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Try Dam: Digital Checkers Game Application Based on Machine Learning

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Abstract

A traditional game like checker or dam is often played by people in the past during their free time. Despite their leisurely and compelling activities, the games stimulate the cognitive, social and emotional well-being of players, to plan the right strategy to win the game. However, moving along with the difference in time, traditional games that used to be often played by all sections of society are increasingly being marginalized by the younger generation. Due to the development of technology, the younger generation appears to be more inclined to play mobile games than traditional ones. The proposed solution to this problem is to create a traditional game in digital form; and this paper aims to develop a digital checkers game application using machine learning and to test the functionality and effectiveness of the game. The development of this digital checkers game applies agile model, combined with game design strategy. The Alpha-Beta Pruning algorithm will be used to produce a computer capable of playing checkers. Based on the game competition result, the player's winning rate decreases along with the chosen difficulty level. Once the difficulty level increase, players need to demonstrate their mastery to play against computer. The computer has gained increased information to defeat the opponent using various strategies using "alpha-beta pruning" technique. This digital checkers game is expected to increase awareness and passion among generation young towards the local traditional games. Expected game play experience from the application include entertainment and easy access especially using smart telephone device.

Keyword: Traditional Game, Checker, Game Play, Agile, Machine Learning

Introduction

A traditional game is a game played by people in the past to fill their free time. In the past, this traditional game was enjoyed by all groups of people regardless of age and race. Because Malaysia is a multi-ethnic and multi-cultural country, various types of traditional games are formed. Among the traditional games found in Malaysia are tingting, sepak raga, batu Seremban, congkak, checkers, Mahjung, Go, Xiang Qi, Chaturanga and also Kabadi. The games are the traditional games of the three largest races in Malaysia, the Malays, Chinese and Indians.

As natural and compelling activities, traditional games stimulate cognitive, physical, social and emotional well-being to players, particularly children (Wahida Mohamad Noor &

Ahmad, 2019). Traditional games are an asset of our country's pride. Traditional games have actually become an attraction for tourists to come to our country (Yusoff et al., 2020). This can indirectly increase the economy of the people in Malaysia. Traditional games can also be a medium to strengthen community relations in Malaysia. which is multiracial because all races will try to play traditional games of other races.

One of the traditional games that is very interesting to play is the game of checkers or *dam*. The game of checkers is a competition that was usually played in restaurants in the olden days. The game of checkers is played by two people facing each other. Checkers is a game that is very similar to the game of chess. However, checkers do not have a character like in a chess game and all pieces are only able to move sideways forward. This game is a turn-based game and the winner is determined when the opponent's checkers are no longer on the checkerboard.

However, moving along with the difference in time, traditional games that used to be often played by all sections of society are increasingly being marginalized by the younger generation. This is caused by various factors but the development of technology is among the main causes of this problem. Due to the development of technology, the younger generation are more inclined to play mobile games than traditional ones. Tremendous progress in digital game research and development in various areas such as in learning, health care, climate change also lead to increase game popularity (Damayanti et al., 2022; Damayanti & Ali, 2022; Nursyahida et al., 2018; Ramli et al., 2022; Razali et al., 2022).

Another factor that may be responsible for the sinking of traditional games in the current era is due to the lack of exposure. Many of today's children are unaware of traditional games. Lack of exposure from parents and school lead these traditional games to be further marginalized. Difficulty in obtaining equipment to play traditional games is also a major contributor to the decline of traditional games today. The availability of friends to play with may also be a factor in the marginalization of this traditional game.

People will find it easier to play video and digital games that can be found on the Internet and can be played in the room without having to leave the house. There are many examples of digital game inspired by traditional games, such as tarik upih (frond sledding) (Jamil & Kadir, 2015), dam haji (checkers), ceper (bottle steel cap), batu seremban (tossing stone), guli (marble) and gasing (tops spinning) (Fadly et al., 2016).

The proposed solution to this problem is to create a traditional game in digital form. This paper address the problem with two objectives: i) to develop a digital checkers game application using machine learning and ii) to test the functionality and effectiveness of a digital checkers game using machine learning.

Digital Game Application using Machine Learning

In this age of technological sophistication, game playing like checkers alone against the computer is not impossible. Artificial intelligence and machine learning are already pervasive in everyday life in applications such as gaming. Artificial intelligence refers to algorithms and processes by which an application performs tasks that seem to mimic human behaviour or intelligence (Voulgari et al., 2021). Meanwhile, machine learning represents a subset of the algorithms whereby a computational processing gradually acclimates and progresses in performance for specific tasks.

Thanks to the development in artificial intelligence allows us to develop a computer program that is capable of thinking. Game playing is among main application domain in artificial intelligence research in general and for machine learning in particular (Johannes

Funkranz, 2017). While initially the research mostly concerned with learning in strategy games such as chess, tic-tac-toe, and backgammon, recently more attention has been given to computer and video games.

Even though artificial intelligence stands as a new technology, its usage in game playing has been around for more than 70 years. At that time, the Ferranti Mark 1 AI machine was used to program both checkers and chess games at the University of Manchester. The program was among the first one ever written. Twenty years later, artificial intelligence became an integral part of video game development. In 1978, the world-famous Space Invaders used increasingly hard levels and different movement patterns based on player input.

Following the progress, Pac-Man introduced AI patterns to its mazes in 1980. Starting from there, AI also permits entities in the game to have different personalities. Among others, fighting games began to use AI technology, such as Karate Champ in 1984. Artificial intelligence in game works to generate in-game responses to produce smart judgements when circumstances necessitate rational. Artificial intelligence in games is mostly used to produce non-player characters (NPCs) to battle against human player.

Besides the benefits of machine learning in game playing, there are concerns on the potential drawbacks and challenges regarding the decisions machine learning can make, including the values and bias embedded in their design (Voulgari et al., 2021), Artificial intelligence for game playing entails the application of a set of algorithms and procedures to deliver solutions to various problems related to game. Many of the techniques lack of the ability for adjustment during the game to the performance or behaviour of the player (Galway et al., 2008).

Thus, machine learning procedures offer better way to adjust the progress and dynamics of the process by assisting the generation and choice of improved decision (Ariffin & Tiun, 2022; Lei et al., 2022). These aim to enhance game performance and to generate better engagement and satisfaction in game playing experiences. Recently, the player adaptability and personalization set up on recognition of elements such as pictures, human emotions and speech, control of the complexity of game levels and game contents has been progressed (Dyulicheva & Glazieva, 2022).

To design a good game, players expectation need to be fulfilled (Fabricatore, 2007). For this digital checkers game, players pursue challenge, proficiency and reward, to be packaged in entailing and motivating activities. The selected algorithm for this game called the alpha-beta pruning. This algorithm is a recursive or backtracking used in decision making and game theory. It provides optimal movement for the player assuming that the opponent is also playing optimally. This algorithm uses recursively to search through the game tree.

As one of the most powerful and essential MiniMax search improvements, Alpha-Beta pruning was designed for sequential two-player zero-sum perfect information games (Saffidine et al., 2012). The algorithm suits the sequential zero-sum two-player games with perfect information for games like Tic Tac Toe, Chess and Checkers. The algorithm maintains upper and lower value bounds to decide whether branches can be cut that leads to considerable search reductions.

Method

The development of this digital checkers game applies agile model, combined with game design strategy. Since the agile development models have evolved in software engineering to increase the quality and efficiency of system development projects, game development

methodology may applies the principles by taking into account the similarities and dissimilarities between game development and software development (Kortmann & Harteveld, 2009; Ruonala, 2016).

The agile model promotes more value in individuals and interactions over processes and tools, and responding to change over following a plan. Agile development involves iterative, incremental and thus evolutionary procedure. It uses iterations to incrementally build more value into the product. There are five phases for game design using agile model, as presented in Figure 1.

Planning

In phase 1, planning steps lead from project organisation to a set of game specifications. The project is initialised to determine the organisation, scope, requirements and constraints related to socio-technical system around which the game is built.

Design

In phase 2, the design of the game is produced including the algorithm and a detailed conceptual design, are outlined. The underlying system is analysed following the project scope determined earlier. In this phase, a functional description of the artefact is sketched based on the requirements and constraints formulated in phase 1. The functional systems design is then elaborated in detail to prescribe the system architecture, coding techniques, and use of existing tools and libraries.

Development

A blueprint of the game is created in phase 3, consisting of five steps to select and define design specifications, for instance, game elements, techniques, a format, and a way to report on the design. The main activities consists of the actual game coding. Development of Try Dam application applies Android Studio as the integrated development environment while Sqlite work as the internal database to store user performance record. The programming language for application functions uses Java and Xml.

Test

During phase 4, a prototype is built, tested, modified and technically evaluated until the game is considered finished. Among main activities involve testing the code in parts and the game as a whole: verification (does the game comply with its specifications and constraints?), validation (does the game accomplish its intended requirements?). User testing: usefulness (which tasks can be performed with the system), usability (easy of use).

Deploy

Eventually, in phase 5, the game is integrated in user's environment, facilitated, and disseminated. The game implementation considers integration with other systems and development of manuals to familiarise users with the system.

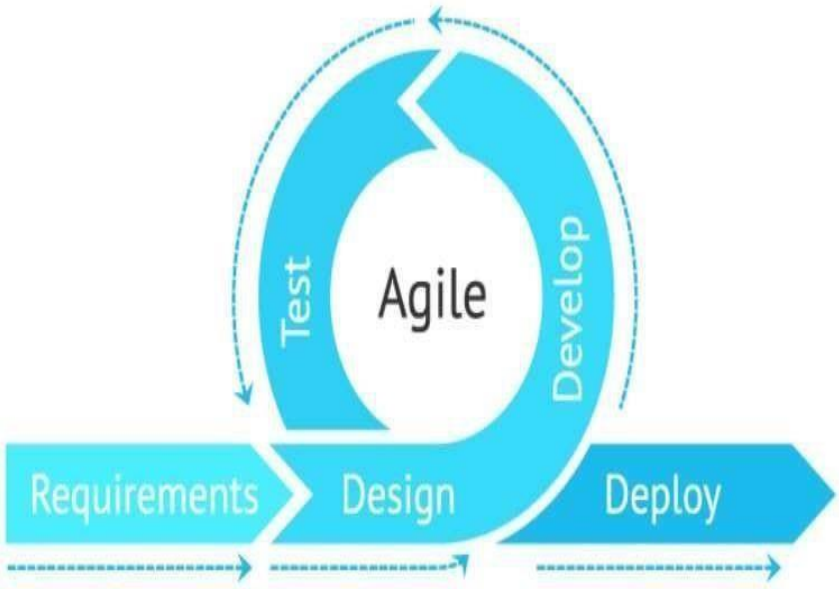

Figure 1. Agile model

Implementation, Results and Discussion

This section presents the results of application development. The interface and interaction design especially the game representation and miscellany is highlighted to emphasis the game selection. The welcoming screen of Try Dam is shown as in Figure 2. Player options menu in the application as shown in Figure 3 provides two modules: single vs multiple player. To experience the game play (as presented in Figure 4), users will see the checkers setting for player and opponents sides in contrasting colors of dark and bright. The game board applies an eight times eight panel with each player initially starts with 12 pieces. The game aims to capture all the opponent's pieces by jumping over them.

Players may choose varieties in the game, i.e. to set difficulty level and game mode, whether to play against another human player or against computer, as shown in Figures 5 and 6. Outcome of the game provides the result as win or lost, as presented in Figure 7. To qualify for a win, players need to make the opponent lost all his pieces, so the game will end and this is the most common way. The other ways include making the opponent unable to move at all.

Figure 2 Welcoming note to the game

Figure 3 Player mode selection

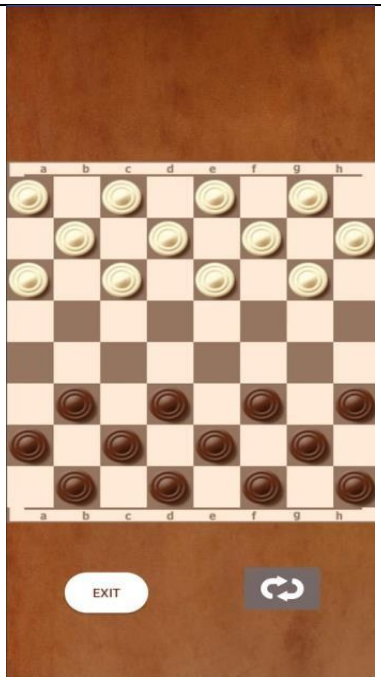

Figure 4 Game Representation

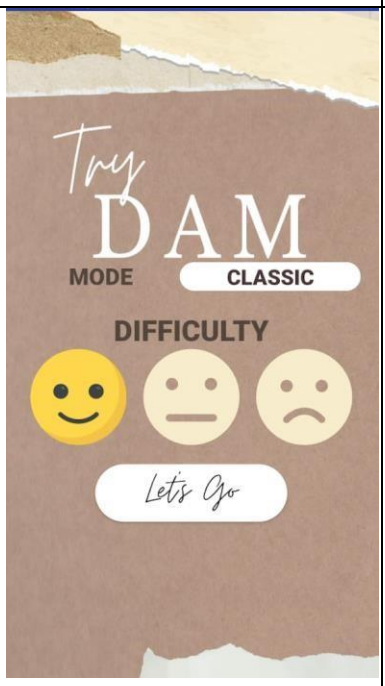

Figure 5 Difficulty level selection

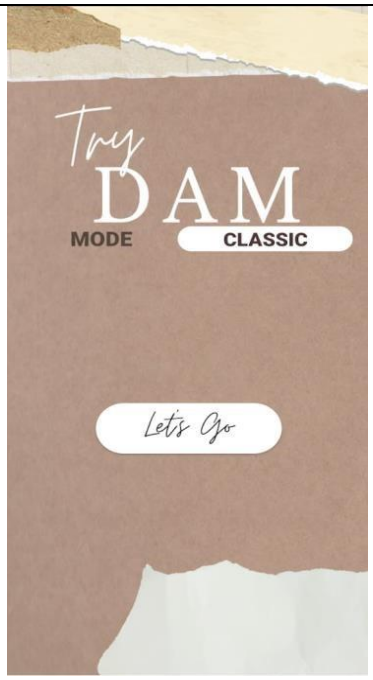

Figure 6 Game Mode selection

Figure 7 Game results

The non-functional testing was conducted involving ten different players to play against the computer. They were asked to repeat the game three times according to the difficulty level. Table 1 provides the results based on difficulty level. For easy level, nine players won the game while one player lost. In the next level, moderate, half of the players won while the other half lost the game. In the difficult level, almost all players lost the game and only two succeed to win the game.

Table 1
Results of the Competition against the Computer

Difficulty Level	WDL status	Description
Easy	9-0-1	9 players won and 1 player lost in easy difficulty level
Moderate	5-0-5	5 players win and 5 players lose in medium difficulty level
Difficult	2-0-8	2 players win and 8 player loses in hard level

Based on the results, it can be concluded that the player's winning rate decreases along with the chosen difficulty level. Players get higher chance to win in easy level as much as they can handle the novice or ordinary players. Once the difficulty level increase, players need to demonstrate their mastery to play against computer. The computer has gained increased information to defeat the opponent using various strategies using "alpha-beta pruning" technique.

The alpha-beta pruning algorithm allows the computer to find the best possible moves in Try Dam. In the machine learning process, computers build a tree of various possibilities for the game and eventually work backwards to find the passage that will give the best result (Felstiner, 2019). The algorithm helps the computer to overcome the challenge to find ways to win but able to avoid searching in entire parts of the tree.

The Try Dam game application is an example of creating digital version of traditional game to offer younger and new generation with how people may use game to increase creativity in mind development. Practices and continuous exposure to the game may strengthens the quality of learning of players from all ages that benefit the society (Fadly et al., 2016).

The development of this application applies Agile model, that has taken place widely in software development projects. Slight modification of the model is required in game development (Lamrani & Abdelwahed, 2020) due to inherit game development features but tolerance towards greater similarities in the development process. Sustainable elements in development process has gained increasing attention among researchers that also be possible to be applied in game design and development in near future (Shamshiri, 2021).

Conclusion

Traditional games in Malaysia should be exposed to younger generation in order to inherit down its hereditary. This paper has demonstrated the development of Try Dam, to present the digital version of traditional Malay dam to wider audience. The game application development applies machine learning procedure, particularly Alpha Beta algorithm. The paper has also discussed the functionality and effectiveness test of the digital checkers game using a sample of players.

This digital checkers game is expected to increase awareness and passion among young generation towards the local traditional games. Expected game play experience from the application include entertainment and easy access especially using smart telephone device The selection of game algorithm fits the function as this machine is expected to assist in sharpening the skills and cognitive of younger generation in the strategy to defeat computer in the game play.

Try Dam prototype fulfills the objective of its development, despite some deficiency in the game. Among the shortcomings in this application is no undo button that can enable players repeat steps previously if they accidently chose wrong movement. In future, more traditional game such as *batu seremban* could be researched to be presented as digital game and the current topic could be explored using other algorithm such as Mini max procedures.

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