Digitizing Malaysian Traditional Game: e-Congkak

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ABSTRACT
Due to the advancement of technology, there’s a trend among young generations who are favour to digital contemporary games instead of playing their own traditional or cultural games. It becomes a major worry if this trend continues, the interest of playing cultural games will die and cultural games will be totally forgotten. Realizing this, there are lots of intentions and efforts are made to attract young generations with cultural games by promoting, preserving and cultivating cultural games using myriad mediums such as books, e-books, blogs, social media and portals. In Malaysia, The Ministry of Culture, Arts and Heritage has established Jabatan Warisan Negara (JWN) to cultivate, conserve, preserve and protect national heritage for younger generations through their portal. Digitizing Malaysian cultural games can be seen as one of the efforts in preserving our national heritage. This paper discusses the digitization of Congkak, a traditional Malay cultural game. e-Congkak was developed based on Mancala game using Artificial Intelligence technique, which is Neural Networks. Methods, findings and evaluation of the digitized Congkak are presented and discussed.

Keywords: digital games, digital traditional games, Congkak, Neural Network

I INTRODUCTION
Cultural or traditional games of a nation are unique and usually reflected strong sense of the community. In Malaysia, cultural games activities are usually held during festive season such as wau (kite) and gasing (spinning top) that are played during the paddy harvesting season. Nevertheless there are also other cultural games that being played to accommodate free time for the adults or as part of everyday life for children. Among those games are sepak raga, guli, kasut tempurung, batu seremban and also Congkak. These games were still being played the last twenty years not only by children in the village but also those living in the cities. However, with the new media culture nurtured by the rapid advancement of the technology and tools, these cultural games starts to become forgotten. Younger generations are more familiar and preferably engaged with contemporary games on their smart phone or tablet PCs. Game such as Angry Bird has been a phenomenal around the world and managed to attract not only children but also adults. Therefore, there is a significant need to preserve these games from extinction in order to prevent the loss of these cultural values. With that concern in mind, and alongside the advent of computer technology, we proposed digitization as an approach towards preserving the cultural games.

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This paper will proceed with a brief discussion on digital game in general. Section 3 discusses digital games and its genre. Discussion on a traditional Congkak covered in Section 4, while Section 5 will discuss on the development of our e-Congkak. Findings and result are covered in Section which discusses on the evaluation of the developed e-Congkak. The paper will then ends with a conclusion.

II DIGITAL GAMES
A computer game is usually defined as an interactive program for one or more players; meant for entertainment (Hsu & Lu 2004). It can either be a web-based application that relies on the Internet or standalone. Digital games or computer games are tremendously popular and proven to be a successful interactive computer application. Computer games often involve problem solving thus requires brain power (Von Ahn, 2006). There is also role-playing type of games played online resembling text-based Multi-user Dungeons (MUDs), which combine adventure games and chatting (Hsu & Lu
Despite of that, people play games for fun and to be entertained (Von Ahn, 2006); with features that help gamers to play efficiently and interestingly (Dyck et al., 2003). Researchers has characterized games as a combination of challenge, fantasy and curiosity (Kirriemuir and McFarlane, 2004, Malone, 1984). Malone (1984) further described those characteristics as follows:

**Challenge.** If the outcome of a game is predictable or certain, the game will not be challenging. Games’ uncertain outcome could be achieved through variable difficulty level or multiple game goals. Besides that, game should also provide performance feedback as a motivation factor for the players.

**Fantasy.** Game should be a system that evoke mental images of physical objects or social situation that are not actually present. This characteristic is more common in adventure games such as Warcraft, Doom and Tomb Raider. The realization of this characteristic is usually defined through emotion as well as the use of metaphors.

**Curiosity.** To ensure the level of curiosity, the game environment should neither be too simple nor too complex with respect to players existing knowledge. Introducing the elements of surprise could be beneficial but need to make sure that it is not completely incomprehensible. Curiosity could be achieved by manipulating sensory effects such as the use of sound effects or through randomness or may be humor.

Currently, the increased power and flexibility of the computer technology has contributed to the vast advancement in game development. Whilst being the source of entertainment, certain games have also been utilized for educational purposes (Von Ahn, 2006, Hasibuan et al., 2011, Amory et al., 1999). Game has found to be effectively used to provoke interest as well as teaching domain knowledge, strengthen engagement, information processing, problem-solving, social development and finally to increase academic abilities (Hasibuan et al., 2011).

**III GAME TYPE AND GENRE**

Computer games are often categorized by genre. From the literature, it is found that there are different school of thoughts when categorizing game type and genre. Sometimes it has been used interchangeably. Grace (2005) differentiates between game type and genre. Game type refers to the description of the game play namely action, adventure, puzzle, role playing, simulation and strategy, whereas genre focus more on describing the narrative content of the game; usually influenced by film genre (Grace, 2005, Wolf, 2002) such as drama, crime, fantasy and fiction. Action games offer exploration and puzzle solving as the main attraction, while adventure game offer exploration and puzzle solving as the main attraction. Role play game offer the opportunity for players to immerse themselves in the character’s situation and simulation game provide the simulation elements with abilities to match with the real world. As for strategy games, it entertains through reasoning and problem solving, and finally the puzzle games.

Most of the game types mentioned above is derived from the modern era whilst there are also classical games or traditional games which have been adapted using the flexibility of the computer technology to suits the current demand. As for the traditional Malay games, there have been a few efforts in adapting such games. For example, a modern version for game of *batu seremban* have been developed with a touch of computer technology and renamed as DigiToss(Ramli, 2009). Despite of that, there are a lot more of the traditional Malay games that is dying, desperately need to be preserved for the younger generation. Having that concern, this research attempted to give a new hope to these cultural games, starting with Congkak.

**IV THE TRADITIONAL CONGKAK**

Congkak is a traditional cultural game used to be played by women during Malay ancient times. It is known as a game of strategy and played between two players. The word Congkak is originated from ‘Congak’ which means counting in the old Malay language. Traditionally, the game was played by digging up holes in the ground. Each player will have seven holes in a row with one large hole at their left end respectively called “home”. Each hole will consist of seven “buah” often made of pebbles, tamarind seeds or even shells.

As Congkak evolved, people used a wooden board mimicking the holes on the ground, as illustrated in Figure 1.
Known as a game of strategy, Congkak involves counters or pieces being moved on a surface or board according to a set of rules. Unlike chess or checkers, Congkak board game refers to the holes being housed on a wooden board. To play the game, each player will start simultaneously and will move to their left (clockwise) while depositing one pebble in each hole including the “home” (same move rule applied) until both had ended their turn. Then, the last player who ended their turn last will go first in the next turn. The endgame is reached whenever a player had the entire holes on his side empty. Both players will count the total pebbles collected in their storehouse. Player with the highest number of pebbles wins will start first in the next round.

To start the next round, both players will fill back their empty holes with pebbles from their storehouse. The players must do it from the left to the right hole (on their side), and each hole must be filled with exactly seven pebbles and the remainder will be stored in the storehouse. A non-filled hole is considered “burnt” and will be ignored during game (this is called burnt_house rule). The burnt_house rules allow the loosing player to reclaim pebbles from their opponent in next round, (Yaakub, 1981).

V  e-CONGKAK

A digital Congkak, e-Congkak was developed to simulate the traditional Congkak. A combination of Congkak rules defined in Section IV and algorithm of Mancala, a similar game to Congkak have been used in the development of the digital Congkak. Mancala is a traditional game originated from Africa that has similar rule and board shape to Congkak but is much simpler (Voogt, 2001). Although both games are very similar, Mancala applies a different rule compared to Congkak.

Unlike Congkak, Mancala does not feature multi-lap move, no multi-stage game and no burnt_house concept. Mancala player start playing the game by picking up pebbles from a hole on the player's side and move counter clockwise while deposited a pebble each time the player passes a hole or storehouse. If the player emptied his hand on an empty hole then he will lose the current turn. If this hole is his own side then he can capture pebble from the opposite hole and put them (and the last pebble he deposited) into his storehouse. However, if this hole is his opponent's hole then he must leave the pebble there. Mancala player can deposit pebbles in any hole except his opponent storehouse which he must skip (Cofer, 2003).

Our e-Congkak was develop using Java which contains five main classes; CongkakNNMove.java, CongkakServer.java, CongkakDataKnitter.java, CongkakBoard.java, and CongkakTrainer.java. To make the e-Congkak more intelligent, Artificial Neural Network (NN) and Min-Max algorithms have been used. Min-Max is an algorithm that uses state searching to find the best possible move. Many board games (such as Mancala) used Min-Max as an artificial agent and as a benchmark to other artificial agent because of its completeness in finding solution. Min-Max algorithm is known as the most effective algorithm for creating an artificial agent for board game. For e-Congkak, the Min-Max evaluation function is the amount of pebble contained in the agent's storehouse minus the pebbles contained in the opponent's storehouse (the difference of pebbles).

A simple GUI of e-Congkak is shown in Figure 2. It is designed based on the original layout of the Congkak board; seven boxes on each player’s side, a home box at the left-hand side of each player, and a box indicating the number of pebbles in hand.

Figure 2. A Simple GUI Of Digital Congkak
VI FINDINGS AND DISCUSSION

The developed e-Congkak has been tested in terms of its functionality. It runs perfectly as the traditional Congkak is played. Due to time constraint, the digitization only concentrated on the functionality, thus only simple GUI is produced.

In terms of the added value, it was tested with different player agents. Table 1 shows the win-lose count for all artificial agents. Min-Max scored highest point for all games, while Neural Network is the lowest.

<table>
<thead>
<tr>
<th>Artificial Agent</th>
<th>Winner</th>
<th>Tie</th>
<th># of games</th>
<th>Win ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Random vs MinMax</td>
<td>1</td>
<td>2</td>
<td>19</td>
<td>10</td>
</tr>
<tr>
<td>Neural MinMax vs MinMax</td>
<td>0</td>
<td>20</td>
<td>20</td>
<td>01</td>
</tr>
<tr>
<td>Neural MinMax vs random</td>
<td>52</td>
<td>1</td>
<td>53</td>
<td>002</td>
</tr>
<tr>
<td>NN vs Neural Min Max</td>
<td>0</td>
<td>100</td>
<td>100</td>
<td>01</td>
</tr>
<tr>
<td>NN vs random</td>
<td>39</td>
<td>59</td>
<td>2</td>
<td>100</td>
</tr>
<tr>
<td>NN vs MinMax</td>
<td>0</td>
<td>30</td>
<td>30</td>
<td>01</td>
</tr>
<tr>
<td>Neural MinMax vs Neural MinMax</td>
<td>60</td>
<td>40</td>
<td>100</td>
<td>32</td>
</tr>
<tr>
<td>NN vs NN</td>
<td>50</td>
<td>50</td>
<td>100</td>
<td>11</td>
</tr>
<tr>
<td>Random vs random</td>
<td>41</td>
<td>42</td>
<td>8</td>
<td>90 .98</td>
</tr>
<tr>
<td>MinMax vs MinMax</td>
<td>0</td>
<td>54</td>
<td>54</td>
<td>01</td>
</tr>
</tbody>
</table>

Each testing is capped at maximum 10 rounds, and the test is repeated for 10 times for each combination of agents; resulting in total of 100 rounds for each combination. Min-Max is played less than 100 round; this is because Min-Max immediately win in each game; and on average Min-Max only need 2 round to defeat the other agent: so it only played a maximum of 10x2=20 games.

The neural network agent was trained using “defensive move” and “custom strategy” move evaluation functions. In total there are only two game evaluation functions; “winning move” and “defensive move”. As a result, Random Move had more wins than Neural-Network and Min-Max is unbeatable.

VII CONCLUSION

e-Congkak is successfully developed. To give a value added to it, it has been integrated with different types of player agent for selection purpose. Although it is perfectly functional, there are rooms for improvement especially it’s GUI. Series of tests are recommended to be conducted involving different levels of player to measure their acceptance of the digital version of our cultural games. This digital version of Congkak can be seen as a basis for future research in digitizing cultural games.

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