Personalised Mobile Picture Puzzle

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Abstract—Mobile Picture Puzzle is a mobile game application where the player use existing images stored in the mobile phone to create a puzzle to be played. This traditional picture puzzle is not so challenging once the player is familiar with the game. The objective of the developed mobile game application is to have a similar mobile game application that can provide the player with more challenging gaming experience. The developed mobile game application is also a mobile picture puzzle game application to create a puzzle to be played but instead of just using existing images that are stored, the personalised capability allows the player to use the built-in camera phone to capture an image and use the newly captured image to create the puzzle. The development of the mobile game application uses Symbian Operating System (OS), Mobile Media API (Application Programming Interface), Record Management System (RMS) storage and TiledLayer class from Game API.

Keywords—Picture Puzzle, Pervasive gaming, J2ME.

I. INTRODUCTION

THE tremendous growth in mobile devices such as mobile phones and Personal Digital Assistant (PDA) and the recent investment in 3G technology [2] have resulted in such devices being used for various purposes. Traditionally mobile phones are used for making and receiving calls or sending and receiving text messages. Nowadays, they can be used to record and send short videos, taking photos and playing games. With the growth of mobile devices coupled with the growth in the field of pervasive gaming, mobile devices are also being used widely for playing games. Pervasive gaming is an emerging genre in which pre-computer traditional games are being played with computer functionality [1]. Besides mobile phone, there are also other types of handheld devices that offer pervasive gaming experience such as Cybiko, Gameboy Advanced and Game Park GP32 [2]. Traditional board games such as Chess, Go and jigsaw puzzle that are now being played using computing technology offer a new and engaging gaming experiences to the players [1].

Picture puzzle is a puzzle that is made of a square-shaped image that has been broken up into smaller pieces and scrambled. The smaller pieces are usually in a square-shaped form. In order to reorganize the picture, the smaller pieces are slid which means that one piece is removed to allow for the movement of the pieces. Picture puzzle game applications are already available in the desktop environment and mobile environment. Some traditional picture puzzle game

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applications use built-in images to create the puzzle. This is not going to be as challenging after the player has gotten used to the image and the application. In order to make picture puzzle game to be more interesting, some applications have the features that allow picture puzzle to be personalised. Players have to upload the image and the program will break the image into smaller pieces for the player to assemble to its original form.

The proposed development of personalised mobile picture puzzle is also a mobile picture puzzle game to create a puzzle that can be played but instead of just using existing stored images, the personalised capability allows the player to use the built-in camera phone to capture an image and use the newly captured image to create the puzzle. This mobile game application can also be played using any existing images that are already stored in the mobile phone. The player can also choose the level of difficulty of the puzzle and play against the time to solve the puzzle. These features together with the personalised capability give the player a more challenging way of playing the picture puzzle game.

The developed personalised mobile picture puzzle game is a mobile game application that can be played using any Java 2 Micro Edition (J2ME)-enabled mobile phones. The game application allows the player to capture any image using the built-in camera phone in order to create a puzzle that can be played. The image that is taken is displayed as a scrambled grid and the player is required to scramble the image to start the game.

II. RELATED WORKS

There are numerous picture puzzle game applications in the market that allow personalised images to be used. An example of a picture puzzle games in a desktop environment is Picture Puzzle Wizard, a freeware picture puzzle wizard developed by VSI Systems. This application allows the player to upload any bitmap images to create a new game. However, the application does not come with features that are normally available in a game. The game application does not provide the player with scores after each game. Player also cannot set the level of difficulty for a particular game [7].

All-Star Puzzles is another company that offers personalised picture puzzle to its player. All-Star Puzzle requires the player to upload the images to the company's server. The image sent cannot exceed 250 KB in size, cannot be wider than or taller than 700 pixels but must be wider than and taller than 100 pixels. At the end of process, All-Star Puzzle will provide a URL address to the player and the player can share the URL address with other players. Unlike the developed personalised

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mobile picture puzzle game which can be played as long as player keeps the images in the mobile phone, the All-Star Puzzle is active for at least one month after it has been created [8].

Mix Pix is an example of another personalised picture puzzle game and it is developed by Nokia Corporation. This Java-based game is pre-installed in some Nokia mobile phones. The application allows captured images to be used as the image for the puzzle. In this application however, the player is not allowed to select a timer. Player is able to complete a puzzle without being confined to a specific time range. Mix Pix also does not provide the capability to view the solved puzzle as a hint to the player.

Mobile games can also be developed using Macromedia Flash Lite. Omega Mobile is a company that develops mobile applications using Macromedia Flash products [9]. Examples of the picture puzzles developed by Omega Mobile are Dogs Puzzle Pix, Cats Puzzle Pix and Cars Puzzle Pix. The images used in these applications cannot be personalised. These picture puzzle game applications have a hint function that allows the player to identify the correct puzzle piece at a selected position whereas the developed personalised mobile picture puzzle provide a hint function that allows the player to review the image for 5 seconds before starting the game.

III. SYSTEM MODEL

The development of the mobile game application uses Symbian Operating System (OS), J2ME Wireless Toolkit as the development tool and Mobile Information Device Profile (MIDP) 2.0 specifications. MIDP 2.0 provides us with the persistent storage and gaming API of J2ME. The mobile device used for this project is the Nokia Series 60 mobile phones that are equipped with a built-in camera phone.

The components of J2ME that are used in this game application are the Mobile Media API (Application Programming Interface) package, Record Management System (RMS) storage and the TiledLayer class from the MIDP Game API package. The mobile phone uses Symbian OS as its operating systems and is J2ME-enabled.

Mobile Media API (MMAPI) is an optional J2ME package. The Mobile Media APIs enable the playing and recording of audio, taking pictures and playing videos [10]. The MMAPI specification includes a code fragment that describes how to capture an image using the device's camera [5]. The Game API package provides a series of classes that enable the development of rich gaming content for wireless devices [11]. We use the TiledLayer class from this package to break up the image into a series of equally-sized tiles. Each tile is assigned a unique index number. The tile located in the upper-left corner of the image is assigned an index of 1. The remaining tiles are then numbered consecutively in row-major order from left to right. These tiles are regarded as static tiles because there is a fixed link between the tile and the image data associated with it [6]. Although TiledLayer class allows different arrangement of tiles to form an image, we chose to have the image in square shape. With the Game API package, the image taken is

automatically displayed as a scrambled grid with each grid cells records are stored in the RMS.

The data flow of the developed mobile game application is as shown in Fig. 1. There are 5 processes that collaborate with the Record Management System (RMS) storage and the built-in camera phone.

The data flow is initiated by the player. The player first selects the option whether to use existing images stored in the mobile game application or whether to use a new image. If the player decides to use a new image, the application collaborates with the built-in camera phone to capture the new image and the image is then stored in the RMS storage. Alternatively, the player can choose to start the game using existing image in which the developed mobile game application loads the image into the application. The player can then select the difficulty level. The player also has the option to play with timer sets or not. If the player decides to play with the timer sets, the player has to play against the time specified. Otherwise the player can play until the game is completed. After all the options have been specified the image is scrambled and the game is loaded and started.
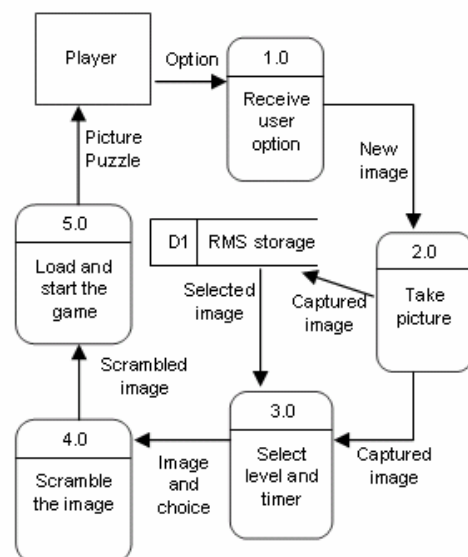
Fig. 1 Data Flow Diagram

Fig. 2 shows a class diagram for the developed mobile game application. The classes used are interconnected in a hierarchical fashion. It is designed with user-defined classes and are collaborated with the development system packages namely javax.microedition.lcdui. The classes used from this package are Form, Textbox and Canvas. The class Form and Textbox are subclasses for the class Screen. The class Screen and Canvas are subclasses for the class Displayable. The user-defined classes are:

- The GameMIDlet class extends the MIDlet package and it provides implementations for the MIDlet life cycle methods. The MIDlet life cycle consists of pause, start and terminate functions of the mobile game application.

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This class also acts as an application controller since it provides a number of callback methods that are invoked by the application's user interface objects in response to player's command.

- The ChoiceForm class loads the names of any stored images and displays them as an instance of a ChoiceForm class.
- The Capturer class is for creating and initializing the VideoPlayer. The VideoPlayer is used to indicate that the data source is the built-in camera phone and to initialize it with the CaptureCanvas class. The image is taken and returned as a PNG image.
- The CaptureCanvas class provides the Canvas package in which the output of the camera is made. When the player is satisfied with the scene, the image is taken by selecting the "Capture" command.

Fig. 2 Class Diagram

- The ImageNameBox class extends the TextBox package and provides an area for the player to enter a name for the new image. In this class when the player selects the "Save" command, the image data and the name are saved to the RMS storage.
- The PuzzleCanvas class is where the board for the mobile game is created. The player's selected level of difficulty is used in a method called createBoard() class to create the scrambled puzzle. This method implements the TiledLayer algorithm and also the timer function.
- The PuzzleCanvasXTime is a class that performs the same function as the PuzzleCanvas class but the only different for this class is the timer function is not being implemented.
- The RMSHandler class handles loading of previous image from storage, saving a new image to storage and deleting images from storage. The RMS record storage provides

persistent storage of data in the form of records within the RecordStore. There are two RecordStore being used, one is for storing the image data and the other one is for storing an index. The index RecordStore is used for storing the image's name and the record ID.

- The Level class and SelectTime classes are used for handling the player's selections, which are difficulty level and timer options.
- The GameHelp class is created to provide the player with the game information and game instructions.

IV. THE APPLICATION

The application is a mobile game that enhances the picture puzzle game by using a newly captured image rather than just using existing stored images. It also comes with several features such to make the game application more challenging to be played. The developed mobile game application is used together with the built-in camera phone to capture image for the game. The image captured can be saved or deleted. Player can then choose features such as difficulty level, timer option and hint function. Fig. 3 shows the main interface of the developed Personalised Mobile Picture Puzzle mobile game application.

Fig. 3 Scrambled picture puzzle to be solved

The developed mobile game application has basic functionalities such as:

- Save or delete function

Fig. 4 shows the functions for saving and deleting images. These functions are used to organise the images stored in RMS storage. New images can be saved into the RMS storage and all images stored in the storage can be used again to play the game.

Fig. 4 Save and Delete Functions

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▪ Capture function

Fig. 5 shows the interface for a function that captures new images. The mobile game application uses the image taken by the built-in camera phone to create the scrambled image. When the player chooses to start the game, he/she has to choose whether to capture a new image or to use one of the stored images. The personalised approach allows the player to capture a new image and use the image to play the game.
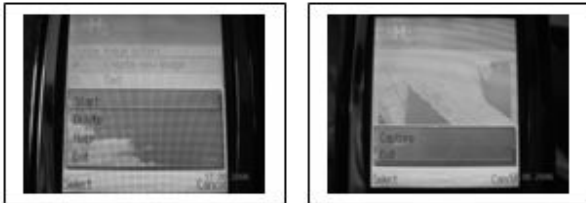
Fig. 5 Capture Function

▪ Level of difficulty function

Fig. 6 shows the level of difficulty a player is to choose to play the game. There are 3 difficulty levels; beginner, intermediate and expert. The level of difficulty function is implemented using the TiledLayer class. It breaks the picture taken into a series of equally-sized tiles. The width and height of a single tile is in pixel and is determined according to the level of difficulty that the player has chosen. The actual dimension size (width x height) of the picture taken for the developed mobile game application is 160x120 pixels. For the beginner level, the dimension of a single tile is 40x30 pixels, for the intermediate level, the dimension of a single tile is 32x24 pixels and for the expert level, the dimension of a single tile is 32x20 pixels. All tiles are assigned with a unique index number.
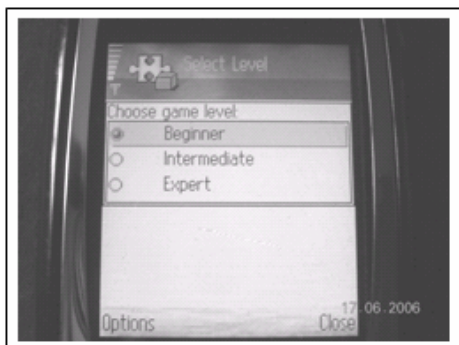
Fig. 6 Level of Difficulty Function

The collaboration with the TiledLayer's grid is made up of equally sized cells, which consist of rows and columns. The difficulty levels determined the grid size that is applied for scrambling the picture. The TiledLayer's grid is divided into a few sizes. For the beginner level, the grid size is 4x4, for the intermediate level, the grid size is 5x5 and for the expert level, the grid size is 6x5. The physical size of the cells is defined by the size of the tiles and the content of each cell is specified by tile index number. The mobile game application is then used the user-defined class to jumble up the tiles within the grid. While the mobile game is played the application determines

whether the current arrangement of tiles is equal to the original image. If both images are identical, the game is considered to have been successfully completed.

▪ Timer Function

Fig. 7 shows the interface for the timer function. This function allows player to choose whether to play the game with the timer set. When timer is sets to on, the player has to play against the time. The timer is determined according to the level of difficulty that has been chosen earlier. For the beginner level, the timer is set to 4 minutes, for the intermediate level, the timer is set to 3 minutes and for the expert level, the timer is set to 2.5 minutes. Alternatively, the player can choose not to play with timer on so that the player is able to play the mobile game until the puzzle is completely solved without any time constraint.
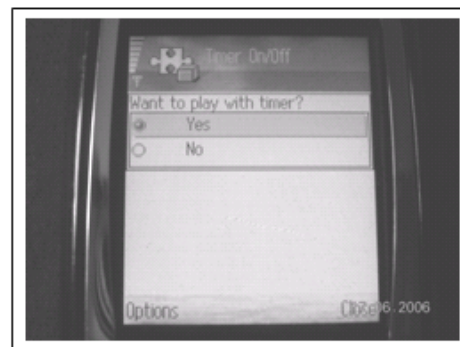

Fig. 7 Timer Option Function

▪ Hint Function

Fig. 8 shows the interface for the hint function. The hint function provides the player to review the original image for 5 seconds before the game starts.

Fig. 8 Hint Function

V. THE EVALUATION

A preliminary user evaluation was conducted at Universiti Teknologi PETRONAS (UTP), Malaysia. Since it is only a pilot study, there were only 15 participants involved in the evaluation. Two stages of evaluation were carried out. Before the evaluation started, the participants were given the opportunity to familiarise themselves with the game application.

In the first stage, all the participants were required to play the developed mobile game for each of the difficulty level without being constraint to any time limit. Fig. 9 shows the

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result of the first stage of the evaluation. It can be concluded that, more participants required more time to complete the game if the game is played with higher level of difficulty. For the lowest level of difficulty i.e the beginner level, more participants can complete the game faster. Generally, none of the participant can complete the game regardless of any the difficulty level for one minute or less.
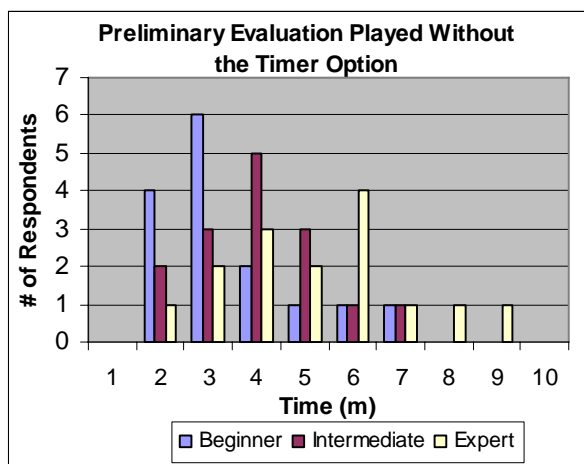
Fig. 9 Preliminary Evalution Played Without Timer Option
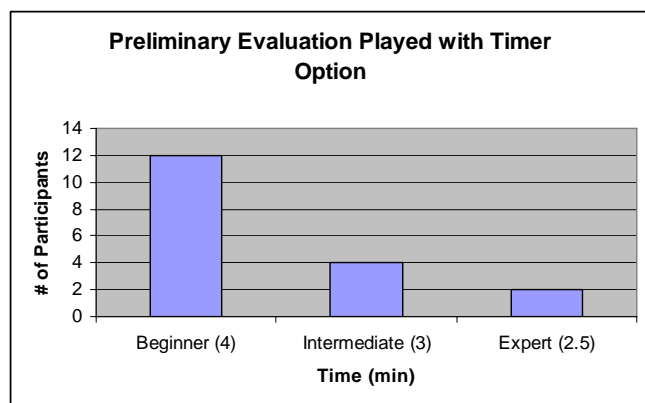
Fig. 10 Preliminary User Evalution Played With Timer Option

In the second stage of the evaluation, the same 15 participants were required to play with the timer option. For the beginner level, the participants were given 4 minutes to complete the game. For the intermediate level, the participants were given 3 minutes to complete the game. For the expert level, the participants were given 2.5 minutes to complete the game. Fig. 10 shows the result of the second stage of the evaluation. The result shows that 12 participants were able to complete the game within the given time period for the beginner level, 4 participants were able to complete the game within the given period for the intermediate level and only 2 participants were able to complete the game within the given time period for the expert level. This proves that the less time allocated to complete the game, the difficult the game can be.

The results from both stages of the evaluation show that the higher the difficulty level chosen, the more time taken to complete the game. Together with timer option, this mobile game application gives a more challenging way of playing the game.

VI. CONCLUSION

Images captured from a mobile phone built-in camera are no longer being used only for printing, sending MMS, transferring to personal computer (PC) or setting as wallpaper. It can also be used in games such as picture puzzle game as a medium for entertainment. The developed personalised mobile picture puzzle provides its player to capture an image using the built-in camera phone in which the player needs to scramble the image in order to start the game. This paper has highlighted that the developed personalised mobile picture puzzle is able to give the player a more challenging experience in playing a picture puzzle game. Such gaming experience is possible with the personalised feature together with other features such as the difficulty level and the timer function. We use J2ME technology and MIDP 2.0 specifications to develop the personalised mobile picture puzzle game. MIDP 2.0 provides persistent storage through its Records Management System (RMS) storage and the gaming API of J2ME. The Mobile Media API is used to capture images using built-in camera phone. We used the TiledLayer class from the MIDP Game API package to scramble the image into equally-sized tiles. Although there are variations of mobile picture puzzle in the market, the difference between these applications lie in a number of factors such as mobile game features, system development approach and many others.

There are many directions in which the authors would like to extend the study reported in this paper. The functionality of the developed mobile game application can be extended by including a ranking function. The ranking function should allow the player to save his/her achievement in terms of the user's name, the time taken to complete the game and the game's level of difficulty. The mobile game application may also include interactivity in which multiple players with more than one mobile devices being used.

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