was primarily defined as the procedure of smearing a systematic method to the seizure, structure, management, and distribution of knowledge throughout an organization to work faster, reprocess best practices, and reduce costly rework from project to project (Nonaka and Takeuchi, 1995). KM signifies a thoughtful and systematic approach to guarantee the full operation of the organization’s knowledge base, coupled with the potential of individual knowledge base skills, competencies, thoughts, innovations, and ideas to create a more efficient and effective organization. Through the practices of KM, an organization focuses on the systematic exploitation and reuse of knowledge by identifying the administration’s modest position in defining tactical gaps in its prevailing knowledge and to gain more on individual knowledge (Bloodgood, 2019).

C. Role of Knowledge Management in Strengthening Internet Banking

The banking system of today has been deep in greater risk ascending from a universal economy letdown. The banking sector, the ultimate drivers of modernization, is fighting to emerge from both financial letdown and misery by apprehending and retentive more reliable and steady users in the monetary phase (Oloclude & Oladejo, 2013). The presence of internet banking has enabled the banking sector to handle a huge volume of data and manage various banking transaction processes. However, at the same time, internet banking has also caused various challenges and setbacks. Therefore, the usage of information technology towards managing knowledge must grant KM a new dimension. Living
in a society where access to technology is becoming more significant, skills possessed by internet banking users can enable them to enhance their sense of self-worth, confidence, and security. Eventually, knowledge-intensive organizations have to gradually initiate KM in strengthening internet banking by advancing their tactics and broaden performance (Sukumaran, et al., 2018). These benefits are substantially connected to diverse reassurances in performance such as improvement in the area of choice making, enlightening the user relationship administration, generate new value via means of new facilities innovations, and producing supplementary dealings (Sukumaran, et al., 2018) for internet banking users.

Distribution of incomparable products and services to internet banking users can strengthen user’s satisfaction and volume of sales, while banking sectors will notice the influence of knowledge advancement over their performance (Cebi, Aydin, & Gozlu, 2010; Bogner & Bansal 2007). Implementation of KM has offered diverse unified supports to the IB platform, rendering it to make use of its funds proficiently and successfully (Cebi, et al., 2010). Effective implementation of KM application offers unified and multilayered assistances such as performing activities of knowledge, performance procedure, the performance of employees, performance on market and performance on the organization as a whole which affect each other in one way or the other via direct and indirect in the banking sectors (Sukumaran, et al., 2018; Memon, Rizvi & Syed, 2017). However, most of the available internet banking platforms still facing numerous issues comprising of large-scale competition for users’ deposits, withdrawal, insecurity, loans, growing users demands, shaking income restrictions, and the essential in keeping up with the new monetary technologies in abetting IB transactions and services (Rashed, 2016; Olodude, et al., 2013). Hence, the broader the opportunity on the internet banking platform is, the stronger the capability of users towards their KM while on the platform.

Transferring of KM ideas in the aspect of the banking sector has been fast compared to other related fields (Omotayo, 2015; Apak, et al., 2012). Recently, KM has been used as an actual avenue to address the apprehending and transmission of knowledge (Memon, et al., 2017; Uğurlu & Kızıldağ, 2013). The study of Hislop, Murray, Shrestha, and Syed (2018) emphasized KM as watchful and orderly organization of knowledge done via allocating, producing, and smearing to enhance value by recycle, which is skilled via nourishing the appreciated lessons learned (Meïhmi and Meïhami, 2014). Besides, KM intends to endure a lasting modest benefit through keeping organizational knowledge and enhance the eminence, worth, mindfulness, and transferability of info safety knowledge among security personnel across organizations (Lee, Choi & Lee, 2020; Jennex & Durcikova, 2019). With regards to internet banking, knowledge is required in the selection of suitable choices concerning choosing appropriate information controls, strategies, and measures in a way of put on proper measures that can central on enhanced performance while on the system (Eslamkhah & Hosseini Seno, 2019).

III KNOWLEDGE MANAGEMENT AS A TECHNIQUE TO FIGHT AGAINST PHISHING ATTACKS

Phishing has been recognized as one of the terminal attacks (Chin, Xiong, & Hu, 2018). Banking institutions throughout the world have spent a fortune on modern tools and technology to protect internet banking users from being the victim of any basic social engineering harm. Being too dependent on technology in safeguarding their network, the institutions tend to ignore on the human aspects (Robb, 2020). For instance, they disregard the importance of knowledge sharing that need to be regularly communicated to their employees and individual customers. Organizations and customers should communally work hand in hand in a way of merging their existing knowledge in generating a new one (Olodude, et al., 2013). For KM to be effectively shaped and applied in any organization, serious elements such as related policy ought to be linked to organizational objective in attaining benefits. In addition, both employees and customers should be given opportunities to contribute valuable and constructive ideas towards the betterment of the institutions (Omotayo, 2015; Merlyn & Välikangas, 1998).

Educational training is vital on KM to enable internet banking users to fight against phishing attacks. Educational training equips users with the necessary skills to identify a phishing scam. Online phishing communities accumulate data repositories that allow users to share useful information about phishing incidents, creating a knowledge base for online users (Perry, 2020; Baadel, Thabtah, & Majeed, 2018). Besides, phishing attacks get more sophisticated daily with attackers engaging in diverse strategies. Thwarting these attacks is possible through active communication towards strengthening KM by bringing both safety and secured messages on the platform (Jensen, Durcikova & Wright 2017; Jang-Jaccard & Nepal, 2014). These messages must not just caution users towards the widespread deceitful transactions but also to reassure them. KM is one of the most well-known theoretical tactics for the study
of online communication that helps in enabling messages on phishing prevention (Jensen, et al., 2017).

Cassim (2014) and Larson (2010), emphasized that legislation needs to be put in place to grant large-scale damage towards any phishers against internet services providers in hopes that will inspire them in playing their role in the fight against phishing attacks. Individual users of internet banking will always be curious in clicking on links while on the platform, since most of the users do not always pay vigilant attention when on the internet banking platform (Palmer, 2020). As phishers constantly review their tactics, human elements remain the weakest link. Oftentimes phishing emails look so real in tricking users into falling victim (Stafford, 2020). Capitalizing on educational training to keep users on their toes is a smart means of reducing the risk of any invasions (Palmer, 2020). Educational training can be sent to internet banking users by email with links. Monitoring how individuals partake by making them aware that imitation phishing experiments need to be carried out which are measured on their aptitudes to appropriately recognize phishing emails (Hong, 2012). Therefore, there is a need for global educational training that phishing is the root cause of most cyberattacks. Now all needed is to create a general understanding for individuals on how to be more educated and trained in straightening users gaining more on KM to thwart phishing attacks. This does not work as a one-time training; it must be multi-faceted to fully minimize the threat and happen oftentimes for the message to stay fresh with the users.

Once having the proper education, one should fight against any phishing attack through individual practices (Stafford, 2020; Daniels, & Oberly, 2019; Hong, 2012). This implies conceptualization of work exactly the way they are carried out. Individual practices require to be established for effective enhancement, and user’s security (Lord, 2020). In addition, such practice facilitates the individual improvement without being the source of error. The individual improvement and enhancement can be achieved through continuous learning. Practice is a proper procedure to enrich and nurture one’s creativity in handling respective tasks (Schon, 2015). Educational training and individual practices are vital to fight against phishing attacks. Besides, the notion of practice indicates recurrent activities in line with certain principles and ideologies in a way of attaining the precise goal (Siriwardena & Gillam, 2014). Regular and frequent training is required to ensure effectiveness for users in protecting them from malicious attacks (Palmer, 2020). Multi factors verification help in offering a strong barrier against phishing attacks since it entails an extra step for hackers to overcome in conducting successful attack. The individual practice approach anticipates that one can only understand knowledge concerning the context in which it was generated. Therefore, quality advancement techniques can be used in improving individual practice which can always strengthen individual relationships and loyalty.

IV DISCUSSION

KM in banking is no different from other industries but the growing complexity of financial activities makes the implementation of its applications more challenging. Banks have realized the key role of KM in advancing an edge in the competitive field of managing risks, reducing fraud and ensuring compliance (Chigada, 2014). Study from Frauenstein, (2013) pointed out that banks should be tactically aligned with internet banking users to be aware on the occurrence of phishing attacks occur in order to offer better services. This is vital since some of the factors that contribute to the success of phishing attacks are weak organizational policies, negligence in human behaviour and inadequate technology controls. Therefore, both banks and their customers ought to be educate and trained on the importance of those factors mitigating security threats.

Internet banking customers can be trained on security awareness’ by having a rapid and easy access to a complete library read-to-use content and material. This can be achieved through various forms such as adding the content to a bank’s website, email newsletters, statement stuffers, or placing posters inside the banking halls of various branches (Sundaram, Thomas, & Agilandeeswari, 2019). However, training users on the issue of phishing attacks can be challenging and requires a determined effort by all bank stakeholders. Once users are aware and educated on phishing scams, they will be more cautious and less likely to fall into such suspicious agenda. As for the policymakers, best practices are required to be devised and strictly followed. Moreover, the banking sectors needs to collaborate with the internet banking providers to come up with phishing proof mechanisms to guarantee the integrity of transactions while improving users’ levels of trusts (Bhasin, 2016).

To successfully instill awareness among the internet banking users, the banking industry must recognize KM as one of the top priorities in coming up with relevant and effective strategy to cope with related challenges. The integration of KM into internet banking actions facilitates in the provision of more accurate understanding of KM as an enabler of information strategy specifically for the internet banking platform.
V CONCLUSION AND FUTURE RESEARCH

Security is seen to be a fundamental issue regarding the banking industry. Despite the growing penetration of internet banking by its users, several issues have aroused that gave doubt towards internet security due to phishing attacks. Fight against phishing attacks has considerable potential to enhance customer bank relationships and likewise add value to the bank by retaining and gaining new customers. KM technique request is supposed to be the desires of the banking sectors in relations of offering knowledge-oriented support in giving and strengthening learning opportunities to internet banking users. However, concern for internet banking users is for banks to guarantee that transactions on the internet banking platform are protected from phishing attacks.

To be effective, educational training and individual practices need to be implemented and use continuously. Likewise, improvement is deemed necessary on the part of banking institutions as well as their customers’ participation in solving problems by imparting related knowledge and widening their experience in a way of accomplishing strategic aims in the long run. Once become more familiar with educational training and individual practices, users tend to have higher confidence while using the online platform. Hence, KM can be used as a technique to strengthen the internet banking user in fighting against attacks. This should be one of the top priorities of banking sectors in terms of coming up with relevant and effective strategy in handling the challenge of internet banking activities.

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ABSTRACT
A systematic way of handling programming assignments’ assessment via an automated approach is highly demanding. Thus, a method that is called Automated Programming Assessment (or APA) has been widely utilized to support automated marking and grading on students’ programming exercises or assignments. Generating useful and meaningful feedbacks automatically via APA is essentially reducing lecturers’ efforts, and students could learn to identify their own programming mistakes so as towards the end of learning process they can themselves achieve certain extend of good quality in programming. In this paper, we reveal an initial analysis of a mapping study related to these two contexts of areas so as to identify the criteria and matrices used to support automated feedback generation for more comprehensive features of APA.

A technique known as Systematic Mapping Study (SMS) was utilized to comprehensively review the focused studies considering both the fully and semi-automated APA.

Keywords: Automatic Programming Assessment, summative feedback, formative feedback, Systematic Mapping Study, software testing.

I INTRODUCTION
Learning programming languages is extremely important for university students who pursue their studies in the fields of Information Technology, Software Engineering, and Computer Science disciplines which are known as practical subjects to improve students’ or learners’ understanding of programming principles (Lajis et al., 2018). Renumol, Jayaprakash and Janakiram (2009) quoted that “programming is the process of writing, testing and debugging of computer programs using different programming languages”. As to achieve learning programming efficiently, assessing the quality of learners’ programming solutions (Insa & Silva, 2018) and providing useful and meaningful feedbacks are vital. Feedback quality is an important factor in improving learners’ programming skills (Buyrukoglu, 2018). Furthermore, feedback helps students to understand problems and find suitable way to address them (Buyrukoglu, 2018).

One of the important activities in learning programming is evaluating students’ assignments (Insa & Silva, 2018) or is commonly known as programming assessment. Generally, assessment on students’ work can be either formative or summative (Buyrukoglu, Batmaz & Lock, 2016a; Buyrukoglu, Batmaz & Lock, 2016b). Scriven (1967) stated that a summative assessment is with regard to the measurement of students’ learning and their own achievements in learning. Taras (2005) stated that the formative assessment is in fact a summary of assessment that is added to the feedback used by the learners. Formative assessment is directly related to enhancement of student education by providing immediate and periodic feedback (Buyrukoglu et al., 2016b; Melmer, Burmaster & James, 2008).

Automatic Programming Assessment (or APA) emerged long time ago and has long history since the 1960s and is still active to research field and also researchers' focus (Buyrukoglu et al., 2016a). The main purpose of APA is to implement automated assessment and provides consistent and effective feedback to learners for improving their learning in programming as well as promotes workload reduction for lecturers (Buyrukoglu et al., 2016a). Manually marking programming exercises or assignments is well known as troublesome and tedious works (Blau, 2015; Huang & Morreale, 2015). In addition, the lecturers face challenges with assessing efficiently a huge number of students’ assignments (Bey, Jermann & Dillenbourg, 2018; Blau, 2015; Romli, Sulaiman & Zamli, 2015) and frustrating to give their students individualized attention (Blau et al., 2016). Therefore, APA has become one of choices for assessing students’ programming assignments automatically without the need of humans’ involvement (Saikkonen et al., 2001).

Programming assessment is a part of software testing techniques, which can be categorized as dynamic testing or static analysis (Lajis et al., 2018; Romli, Sulaiman & Zamli, 2010; Saikkonen et al., 2001). Software testing is a process to measure, define, locate and detect the errors in a program (Latiu et al., 2012). Static analysis is mainly used to detect and inspect the errors that are committed has not to prove the validity of the program (Lajis et al., 2018). On the other hands, dynamic analysis is performing an
assessment for the execution of a program to assess the style, software metrics and design of programs (Lajis et al., 2018).

APA together with a function to generate feedback is to promote effective learning (Buyrukoglu et al., 2016a). Generating feedback automatically is essentially to reduce lecturers’ efforts as a part of assessment as well as it can motivate learners and guide them to produce a better quality of programming solutions. According to Romli et al. (2013), providing immediate feedback for learners in learning programming lead them to mastery learners’ levels on programming. Thus, feedback generation is particularly important in APA systems (or APAS) that can help students from different level to enhance their knowledge in programming as well as avoiding any unfair assessment (Insa & Silva, 2018; Lajis et al., 2018). Also, this feature enhances the understanding of learners, particularly for undergraduate studies who are in expansive classes where lecturers’ time is constrained or limited.

Providing useful and meaningful feedback on students’ programming exercises and assignments is necessarily important to develop and enhance students’ programming skills. Furthermore, assessing students’ programming manually has been proved as very cumbersome and may lead to timely feedback, resulting in significant failure (Lajis et al., 2018) and it becomes more problematic when the size of classes is huge. Thus, most of these issues can be resolved by utilizing APAS. However, there is a lack of personalized and comprehensive feedback in existing APAS due to the sheer number of student submissions precludes the manual assessment option (Koprinska, Stretton & Yacef, 2015).

Thus, this study intends to review comprehensively related works that focus on these two context of areas to reveal on the current state of criteria and matrices used to support automated feedback generation in programming assessments or APA. The criteria and matrices include software testing techniques covered: static analysis and/or dynamic testing (white-box and black-box testing), and their respective quality matrices/factors, types of assessment feedback (formative and or summative) and its details, and features included in the APAS. However, this paper merely reveals some concepts involved in APA and feedback generation to highlight among of the common criteria and matrices applied, some of the review studies done as well as an initial analysis of the conducted mapping studies.

The content of the remaining sections is organized as follows: Section 2 discusses related reviews of selected studies as primary studies. In Section 3, we describe the applied research methodology of conducting SMS and the process of collecting relevant research papers. Section 4 presents the initial analysis of the conducted SMS. Finally, Section 5 concludes the paper and provides a brief discussion of future works.

II RELATED WORK
This section covers the discussion on basic concepts of software testing and programming assessment, types of assessment, and their related review studies.

A. Software Testing and Programming Assessment
Software testing is defined as measuring the quality of the software products (Latiu et al., 2012) and involves the process of analyzing a program to identify errors, playing an essential role to guarantee and maintain the quality, correctness and reliability of the software products (Myers, Sendler & Bandgett, 2011).

Programming assessment is related to the theory of software testing (Jackson, 1996). Software testing is commonly the basic concepts applied for tools related to improving programing analysis and comprehension skills among students (Souza et al., 2016). According to Sharma, Banerjee, Vikas and Mandal (2014), student programming code can be statically or dynamically analyzed. In dynamic testing, it involves an execution of the program code, and the result is then checked to ensure the correctness, accuracy and validity of the program (Buyrukoglu et al., 2016b; Zougari et al., 2016a). For dynamic testing, the assessment process can be done by looking at the structure of the code (white box) or simply based on the functional behaviour of a program (black box) (Romli et al., 2010).

Programming assessment may use static analysis for analyzing the program code structurally (Salman, 1999) based on the code’s properties. Static analysis is a method used to assess students’ programming solutions without an execution of the code (Rahman & Nordin, 2007). Among the quality factors applied in the static analysis include program properties, proof of its practicableness, and look for errors within the code (Novikov, Ivutin, Troshina & Vasilyev, 2017). Also, static analysis has its assessment criteria such as programming style analysis, error detection (syntax or semantic or logic), metric analysis, keyword analysis, structural analysis, plagiarism detection (Rahman & Nordin, 2007; Zougari et al., 2016a).

B. Types of Assessment
Formative, diagnostic and summative are types of assessment (Buyrukoglu, 2018). These types of assessment are very important so as to develop knowledge of students who learn programming (Buyrukoglu, 2018; Buyrukoglu et al., 2017).
Formative assessment is a type that students can enhance their knowledge on learning programming on timely feedback (Buyrukoglu et al., 2016) as well as allowing students to enhance their thinking or behaviour in order to develop learning skills (Shute, 2008). Students can understand more deeply in their learning through formative assessment (Clark, 2011). Formative feedback is an important factor to help student learning and develop their works (Keuning et al., 2016).

The purpose of diagnostic assessment is similar to formative assessment (Buyrukoglu, 2018). However, diagnostic assessment is to measure the weaknesses and strengths of students while studying which can be useful for lecturers to know students’ capabilities in certain knowledge (Conole & Warburton, 2005).

Meanwhile, summative assessment is a type of assessment that provides a report on the students understanding and achievement at the end period of study (Buyrukoglu, 2018). Most of the APAS and semi-APAS support both the formative and summative assessments.

Thus, it can be concluded that summative assessment is with regard to evaluating of students’ works by providing results of assessment towards end of the assessment process, and on the other hand, formative assessment can be related to providing appropriate feedbacks based on the results of the evaluation such that they can develop and enhance their knowledge or skills on certain learning concepts.

C. Review Studies on Automatic Programming Assessment and Automated Feedback Generation

It has been found around ten review studies between the year of 2009 and 2018 related to APAS and Semi-APAS that focused on generating feedback. In terms of the review of APAS, thus far, several limited review studies had been conducted such as by Caiza and del Alamo Ramiro (2013), Edwards, Kandru and Rajagopal (2017), Ihantola et al. (2010); Lajis et al. (2018), Liang, Liu, Xu, and Wang (2009), Romli, Abdurahim, Mahmood and Omar (2016), Romli et al. (2010), Souza et al. (2016), and Striewe and Goedicke (2014). Ihantola et al. (2010) in their review covered developed APA tools in certain period from 2006 to 2010.

Another review study focuses on dynamic-structural testing (or white-box testing) conducted by Romli et al. (2016) reported that most of lecturers typically rely on the structural code coverage specified in programming assessment and even have a great learning to allow those criteria to be taken into consideration of implementing the APA. Similarly, Liang et al. (2009) reported that dynamic testing and static analysis as the major approaches of APA. Lajis et al. (2018) conducted a review that revealed most of APAS do not have a common grading model that refers to the learning taxonomy. Similarly, Caiza and del Alamo Ramiro (2013) also performed a review on the art of the APAS, which shows the lack of a common grading model as the major issue. Caiza and del Alamo Ramiro (2013) referred to those APAS that provide timely and consistent feedback on students’ code scripts and among the related studies within the year of 2010, the main metric for grading is correctness. Edwards et al. (2017) in their study focused on investigating nearly 10 million static analysis errors found in over 500 thousand program submission made by students over five semesters. They used in their investigating two open-source static analysis tools (PMD and Checkstyle) to compare their features. They found that the most common static analyses errors are on formatting and documentation (Javadoc commenting) errors are the most common static analysis errors.

Ihantola et al. (2010) presented a Systematic Literature Review (SLR) to review the key features of related APA studies published between 2006 and 2010. They concluded that many proprietary APAS were developed and provide suggestions on APAS developers to make their systems open source such that it is easier for others to contribute enhancement on the tools because the lack of open source systems may be one of the reasons for the continuous development of newly refined APAS. Similarly, Souza et al. (2016), also performed a SLR to find out among APA tools that were developed for over last 10 years. They investigated 30 APA tools particularly to focus on their features in assisting lecturers to identify APA tools better for their needs. The selected tools have been found that they can provide immediate feedback which encourage students to improve their solutions continuously. Striewe and Goedicke (2014) reviewed APA tools that only focus on static analysis approaches in detail for diagnosing students’ programs. They found that some of APA tools may be considered insufficient to use the full power of static analysis in terms of generating feedback in e-assessment systems. On top of that, Romli et al. (2010) reviewed the approaches implemented in several studies that focus on APA, test data generation and their integrations.

There are in a total of two review studies have been found for automatic feedback generation for programming exercises by using APAS conducted by Keuning et al. (2016) and Keuning et al. (2018). Keuning et al. (2016) reviewed 69 tools while Keuning et al. (2018) reviewed 101 tools that classified the kinds of feedback generation into five
categories: Knowledge about Task Constraints (KTC), Knowledge about Concepts (KC), Knowledge about Mistakes (KM), Knowledge about How to proceed (KH), Knowledge about Meta-Cognition (KMC). These review studies mainly focused on formative feedback that is defined as “information communicated to the students with the intention to modify their thinking or behavior for the purpose of improving learning” (Shute, 2008). Keuning et al. (2018), Keuning et al. (2016) in their studies analyzed the selected APA tools for their review to find what kind of feedback that each APA tool support based on the five kinds of feedback that mentioned above. Keuning et al. (2018) referred that every APA tool of all selected APA tool in their study can provide more than one kind of feedback but they reported that, in general, the feedback that APAS generate is not very varied and focuses mainly on identifying errors. Keuning et al. (2016) concluded that most of the APA tools rely on test cases and the provided feedbacks were merely on how to correct errors rather than comprehensively providing meaningful and rich feedback that could help them in identifying on their mistakes for further improvement on the quality of their programming solutions. Keuning et al. (2018) found that solution errors based on the KM, are in the most of selected APA tools with 59.4% while Keuning et al.(2016) in their previous review found test failures in many of APA tools.

III METHODOLOGY
A Systematic Mapping Studies (SMS) technique (Petersen, Feldt, Mujtaba, & Mattsson, 2008) has been adopted to conduct the proposed review study. The following summarizes the process of SMS that consists of five steps:

i) Definition of Research Question
Specifying the research question (s) is the most important part of any systematic review including SMS. The following are the research questions that have been identified:
RQ1: To what extend does the criteria and matrices used to support automated feedback generation are implemented in APA?
RQ2: What are among the promising criteria and matrices that can be utilized in realizing automated feedback generation to support a better feature of APA?

ii) Conduct Search
Conduct search is a step to select the related studies (Petersen et al., 2008). It includes two steps: (1) using search string to retrieve information from electronic resources, and (2) databases selections. Figure 1 shows the keywords and search strings that were formed in searching the related studies from electronic databases.

![Figure 1. Search String](image)

After designing the search string, the relevant databases have been chosen. Seven electronic databases were selected include ACM Digital Library, Google Scholar, IEEE Xplore, Scopus, Search Gate, ETHOS e-thesis online services and ScienceDirect which are known as the most relevant to scientific sources which primary studies likely to be contained (Souza, Papadakis, Durelli, & Delamaro, 2014) and some of the selected databases are among the main databases in state of Computer Science.

iii) Screening of the papers
This stage is about screening the primary studies selected to the topic of this study such that the studies that are not related to answer the RQs can be excluded (Petersen et al., 2008). The inclusion and exclusion criteria applied in this study are depicted in Table 1.

<table>
<thead>
<tr>
<th>Inclusion Criteria</th>
<th>Exclusion Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abstracts and keywords are written in English</td>
<td>Papers that directly related to programming assignment</td>
</tr>
<tr>
<td>APAs studies</td>
<td>Studies that did not focus on programming assessment</td>
</tr>
<tr>
<td>Semi-APAs studies</td>
<td>Papers where the main language is not English</td>
</tr>
<tr>
<td>Studies that explain software testing techniques</td>
<td>Duplicated papers</td>
</tr>
<tr>
<td></td>
<td>Studies that do not include related tool for fully or semi-APA</td>
</tr>
<tr>
<td></td>
<td>Studies that do not indicate issues related to programming assessment.</td>
</tr>
<tr>
<td></td>
<td>Papers that are not in the fields of programming education</td>
</tr>
<tr>
<td></td>
<td>Secondary studies (e.g. review studies)</td>
</tr>
</tbody>
</table>

iv) Keywording using Abstracts
Keywording was performed in two steps firstly, the abstract was read with its keywords and then, concepts that reflected the contribution of the paper were identified.

v) Data Extraction
Data Extraction is the final stage of SMS process. The data extraction procedure was conducted in one stage. The stage was to collect the information about

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the paper to address the RQs of this mapping study by presenting them in tabulation. This involved grouping out the data based on the combinations of the dimensions and categories and displaying them using bubble plot. In this stage, nine categories or dimension were classified by using a classification scheme for the selected studies. The classification scheme is as shown in Table 2.

### Table 2. Classification Scheme of Selected Study

<table>
<thead>
<tr>
<th>Categories</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Study identifier</td>
<td>Study Id (e.g. S001)</td>
</tr>
<tr>
<td>Author(s) and year (ref)</td>
<td>Name of author(s) of the selected studies</td>
</tr>
<tr>
<td>Software Qualities Metrics (static analysis)</td>
<td>Static analysis metrics applied to access students’ programming solutions</td>
</tr>
<tr>
<td>Software Qualities Metrics (dynamic testing)</td>
<td>Dynamic testing metrics applied to access students’ programming solutions</td>
</tr>
<tr>
<td>Programming Languages used/supported</td>
<td>The programming languages used/supported by the developed APAS. For example: Java, Python, C, C++ and etc.</td>
</tr>
<tr>
<td>Technique(s) of testing applied</td>
<td>Type(s) of the testing applied in the assessment, could be the static analysis or dynamic testing or both of them.</td>
</tr>
<tr>
<td>Type of the tool</td>
<td>Type of the tool developed could be stand alone or web-based or mobile-based</td>
</tr>
<tr>
<td>Feedback details</td>
<td>The detailed descriptions of feedback provided via the performed assessment</td>
</tr>
<tr>
<td>Feedback types</td>
<td>Type of feedback provided either formative or summative feedback</td>
</tr>
</tbody>
</table>

### IV INITIAL ANALYSIS OF MAPPING STUDY

This section presents the initial analysis obtained from the conducted mapping study.

#### A. Search and Selection Results

Initially 281 papers were retrieved when the designed search protocol was applied to the selected scientific databases. Inclusion and exclusion criteria were then applied based on the titles of the retrieved papers. By examining all of the papers based on relevancy of their titles, 158 papers were selected. The reason of excluding 123 papers was due to, they were not truly related to the programming assessment. For example, some of the excluded papers were discussed on learning programming but not focused on assessing students’ codes. After the selection of 158 papers, the duplicated papers were removed as the second criteria of inclusion and exclusion. This round resulted in selection of 112 papers. After that, 87 papers were selected based on their abstracts. Some of the excluded papers were not written in English and some of them were not related to the desired topic. All of the 87 papers were then passed to the next selection round for in depth analysis, which involved reading completely their contents. Finally, 71 papers were selected as primary studies. From the 87 papers, one paper was dropped out because it focused on learning programming rather than programming assessment. The remaining papers were excluded because they were categorized as review papers.

#### B. Publication Year

After the process of searching and selecting the final primary studies by applying inclusion and exclusion criteria, it has been found that all of the selected articles were published from 1982 until 2019. Thus, although APA is a research area that has a long history, it still attracts the researchers’ focus and attention until recently. Result on the trends of the publication year distribution of the selected primary studies includes: 1 paper (1.4%) was published in 1982, 1 paper (1.4%) was published in 1993, 1 paper (1.4%) was published in 1995 in (1.4%), 1 paper was published in 1997, 1 paper (1.4%) was published in 1999, 1 paper (1.4%) was published in 2000, 2 papers (2.8%) were published in 2003, 2 papers (2.8%) were published in 2004, 3 papers (4.22%) were published in 2005, 1 paper (1.4%) was published in 2006, 3 papers (4.22%) were published in 2007, 5 papers (7%) were published in 2008, 1 paper (1.4 %) was published in 2010, 2 papers (2.8%) were published in 2011, 3 papers (4.22%) were published in 2012, 4 papers (5.63%) were published in 2013, 4 papers (5.63 %) were published in 2014, 7 papers (9.85 %) were published in 2015, 11 papers (15.49 %) were published in 2016, 3 papers (4.22 %) were published in 2017, 3 papers (4.22 %) were published in 2018, 4 papers (5.63 %) were published in 2019. It can be concluded that the publications on fully APAS and Semi-APAS are keep on increasing through the years.

#### C. Venue Name and Type

A total of 71 venue names collected from searching the related primary studies, which come from a wide variety of journal, conference, symposium, peer-reviewed journal, colloquium and EThOS (Electronic Theses Online Service). Figure 2 shows the venue types included in the conducted SMS. Most of the studies were published in conferences representing 44 studies (62%) and journals representing 20 studies (28%). The rest studies were published in peer-reviewed journals as 3 studies (4%), 1 study in a symposium (1.4 %), 1 study in a colloquium (1.4%), and 1 study in EThOS as labeled ‘Thesis’ (1.4 %) and 1 other study (1.4 %). As a conclusion, majority of the articles are categorized as conference articles and journals.
D. Classification of Relevant Papers

Table 3 shows the distribution of the assessment tools by types (either APAS or Semi-APAS), their features (based on stand-alone, web-based, web-mobile-based), software testing techniques (static analysis or dynamic testing), dynamic testing techniques (black-box testing or white-box testing or a combination both of them), the feedback types (formative or summative feedback or an integration between both of them).

![Figure 2. Venue Type](image)

Table 3. Summary of the Classification Scheme

<table>
<thead>
<tr>
<th>Studies</th>
<th>APAS</th>
<th>SAPAS</th>
<th>Stand-alone</th>
<th>Web-based</th>
<th>Web-Mobile-based</th>
<th>Static Analysis</th>
<th>Dynamic Testing</th>
<th>FT</th>
</tr>
</thead>
<tbody>
<tr>
<td>APA</td>
<td>71</td>
<td>34</td>
<td>37</td>
<td>18</td>
<td>17</td>
<td>18</td>
<td>15</td>
<td>1</td>
</tr>
<tr>
<td>SAPAS</td>
<td>34</td>
<td>71</td>
<td>17</td>
<td>15</td>
<td>20</td>
<td>15</td>
<td>18</td>
<td>1</td>
</tr>
<tr>
<td>Stand-alone</td>
<td>37</td>
<td>34</td>
<td>18</td>
<td>17</td>
<td>15</td>
<td>7</td>
<td>27</td>
<td>28</td>
</tr>
<tr>
<td>Web-based</td>
<td>17</td>
<td>17</td>
<td>15</td>
<td>20</td>
<td>15</td>
<td>18</td>
<td>8</td>
<td>21</td>
</tr>
<tr>
<td>Web-Mobile-based</td>
<td>1</td>
<td>1</td>
<td>NA</td>
<td>1</td>
<td>7</td>
<td>27</td>
<td>8</td>
<td>27</td>
</tr>
</tbody>
</table>

Notes: SAPAS stands for Semi-APA; FT stands for Feedback Types; FF Stands for Formative feedback; SF Stands for Summative Feedback; B stands for Both (formative and summative).

V. CONCLUSION

Overall, results from conducted SMS revealed that applying the static analysis and dynamic testing techniques are the researchers’ focus and interest. Nevertheless, it is also found that most of the selected primary studies integrate both dynamic testing and static analysis techniques in their proposed APA. Another finding is the black-box testing was used and focused in the most of selected studies rather than white box testing. Furthermore, it is observed that the studies which have supported formative feedback are close to those studies which supported the summative feedback. It has been observed that many of fully APAS and Semi-APAS studies supported both the summative and formative feedback. Semi-APAS studies focused on providing formative feedback more than fully APAS due to the need of the lecturers in providing useful feedback for students to get better understanding on their programming solutions. Additionally, Semi-APAS are close to fully APAS in providing summative feedback.

Currently, Semi-APAS in terms of generating feedback depend on the human instead of being fully automatic due to some reasons. However, some criteria used in current Semi-APAS can be used later for achieving fully APAS. In this regard, Insa and Silva (2015) referred to this issue which the fully APAS are lacking in terms of generating feedback, since most of the concern was more on fixing some errors to run the code. As to overcome the lacking in utilizing human involvement, it is more promising to integrate automated feedback generation in APAS as a mandatory rather than an optional for a better consistent feedback provided to students. This add-on feature in APAS is more significant in evading biasness and inconsistency feedbacks.

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Automated Garment Measurement Prototype: A Contactless Means

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ABSTRACT
In garment industry, preparing garment patterns accurately is one of the most important factors in the production of fit garments. Body measurement is the first process that must be encountered before any custom-made garment can be designed. The current practice of obtaining the measurement is by traditional methods using tools like measuring tapes. However, this method is considered to be time-consuming and at times could be inaccurate. Moreover, during this pandemic situation, the conventional way of measuring shall be avoided. Hence, an Automated Garment Measurement Application (AGMA) is proposed. The main objective of this paper is to present the viability of obtaining body measurements via AGMA as the contactless means. The application, which is still prototype, applies the TensorFlow’s PoseNet technique, allows customers’ body measurement be made from a user’s uploaded image, thus leaving the needs to be physically present. The evaluation results show that the respondents perceive that it is viable as it could help them to obtain more accurate body measurements in almost no time.

Keywords: Tailoring application, Automated measurement, Garment measurement.

I INTRODUCTION
Measuring garments requires correct tools and the know how to accurately measure the garments. Not only that, manual garment measurement is also time consuming and prone to human errors. With regards to the ready made garments, the sizing specifications vary from manufacturer to manufacturer. Traditional measurements are performed by experienced tailors using some instruments, mostly by means of a measuring tape, which is intended for measuring circumferences and curvatures. Most measurements made on the subjects are taken in position of standing. However, a few measures need to be taken in different positions. The conventional measurement method requires the consumer to be physically present to allow measurement be made. During this pandemic situation, activities that require such close physical contact between the involved parties should be avoided. To certain extent, this could be harmful especially when the Covid-19 viruses are in the community. To the utmost possible, contacts among individuals should be minimized, if it is not totally unavoidable.

Improper fittings often results in higher rate of return in online shopping. Consumers, especially online shoppers, are educated better and more demanding nowadays. They are no longer satisfied with standardized products that force them to compromise. Bearing those issues in mind, it is very important for customers to get customization services, and enable them to attain near to personalized garments from the market. In line with that and as proposed by Xia et al. (2018), the prototype of an Automatic Garment Measurement Application (AGMA) is proposed.

The proposed prototype will take an uploaded body image of a customer, and produces measurements in no time, and thus allows the measurements be used to get the best-fit garments. Considering the pandemic situation, the customers could get the measurement services from the comfort of their homes, without the needs to leave their homes. Most importantly, they can do so without any contact with others.

To allow nearly accurate estimates, it is important to get the data that are necessary to produce a satisfying garment with quality near to a tailor-made one. Fundamental variables of such data include length, circumference, density and textile matter behavior. Having had these data, it will significantly reduce the amount of data to be analyzed and to be sent out for creating a smart pattern. Moreover, by using anthropometric measurements, like shape and density, it will enable us to identify key referential points, which are essential to ensure proper fit. These points, when combined with data related to textile textures and behaviors, will allow personalized pattern grading, and this would the focus of the current work.

Hence, the main objective of this paper is to present the viability of obtaining body measurements via contactless means as enabled by proposed prototype by looking into the subjects responses on the AGMA experiments.

II RELATED STUDIES
In this section, the details of the concepts related to garment measurements and other relevant concepts as highlighted in previous studies are discussed.

Clothing is one of the most intimate objects associated with the daily life of individuals, as it
covers most parts of our body most of the time. A significant proportion of modern consumers understand the importance of clothing and they demand apparel products with higher added values in terms of functional performance to satisfy various aspects of their biological and psychological needs during wear.

The goal of any sizing system for clothing is to provide a set of sizes that fit most individuals and suggest the set as standard sizes. It is important to note that the sizing systems from country to country varies as the body dimensions chosen to divide the population differ. However, the basic structure of most sizing systems is very similar (Kausher & Srivastava, 2019; Xia & Istook, 2017; Faust et al., 2006; Fan et al., 2004).

With regards to body measurements, Beazley et al. (1998) suggested a procedure for undertaking a size using International Organization for Standardization (ISO) 8559:1989 (E) which included a natural sequence of body measurement comprising three types of data which is horizontal, vertical and others. According to Devarajan and Istook (2004), in the eighteenth century, tailors made custom-made clothing by tailors used various measuring methods that were developed by professional dressmakers and craftsmen. Their techniques for measuring and fitting their clients were unique. In the 1920s, the demand for the mass production of garments created the need for a standard sizing system. In the 1930s, mail-order houses became popular. This led to frequent returns of ill-fitting garments. Hence, a large anthropometric survey of 10,042 women was conducted to develop a sizing system for women's apparel.

In 1999 until 2002, Zhang (as cited in Reitenbach et al., 2009) surveyed 2800 women from East, North and South China, using traditional Martin measuring techniques. Sixty-two body positions were considered and 12 body parameters were drawn of the female torso.

Further to this, research by Wang et al. (2011) has found that the posture of the participant being scanned has an impact significantly on the anthropometric measurements of the participant. However, these researchers focused on the statistical difference between ‘scan’ and ‘dynamic’ posture, or specifically ‘between foot measurements’ and therefore the degree of influence which ‘natural’ and ‘scan’ posture has on the readings is still unknown. However, these studies did not address the precision of the scan measurements themselves.

Wang et al. (2011) and Bigaard et al. (2005) discuss waist circumference definition and its variation. Wang et al. (2011) compared manual measurement between four waist locations, though not the same as investigated in Bigaard et al. (2005). However, both authors agree with that the waist should occur between the top of the iliac crest and lowest palpable rib (see Figure 1). This is in accordance with medical definitions, and suggests landmarks that are easier and more consistent to locate within the population.

Wearing a fit garment usually eases wearer’s movements and thus brings comfort. Jay (1969, as cited in Sohn, 2012) defines eases in fit garment as “the difference between the pattern and body dimensions and as a crucial component of achieving good fit and comfort.” Ease is an additional amount added to the body measurements at certain critical points on the pattern. During pattern construction, a small amount of ease must be added the measurements for comfort and freedom of movement as highlighted. However, ease is not just a simple addition to the dimensions. It depends on many factors including body movement, fabric characteristics, comfort preferences, and garment style. Ease directly affects garment fit, appearance and comfort. There are two types of ease: wearing ease and design ease. However, for comfort, most important of these is the wearing ease that refers to the ease of movement while the clothing is worn.

Wearing ease is critical in garment fit as incorrect wearing ease can limit movement and at times causes wrinkles. There are keypoints where the amount of ease directly affects fit: bust, waist, hip, arm circumferences and armcye. Therefore, the definition of good fit may differ among individuals and situations. In fit research, however, good fit refers to clothing that provides a neat and smooth appearance

Figure 1. Scan Images showing the vertical positions of the hip girth and waist measurements on a human body and the postures used during body scanning capture
and maximum comfort in an intended style of garment.

III AUTOMATED GARMENT MEASUREMENT PROTOTYPE

In developing the prototype for the Automated Garment Measurement, the engine that enables measurements for a good fit with wearing ease garment, as discussed in the subsequent section, is the utmost important. As such, Quasar Framework (Quasar, 2020) was used as the development platform and TensorFlow PoseNet (Abadi et al., 2015; Verma, 2020) used to detect and estimate the key points of human pose estimation.

Human pose estimation is a computer vision technique used to predict the position/pose of body parts or joint positions of a person in images or videos. PoseNet algorithm detects 17 key points based on the input (human image) detected. The 17 key points are the left and right coordinates of eyes, ears, shoulders, elbows, wrists, hips, knees, and ankles, and the nose. In addition, it also provides the value of key point confidence score that tells if an estimated key point position is accurate and ranges between 0.0 and 1.0, or the respective key points be hidden (Verma, 2020). Allowing the confidence score be determined, the key point positions produced is therefore nearly accurate. However, as for garment measurements, only the related key points estimate will be considered, thus leaving out five irrelevant estimates namely the nose, and both the left and right of the eyes and ears. The relevant key points that made up the parameters for garment measurements are shoulders, elbows, wrists, hips, knees, and ankles. However, depending on the types of garments, only appropriate parameters values will be used at any time. From any two key points, the distance between them can be calculated, and appropriate scale could be applied. From the calculation, the value of relevant parameters for garment measurement that is the lengths (or distances) can be determined.

The Quasar Framework and the TensorFlow’s PoseNet are available as open source and thus being adapted for the prototype development. The Android Studio was used as the main integrated development environment (IDE) tool. Further, the Firebase development platform was used to facilitate crucial functions like database for data storage. Screenshots in Figures 2, 3, 4, 5 and 6 show the selected interfaces of AGMA.

Figure 2 shows an interface that requires the user to upload an image taken using digital camera that follows certain specification. Figure 3 is the condition after an accepted image has been uploaded.
4. On the list of garments’ template, the user could choose the desired design as shown in Figure 5. However, in the list in Figure 5, mock designs are used.

Once the user selects the design, the design screen together with its measurements will be shown as illustrated in Figure 6. If the measurements of the selected design meet the measurements produced, then the user could confidently says that the design is a good fit and thus help the user to make an appropriate decision.

IV EVALUATION OF AUTOMATED GARMENT MEASUREMENT

A. The Evaluation Setting
A usability evaluation was conducted on 25 respondents, consisting of tailors and consumers. The respondents were approached randomly and participated in the study on a voluntary basis. The instruments used for the evaluation were the Automated Garment Measurement prototype and a post-task questionnaire. The post-task questionnaire was adapted from Otieno et al. (2008) which comprised of Section A on the respondents’ demographic information; Section B on the respondents opinion about Automated Garment Measurement prototype in a five-point Likert scale where 1 represents strongly disagree, and 5 represents strongly agree. Section B intends to measure the respondents’ perception on the usefulness, ease of use, and their satisfaction of the prototype.

The respondents followed the following protocols to perform the evaluation: (1) read and signed a consent form; (2) use the prototype as stated in the experiment procedure; (3) answer the post-task questionnaire.
The results of the evaluation on AGMA are presented in the Section B.

B. The Respondents’ Demographic Information

Analysis of the respondents’ demographic information revealed that 22 respondents aged between 21 and 25, thus made up the majority of the respondents, and the rest is of other age categories. Regarding types of user, 14 of them respondents are customers and, 11 is tailors. As the evaluation setting is at an education center, it is logical that the age group is within that range, and the consumer is more than the tailor. The consumers are mainly students within the setting. As for the gender, male is 14, and female is 11. An analysis was conducted on the respondents’ responses in Section B of the post-task questionnaire. The respondents’ perception towards the usefulness and the ease of use of AGMA were gauged. It also measured the respondents’ satisfaction towards AGMA. Table 1 shows the average responses for all items of the stated constructs.

V CONCLUSION AND FUTURE WORKS

The AGMA prototype that was developed provides a viable contactless means of obtaining body measurements for various usages including for garment-related business as illustrated in this paper. Shall the prototype be upgraded to become a fully workable robust applications, it may be helpful in curbing the spread of the Covid-19 diseases, to some extent.

There are many aspects of body measurements and manage garment-related issues can be studied. The core reason for the development of AGMA is to enable the customers and tailors to get the measurement done in few seconds and accurately, thus facilitate those in the industry to transform their ways of doing business. Therefore the technologies used by whoever uses the application should support the core objective of the system if it were to remain relevant.

A lot still needs to be done in order to make available technology effective. This may involve training of the staff on how to enter the right and relevant data into the system and the management to keep updating the application. IT and computer systems need to be kept being upgraded as more and more IT facilities software are introduced in today’s IT market. The researcher acknowledges the fact that this application does not handle all staff the tailor shops have like the asset section and staff members in the tailor shop.

| Table 1. User Responses on AGMA |
|-------------------------------|------------------|
| Item                          | Average          |
| **Usefulness of AGMA**        |                  |
| I can register an account using the AGMA without any error. | 4.40             |
| I can login AGMA with the registered email and password. | 4.40             |
| The search button can function well. | 4.53             |
| AGMA meets my needs           | 4.10             |
| AGMA does everything that I would expect it to do. | 4.10             |
| AGMA is useful in overall.    | 4.37             |
| **Ease of Use of AGMA**       |                  |
| AGMA is easy to use.          | 4.20             |
| AGMA is easy to user friendly. | 4.23             |
| AGMA is flexible.             | 4.27             |
| AGMA is easy to learn how to use it | 4.40             |
| I can use AGMA without written instruction. | 4.33             |
| I can easily remember how to use AGMA | 4.23             |
| I do not notice any inconsistencies as I use AGMA. | 4.27             |
| My interaction with AGMA is clear and understandable. | 4.23             |
| I can use AGMA successfully every time. | 4.33             |
| **Satisfaction of AGMA**      |                  |
| I will recommend AGMA to my friends. | 4.17             |
| AGMA works the way I want it to work. | 4.37             |
| I feel I need to have AGMA in my smartphone. | 4.60             |
| AGMA is wonderful and pleasant to use. | 4.50             |

The researcher therefore suggests that for further research into building an application that captures all fields as pertains the tailor shop. Body measurement and the relationship between them change with changing lifestyles, leisure patterns, dietary habits and also growing population diversity. Consequently, the association between garment sizes and body measurements also changes all the time. As a result, regular sizing surveys and measurement series have to be performed to provide a scientific foundation to these and to further provide information on the necessary size segments and their geographical market shares.
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The Design and User Acceptance of IoT-based Access and Entrance Control System Using Voice Recognition

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ABSTRACT

Despite the usability of the conventional security measure to identify user’s identity and gain access approach, biometric security devices-based Internet-of-Things (IoT) are to be trusted more due to its significant and enhanced security features. This paper aims in designing an IoT-based smart voice activation access control system. The proposed Voice-Activation Entrance System (VAES) is developed based on information gathered through a field-testing approach. The system has been evaluated through usability field testing methodology. Eventually, this can be considered as a reference model for developers and researchers in the area to develop similar apps-based IoT.

Keywords: Voice recognition, Internet of Things, biometric, security system

I INTRODUCTION

IoT is now an important topic from various aspects of human life whether technical, social or economic. Various types of products whether small or large are connected to the Internet. With the ability to analyze powerful data, it promises to change the way people work, live, and play. The projections for the impact of IoT on the Internet and the economy are impressive with some expecting as many as 100 billion IoT devices connected to the Internet that will impact the global economy by more than USD11 trillion by 2025 (Rouse, 2019). Even though there is no single definition has been done for the term Internet of Things, The Internet Society defines IoT as “scenarios where network connectivity and computing capability extends to objects, sensors and everyday items not normally considered computers, allowing these devices to generate, exchange and consume data with minimal human intervention” (Internet Society, 2015). An example of IoT implementation is in the security field such as to control the entry of people to certain place such as building, room or even car.

The physical security to enter and gain access to a facility especially to a sensitive area such as data center should be a top priority for any organization. Since the threats to these facilities continue to increase, the term entrance control and access control must be properly understood so that a proper security measure can be taken to control them. The access control confirms authorized users using their credentials such as face, fingerprint, voice, number, proximity card, etc. Then the system will decide whether they are allowed to enter or not. On the other hand, the entrance control is the system that enforces the decision whether by allowing the user to enter the facility or not (Internet Society, 2019). An electronic access control systems restrict entrance to secure areas of a property, building, room, file cabinet, drawer, or other area containing sensitive or proprietary information, assets, or data with round the clock protection and access. (Senseon Secure Access, 2020).

The entrance to a building should be secured to ensure the assets and people’s belonging is safe (Wahyudi, 2007). Many types of security systems still use the conventional authentic approach such as password, smartcard, and key (physical). Password is one of the security methods widely used for user authentication (Strassmann, 2002). It helps to secure building and facilities by preventing unauthorized users from accessing private places. However, most organization institutes’ policies that requires a complex password that is built upon an alphanumeric upper and lower case, digital, symbol, and the least character to secure the password. This causes certain users to be doubtful in using the password as they are afraid that may be unable to memorize the long and complex password. This may result to deniable access if the designated password is not correctly remembered. Another approach is the use of smartcard and keys in order to replaced password. However, there is a chance that users forget to bring their smartcard and key. Furthermore, the cards or keys may be stolen or misplaced. Hence, there is a need for an alternative solution in ensuring the security of buildings or facilities. The biometric technology that uses people’s body features like voice, eyes, face, and fingerprint for user authentication seems to be a promising solution. Biometric is more convenient to be used as compared to using a smartcard or a physical key. But the user are required to follow strict measure so that biometric fingerprints can function effectively. The registered user’s finger must be in an acceptable condition else the system cannot authenticate it (Thakkar, 2020).
The fingerprint will be inaccurate if the user has a skin disease (Thakkar, 2020). The other available biometric measure is the 2D face recognition. This may be insecure because it is easy to be recreated by somebody else. The face is also difficult to be recognized by the system if the system uses low quality imaging technology. In addition, face recognition may cause privacy issues as it cannot be recognized from a distance. The cost of iris and retina recognition is relatively high compared to other biometric. There are too expensive if the system is installed at each door. Hence, a small income organization cannot afford the cost. Due to this problem, there is a need for a biometric measure that is based on user’s voice. The emergence of IoT technology in human life creates an opportunity towards controlling security (i.e user authentication) by using people’s voice. As the IoT system becomes pervasive and integrated into human daily lives, this study investigates the potential of IoT as a tool to electronically control door access using people’s voice. The proposed Voice-Activation Entrance System (VAES), a prototype of an IoT for managing door access using people’s voice was developed and evaluated. The study contributes towards an understanding of the system requirements for such apps and could be a reference model for developers and researchers to improve an electronic process for user authentication based on voice recognition. The upcoming section describes related studies and it is followed by the design and development of VAES. And, finally the conclusion and future work is presented in the last section of the article.

II RELATED WORK

This section describes the background of using people’s voice to open the door. It also includes the significance, objective, and scope of the project. In phonetics and phonology, voice refers to the speech sounds produced by the vocal folds (also known as the vocal cords). Also known as voicing. Each human has a unique tone, rhythm, frequency, and pitch (show in figure 1 express including where they stop in phrases and how quickly they speak depending on where they are in a phrase and it cannot simulate by other people easily. Obviously, the average male has a lower voice than the average female but the average range of each person’s voice is unique. (Voice and Speech Recognition, n.d.) This system use voice to recognize the user. It also calls a voice recognition system. This paper's aim is to design a voice-activated entrance system. Voice recognition system can use in security system.

A Voice recognition system is one of the biometric methods. Biometric is biological measurements or physical characteristics that use in computer science as a form to identify and access control. Biometrics are directly linked to an individual. They are unique and are very difficult to recreate. The term behavioral biometrics may be used to describe another class of biometrics (Alzubaidi and Kalita, 2016).

For the user, it does not require him/her to remember a unique digital passcode. Biometric authentication is convenient to use compared to other security methods like smartcard and password. Smartcard and password maybe will be stolen or lost.

Other examples of biometric are face recognition, DNA, palm print, hand geometry, iris recognition, and retina. Each method has its own advantages and disadvantages based on its usability and security. Among the biometrics methods, voice has high usability characteristics which include the simplicity for the user, feeling of resistance, speed of authentication, and level of false-rejection rate.

There have two different types of methodologies in voice recognition technology. One methodology is speech recognition. Speech recognition also calls text dependent which requires a user to remember a sentence, phrase, and keywords. (Wood, 2020) This means the speaker cannot say anything he or she likes to authenticate. In static text-dependent voice authentication, each authentication uses the same password. In voice authentication relying on dynamic text, a random passphrase, such as a sequence of numbers, will be generated for the user. This content must also be registered.

Another methodology is voice recognition. Voice recognition also call text-independent which requires no specific passphrases. This means the speaker can say anything he or she like to authenticate because it referred to as a voiceprint, which is the identification and authentication arm of the vocal modalities (Wood, 2020). A Voice recognition system can measure the unique biological sound of each individual when speaking.

Figure 2 show the difference between speech recognition and voice recognition.
Voice recognition system have three main component i.e. voice sensor, speaker verification system and door access control. Voice sensor like mic as an input will receive the voice from person. Then, voice sample will send in speaker verification system to verify the authenticity of the person based on his/her voice. Finally, the door will open if the voice is match with sample voice in database. Figure 3 show the process of Voice Activated Entrance System. Figure 4 show the hardware that use in Voice Activated Entrance System.

This system is important because it can help the user to save the cost. (Find Bio Metrics , 2020) The price of acquiring a voice recognition system is usually quite reasonable, especially when compared to the price of another biometric system like fingerprints and iris biometrics. This system relatively low cost to implement and maintain. Because of little equipment is needed, so making the cost-effective. This can help users to save a lot of costs in the security system. Next, this project can help the user enhance the security of a building or house. Some of the buildings use smartcard or passwords as an entrance system. This maybe will affect the safety levels of a building because the smartcard and password will be stolen, lost, forgotten, guessed by other people. By using a voice recognition system as a security system can help users to solve the problem that might occur in using smartcard and passwords as the security system. In addition, this project can help to improve the performance of an organization and customer satisfaction. Since voice recognition systems require little equipment, so it can usually be implemented without the addition of new equipment and system. So, it is so easy to use for everyone. This can let the organization improve performance and customer satisfaction by reducing their personnel and make use of them elsewhere in the company.

This paper’s main objective is presenting the development of a Voice-Activation Entrance System to ensure the security of a building. The VAES is then evaluated by users of different background. However, the study is limited to authenticate registered users and must be used in a quiet environment. This is because of the quality of the microphone deployed in the experiment is not very good. Having background noise can affect the quality of the voice sample and, in return, fail to authenticate users. This system can be deployed in residential house as well as industrial buildings, as long as they have door access. The registered users may include from different age and level such as children, adults, and the elderly. As of now, VAES only supports English language. For the speech recognition system, the user must say aloud a passphrase or word in the English language to open a door.

### III METHODOLOGY

The development of VAES was realized by adapting System Prototyping. There are four basic processes of system prototyping as illustrated in Figure 5.

- **Planning**

  Identify the problem in the current security system were difficult to fulfill customer requirements. At this stage, a plan is proposed to develop a system which is voice-activated entrance system helps security system at building more effectively and meet customer requirement. A project proposal is drafted explaining the problem that happens in the
current security system, the objective of the project, the significance of the project, the scope of the project, and the schedule of the project.

- **Analysis**

The requirement of the voice-activated entrance system will be analyzed by conducting a requirement analysis process. The activities involved in this phase are identifying the functional and non-functional requirements for the voice-activated entrance security system. The requirement will be gathered by analyzing the current voice recognition system, analyzing a similar system implemented in previous, and find detailed information in an online article to improve the voice-activated entrance system. A use case analysis, process modeling, and data modeling will be produced at this stage. The design or the sketches of the user interface will be also produced at this stage.

- **Design**

In designing the Voice Activated Entrance System, Visual Studio Code will be used to design the interface. Dart is the programming language that will be used in the Visual Studio Code. The database of the system is SQL. The Voice-Activated Entrance System will be hosted on a cloud webserver. At this stage, a low-fidelity prototype will be developed to refine the functional and non-functional requirements. The prototype will be shown to the selected users for suggestions or improvement. If a requirement is identified, then the analysis phase and design phase will be repeated. A usability or user acceptance study will be conducted to evaluate the functionality of the Voice Activated Entrance System. A group of random customers who interest in the system will be recruited to evaluate the system.

- **Implementation**

In this stage, the system will be fully implemented by hosting the Voice Activated Entrance System at a cloud service provider. A user training will be conducted to have a smooth transition of the old security system to the new one, Voice Activated Entrance System. The system will be observed and monitored regularly, and customer feedback will be received after the training.

**IV DESIGN AND DEVELOPMENT**

This section describes the design and development of a mobile app for register people’s information and voice and an IoT system for activating the door using people’s voices following the first three phases of prototyping. The section is divided into two subsections; (1) the requirements of a mobile app for register people’s information and voice and an IoT system for activate door using people’s voice and (2) the prototype development of VAES; a mobile app and IoT system developed to demonstrate the gathered requirements. The requirements of a mobile app for register people’s information and voice and an IoT system for activating the door using people’s voices. A requirement gathering process was carried by analyzing documents and related IoT system that using voice to control things like LED from the Internet.

For the secondary requirements gathering process, the documents were searched using Google searching engine by providing keywords primarily “Voice recognition,” “Internet of Things,” “biometric” and “security system.” The documents were analyzed to elicit the requirements for an IoT and mobile app that can use people’s voices to open doors. Table 1 lists five significant requirements with their priority produced from the requirements gathering process. The requirements include register account, login account, select room, view history record, and manage door.

<table>
<thead>
<tr>
<th>ID</th>
<th>Requirement Description</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>VAE_1</td>
<td>Register Account</td>
<td></td>
</tr>
<tr>
<td>VAE_1_1</td>
<td>The system allows first time user to register a new account.</td>
<td>M</td>
</tr>
<tr>
<td>VAE_1_2</td>
<td>The system must save all information of user such as email, phone number and password in database.</td>
<td>M</td>
</tr>
<tr>
<td>VAE_1_3</td>
<td>The system can record the voice of user.</td>
<td>M</td>
</tr>
<tr>
<td>VAE_1_4</td>
<td>The system allow user to do verification by using email.</td>
<td>M</td>
</tr>
<tr>
<td>VAE_2</td>
<td>Login Account</td>
<td></td>
</tr>
<tr>
<td>VAE_2_1</td>
<td>The system allows user login using email and password.</td>
<td>M</td>
</tr>
<tr>
<td>VAE_3</td>
<td>Select Room</td>
<td></td>
</tr>
<tr>
<td>VAE_3_1</td>
<td>The system allow user to select the room.</td>
<td>M</td>
</tr>
<tr>
<td>VAE_4</td>
<td>View Entrance Record</td>
<td></td>
</tr>
<tr>
<td>VAE_4_1</td>
<td>The system allow user to view the entrance history for a room.</td>
<td>M</td>
</tr>
<tr>
<td>VAE_5</td>
<td>Manage Door</td>
<td></td>
</tr>
<tr>
<td>VAE_5_1</td>
<td>The system allow user to open the door using speech recognition.</td>
<td>M</td>
</tr>
<tr>
<td>VAE_5_2</td>
<td>The system will do the verification of user’s voice.</td>
<td>M</td>
</tr>
<tr>
<td>VAE_5_3</td>
<td>The system will make a sound “Welcome” to user.</td>
<td>M</td>
</tr>
</tbody>
</table>

The requirements presented in Table 1 were translated into the computer system functionality.

The next process is visualizing and modeling the requirements of the app using the appropriate modeling method and tools. In this work, the Unified

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Modelling Language (UML) was used to visualize and model the requirements. The models used in this work are two behavioral diagrams namely use case and sequence diagrams, and a class diagram that represents the structural components of the system. The diagrams were drawn using StarUML. Figure 6 illustrates the use case diagram and the communications between the use cases and the actor for an IoT and mobile app that can be used to voice activated entrance system. Five major use cases are register, login, select room, view entrance record, and manage the door. The use case of register, login, select room, view entrance record is the function on the mobile app and manage door are the function for IoT system.

![Use case diagram of Voice Activated Entrance System](image)

**Figure 6. Use case diagram of Voice Activated Entrance System**

The use case diagram is detailed out to show the dynamic behavior of an IOT and the app. Hence, the operations involved in using a mobile app for register people’s information and voice are illustrated in a sequence diagram from Figure 7, 8, 9 and 10. An IOT for activate door using people’s voice are illustrated in an activity diagram of Figure 11. Both diagram shows the alternative flow for each function in each sequence diagram.

![Sequence diagram of Voice Register Account](image)

**Figure 7. Sequence diagram of Voice Register Account**

![Sequence diagram of Login Account](image)

**Figure 8. Sequence diagram of Login Account**

![Sequence diagram of Select Room](image)

**Figure 9. Sequence diagram of Select Room**

![Sequence diagram of View Entrance Record](image)

**Figure 10. Sequence diagram of View Entrance Record**

The structural components of a mobile app for register people’s information and voice are represented in a class diagram as illustrated in Figure 12. The class diagram in Figure 12 shows the attributes and operations of an IoT and the app. The interactions between the classes are illustrated clearly in the diagram.

### V PROTOTYPE DEVELOPMENT

A prototype of a mobile app for register people’s information and voice and an IoT for activate door using people’s voice was developed. It represents the requirements explained in the previous subsection. Software prototyping is a standard way of demonstrating the software requirements so that further comments and suggestions could be obtained from the users based on their experience in interacting with the prototype. The Flutter was used as the main integrated development environment (IDE) tool. Further, the MySQL development platform was used to facilitate crucial functions like user authentication, and database for data storage. Screenshots in Figures 13, 14, and 15 show the
selected interfaces of the software of VAES. Figure 16 show the interface design of hardware of VAES.

VI EVALUATION OF VAES

A. The Evaluation Setting

A usability evaluation was conducted on 5 respondents, consist of different gender and different age group. The respondents were approached randomly online. The instruments used for the evaluation of the VAES are questionnaires online. The questionnaire was consisting of 32 items in two sections. Section A asked the respondents' demographic information and background research in yes, no, or not sure while Section B asked the respondent's opinion about VAES in a five-point Likert scale where one represents strongly disagree, and five represents strongly agree. The respondents performed the following step-by-step procedure for the evaluation: (1) download the VAES (software) by clicking the link at google form description, (2) register the VAES (software) and test all the function of the VAES (software) (3), test the VAES (hardware) by using speech to open the door and (4) after the test the VAES (software and hardware), respondents start to evaluate the system by filling the questionnaire at google form.
Figure 15. Forgot Password Screen (Left) and Reset Password Screen (Right)

Figure 16. Manage Door in Hardware Design

B. The Respondents’ Demographic Information and Background Research

Analysis of the respondents’ demographic information revealed that 40% of respondents are male and another 60% are female. Next, all respondents are between 21-25 years old. Based on the feedback obtained from the respondents, it is learned that as high as 80% of respondents feel that VAES is necessary nowadays. In addition, all respondents wanted to have the VAES in their office. The study also reveals that 80% of respondents feel that VAES is very helpful in reducing the security threats in buildings.

C. Usability of VAES

An analysis was conducted on the respondents’ responses in Section B of the questionnaire. This section is measuring the respondents’ perception towards VAES usefulness, ease of use, satisfaction, and security which contains 25 question Tables 2, 3, 4, and 5 reported the frequency of the responses.

The outcomes of the evaluation suggested that respondents are satisfied with the feature of the mobile app and IOT that facilitates them in VAES.

More than half of the respondents are very satisfied with the system and wanted to recommend it to their friends. All of the respondents also feel the system is useful and easy to use. The respondent can use the system without too many instructions. However, there are still some functions that can be improved to make the system more usable. The look and feel of the system can improved to ensure a good user experience.

VII CONCLUSION

This paper described the design and development of a mobile app for the purpose of user authentication. Only authenticated users (based on voice recognition) are allowed to access/open the door. There are many aspects to activate the door using people's voices like voice recognition and speech recognition. Under speech recognition, it also can divide into two, static speech or dynamic speech. In this study, we are using dynamic speech recognition. In the future, we plan to use voice recognition that using people’s voice patterns in the system. This method can increase the security of the buildings because everyone has a unique voice pattern and voice patterns are hard to recreate. Hence, will help to tighten the security.

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