The University of Hong Kong
Department of Computer Science

COMP4801 – Final Year Project

Interim Report

FLEXIBLE GAMING WITH MULTIPLE CONNECTED DEVICES – DRAGON MYTH

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Abstract

This document is an interim report for a final year project titled ‘Dragon Myth’, a computer-platform game, relating to how multiple electronic devices can be connected to perform a special gaming environment about dragon boat sports. The purpose of this report is to document the various phases of development for the project.

This gaming project is mainly built on Somatosensory and Virtual Reality technologies by a game engine called Unity. It is researched, designed and implemented by using C# and JavaScript. Kinect and smartphone are the key devices for this project. By moving hands in specific tracks and beats, players can control the speed of dragon boat. Extra gaming features will be implemented to this project in the future such as multi-players competition. This project is the first dragon boat somatosensory game.

The current status is at the implementation phare. The game is now containing self-training and part of player versus bot competition. The prototype of the game has been done. Guests can enjoy the prototype of the game. With the problems encountered, the author decides to use 2.5 dimension instead of 3 dimension graphics models at this stage. In the future, more and more new features will be added to extend the game. Hopefully, it will provide a game experience that never occurred before.
Acknowledgements

The author wishes to thank Dr. Chim T W for being the supervisor of this project and his valuable advice.
Contents

Abstract ........................................................................................................................................ P.2
Acknowledgements ..................................................................................................................... P.3
Contents ....................................................................................................................................... P.4
Abbreviations ............................................................................................................................... P.5
List of Figures ............................................................................................................................... P.6
List of Tables ................................................................................................................................. P.7

1 Introduction ................................................................................................................................. P.8
   1.1 Report Outline ...................................................................................................................... P.8
   1.2 Project Outline ..................................................................................................................... P.8
   1.3 Aims & Objectives of this project ...................................................................................... P.9
   1.4 Motivations of designing this project ................................................................................ P.9

2 Background ................................................................................................................................ P.10
   2.1 Definition of Somatosensory Game .................................................................................. P.10
   2.2 Introduction to Dragon Boat ............................................................................................. P.11

3 Methodology ............................................................................................................................... P.12
   3.1 Connected Device - Kinect ............................................................................................... P.13
   3.2 Connected Device - Smartphone ...................................................................................... P.14
      3.2.1 Function performed by Smartphone - VR .............................................................. P.14
      3.2.2 Function performed by Smartphone - AR .............................................................. P.15
   3.3 Connected Device - Smartwatch ...................................................................................... P.15
   3.4 Implementation .................................................................................................................... P.16
      3.4.1 Choice of Game Engine ............................................................................................. P.16
      3.4.2 Programming Languages Implemented .................................................................... P.17
      3.4.3 Graphics Implemented ............................................................................................... P.17
   3.5 Story of the Game ................................................................................................................ P.17

4 Limitations & Difficulties Encountered .................................................................................... P.18

5 Current Stage ............................................................................................................................. P.19

6 Future Plan ................................................................................................................................ P.20

7 Conclusion ................................................................................................................................. P.21

References ..................................................................................................................................... P.22
## Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3D</td>
<td>Three-dimension</td>
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<tr>
<td>AR</td>
<td>Augmented Reality</td>
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<tr>
<td>PVP</td>
<td>Players Versus Players</td>
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<tr>
<td>UE</td>
<td>Unreal Engine</td>
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<tr>
<td>VR</td>
<td>Virtual Reality</td>
</tr>
</tbody>
</table>
List of Figures

Figure 1: Standard Model (top) and Small Model (bottom) of dragon boat for International Dragon Boat Festival……………………………………………… P.11

Figure 2: Pictures of the function of Kinect. (left) Showing the components installed in a Kinect. (right) Showing the real image captured by Kinect………………… P.13

Figure 3: The PokemonGO mobile application applies AR technology………… P.15
List of Tables

Table 1: Comparison between Unity3D and Unreal Engine.................... P.16

Table 2: Timetable of the future plan............................................. P.20
1 Introduction

This section presents the report outline, project outline, the aims and the objectives, and the motivations.

1.1 Report Outline

This report presents the report outline, the project outline, the aims and the objectives, and the motivations. Followings are the background information with the aspects of somatosensory game and dragon boat. After that, each of the devices using are discussed in project overview section. Limitations, difficulties, things accomplished and the plan are coming after the project overview. The project is in development stage which is implementing coding and graphs.

1.2 Project Outline

The description of the project is going to be listed. Dragon Myth is the project name because it is about dragon boat sports game. Computer is the game console. Unity3D is the game engine used for building the whole project with the supported programming language C# and JavaScript. As the project is about multiple connected devices, Kinect, smartphone and smartwatch are three of the main devices used in the project. In this project, the key words are games, sports, dragon boat, somatosensory, Virtual Reality (VR), beats, training program.

One of the reasons why many computer sports games are not popular is the over-simplicity. This project looks at using multiple connected devices to control the paddles and the speed of dragon boat, according to the actions of player and the beat of the game. PVP and training feature are the main parts of this game. Playing game can be fun and not just for people sitting in front of the screens.
1.3 Aims & Objectives of this project

As described in the project plan, this project aims to develop a dragon boat simulation sports game which makes players enjoy a new gaming experience with multiple connected devices and to introduce and promote dragon boat to the public. The primary objectives can be divided into four points.

First is to create the first dragon boat simulation game. After searching the game stores of computer, smartphones, PS4 and Xbox, no dragon boat simulation sports game was found. It means that this project is the first one. Second is to provide different gaming experience and VR experience of dragon boat. As a real dragon boat simulation game, players need to be part of the game. Therefore, adding VR feature can enhance the gaming experience of the simulation. Third is to promote the idea of that gaming is not only sitting and pressing buttons but also doing actions. Many players play games all the day without regular dinning time and sports time. This situation brings them unhealthy bodies. This project hopes to change the thought of them. Last but not least, to promote dragon boat sports to the public. Most of the residents living in Hong Kong do not know that dragon boat competition is widely popular among many places around the world.

1.4 Motivations of designing this project

They are similar to the aims and objectives as there are from the motivations. The original motivations to design this project are to promote dragon boat sports, to create the first dragon boat somatosensory game and to develop a dragon boat training program for those athletes who cannot attend the practices. Moreover, as author has 4 years experience in the Dragon Boat Team of the University of Hong Kong, dragon boat sports becomes part of his life and he wants to pass on the spirit of the dragon boat.
2 Background

Nowadays, it is easy for a person owning multiple electronic devices such as smartphones, desktop computer, wearable devices. It is because old devices are replaced by new and high-tech devices. Those new devices have been installed with diverse kinds of powerful hardware and software. Many people enjoy playing electronic games with new smartphones [1] at home, on the transportation or wherever because of convenience. These lead game developers mainly focus on developing various games in on console controlled by single device. In this project, a somatosensory dragon boat game connected with multiple devices is presented.

2.1 Definition of Somatosensory Game

‘Somatosensory Game’ is a term used to describe a game controlled according to player’s actions and movements. Those actions and movements are sensed and captured by movement sensor such as Kinect instead of the traditional hand controller, for example mouse and keyboard. Game character interacts with player directly, mostly doing the same motions, through related actions done by player. Most of the games required player to jump, shake hands, dance etc.
2.2 Introduction to Dragon Boat

Dragon boat is a traditional Chinese team sport played by a group of people. The common dragon boat in Hong Kong is small boat and standard boat (see Figure 1). 10 and 22 people sit on the boat respectively. By using paddles, players can speed up the boat to win competitions. Team spirit, communication and tacit understanding are the most essential elements. It becomes popular in Hong Kong recently as more and more competitions were held throughout the year. These elements are the concern of building different features of this project such as real time chat room and keys to win.

![IDBF INTERNATIONAL RACING DRAGON BOAT – Standard Model 1222](image)

![IDBF – INTERNATIONAL RACING DRAGON BOAT – Small Model 912](image)

Figure 1: (top) Standard Model and (bottom) Small Model of dragon boat for International Dragon Boat Festival.
3 Methodology

Kinect, smartphone and smartwatch are used in this project as the multiple connected devices. This section presents each choice of devices and their features.

This project contains experimental and developmental methodologies. In the experimental methodology, data was collected by inviting 20 players from all ages. They were requested to perform the paddling and drumming motions. All motions were captured by Kinect. Data was sent to the computer and perform calculation to predict this project algorithm and repeated testing. For the developmental methodology, there are four stages. They are concept, designing, implementation and testing phases. All devices are connected to the computer. The computer is the main console and the processor handling the calculation.

The motion of players’ fists are going to be detected and capture for the calculation by Kinect. By calculate the distance travelled, the speed of boat will be increased or decreased for each paddle. Distance Formula can be applied.

\[ d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2 + (z_2 - z_1)^2} \]

where \( d \) is the distance between the starting point and the ending point, \( x_2, y_2 & z_2 \) are the 3D-coordinates ending points, and, \( x_1, y_1 & z_1 \) are the 3D-coordinates starting points.

As the development of algorithm is still in progress, it cannot be shown at this moment. However, the algorithm can be affected by some special elements like wind, wave, synchronization and etc.
3.1 Connected Device – Kinect

As a motion sensor, Kinect (see Figure 2) detects player’s motions, including hands and body. After calculation on computer, the game character representing player does this same paddling action and accelerates the boat. Images captured by Kinect are reflected in the Unity3D. The game engine matches the respective bodies such as hands. The game character paddles when player paddles. As player cannot perform same motion every time, correction and motion prediction are performed if the motion paths are similar to each other. Otherwise, the speed of the boat will be slowed down.

![Figure 2: Pictures of the function of Kinect. (left) Showing the components installed in a Kinect. (right) Showing the real image captured by Kinect.](image)

Kinect is common and it is easier to be programmed. It does not require any data input but action. It supports voice recognition, facial recognition. Sound and face can be sensed by Kinect and response to the computer program. However, as Kinect is easier to be programmed, it is also easily hacked. At this point, network security is one of the concerns in this project [2]. Updated firewall and data encryption are used to handle network security concern. Firewall is the main gate to protect the system from being hacked. It has to be updated. Even Kinect is hacked, the hackers cannot use the encrypted data unless they have this project’s decryption key. The decryption key is generated by the author. Therefore, those actions can handle the security problem. Kinect can be used in many platforms, like computer and Xbox. PlayStation®Camera is similar to Kinect, but it supports less platforms and not easy to implement for a computer game [3]. Kinect is the suitable choice for this project.
3.2 Connected Device – Smartphone

Smartphone is a device for holding a chat room and being a vibrator of the game. As it is common for people to have at least one smartphone in this age, the view of VR can be displayed through smartphone and the feature of Augmented Reality (AR) can be implemented in parts of the game.

3.2.1 Function performed by Smartphone – VR

VR is an experience that people do not actually feel or touch. It is a Three-dimension (3D) digital world created by computer and the things in that world are displayed through certain devices. By wearing the devices, players experience as they are living in that world [4]. There is a built-in support on Unity for some specific devices [5]. With the technology of VR, player of this game can enjoy the real-like dragon boat competitions or training sections as it seems they are sitting on the boat.
3.2.2 Function performed by Smartphone – AR

AR is a technology that integrate the real world and the digital world (see Figure 4). It is different from VR. AR is adding a digital layer on top of the real world through devices [6]. Parts of the project is displayed with AR to enhance the interest of players such as showing a 3D dragon boat and a paddle.

![Figure 3: The PokemonGO mobile application applies AR technology.](image)

3.3 Connected Device – Smartwatch

Although smartwatch is not that easy to find in normal family as it is not an article for daily use, it is still included in this project. It is because new game features can be added in the future by using smartwatch to play. The main function of smartwatch is vibration and as a microphone. It reminds players to stop or the beat is missed during the game. It acts as a microphone for real time communication between players.
3.4 Implementation

This section talks about the game engine, programming languages and graphics programming used in this project. Each is presented detailed in the following.

3.4.1 Choice of Game Engine

<table>
<thead>
<tr>
<th></th>
<th>Unity3D</th>
<th>Unreal Engine</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Programming Language</strong></td>
<td>C# or JavaScript</td>
<td>C++</td>
</tr>
<tr>
<td><strong>Interface</strong></td>
<td>Easy to use, quick and responsive</td>
<td>Quite bloated and complex</td>
</tr>
<tr>
<td><strong>Cost for Full version</strong></td>
<td>$1,500 USD</td>
<td>5% of income if more than $3,000 USD per quarter</td>
</tr>
</tbody>
</table>

Table 1: Comparison between Unity3D and Unreal Engine

Unity is the game engine of this project. **Unreal Engine (UE)** is also good for being game engine for this project (see Table 1). Unity uses mostly C# or JavaScript while UE uses C++. C# has the flexibility and ease of use of Java. It makes for more robust and flexible way of extending this project in the future [7].

Both Unity and UE have an asset store which sells different powerful game assets for free or certain prices. Both provide vast numbers of plug-ins and extensions for this project. However, Unity’s asset store provides more options for programming Kinect and other electronic devices. Therefore, the game engine of this project is Unity with its high cost-performance ratio.
3.4.2  Programming Languages Implemented
As Unity is the game engine of this project, C# and JavaScript are used. In this project, C# is the most programming language used. Both C# and JavaScript support Unicode and Interpreter. C# is suitable for in-game design and JavaScript is fit for web browser applications. With the features of automatic memory management and safe conventions of codes, C# is best fit for project [8].

3.4.3  Graphics Implemented
Graphics is the main topic to attract more players. 3D graphics are used as the game provides VR and AR functions. The dragon boats and related tools were captured from real life. Author is going to use a software called “Blender”, a 3D modeling design software. Dragon boats model will be created by this software.

3.5 Story of the Game
Becoming the dragon boat world champion is the main storyline. Through different trainings and competitions, players’ characters will be stronger and faster. According to the level skilling up, various ranking and rewards will be unlocked such as new team jackets, paddlers and dragon boat. Player is from an unpopular dragon boat team at the beginning. After several trainings, he or she must face with their first competition. This is the start of player’s journal.
4 Limitations & Difficulties Encountered

This project is handled by one person. Timing and knowledge are the most concerns. Also, as discussed with different teenagers randomly, few teenagers have all Kinect, smartphone and smartwatch at home. Most of them have smartphone only. It makes this project harder to promote the game to the majority.

Besides, when author handled the data of Kinect, the data is not easy to be processed. More than that, graphics handling and the view of AR are also big problems in this project. As 3D graphics is using, other components of the game have to be in 3D too. The time of processing and making 3D models increased. This also affect the view of AR as AR is kind of 3D graphics mixed with the reality layer. However, AR and VR will be implemented in the future.

The game is designed for online competition. However, latency of the signals in the networks and between Kinect and computer is the big problem. Once the huge data transmitted, the latency occurred.

As the project has to be done within limited time, 2.5 dimension or 2 dimension graphics will be decided to use so as to handle the problems of 3D graphics. 3D graphics will be used in the future. It is because the author expects to show the real objects and background as 3D models. To solve the latency problem, author expects to use large bandwidth to minimize the latency of networks and use the simpler algorithm and universal serial bus 3.0 (USB 3.0) to minimize the signal latency between Kinect and the computer. The above solutions are still in the progress.

The core part of the game is the algorithm. It is needed to be concerned that there will be many different paddling paths from various players by using either right hand or left hand as their main-using-hand. Simpler algorithm is the solution. It is still in the progress to handle the algorithm of the game.
5 Current Stage

Implementation phare is the current status. The game is now containing game menu which can be controlled by Kinect or keyboard and self-training section. The idea is that player can act as either drummer or paddler in each simple game. For self-training, player has to follow the beat given by the computer. Once the beat comes, player performs the action of paddling or hitting drum. After player paddles 100 meters, result showing the accuracy of the beat is displayed. The other game section which will be implemented afterwards is the player versus bot competition. It is similar to self-training, but without the beat bar. In the prototype, player has to competition with a static bot programmed with same data. It will be random as the development stage goes on. Planning, designing and part of data collection were done. The prototype of the game is done and the algorithm is improving. The focus now is on algorithm of motion detection and calculation. Player’s fists are the main part for detection. As each paddle is almost vertical movement, the idea of the calculation is to capture the path of those fists and analyze it. The speed of the boat will be reduced because of deviation.
6 Future Plan

<table>
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<tr>
<th>Timetable</th>
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<tbody>
<tr>
<td><strong>Current</strong></td>
</tr>
<tr>
<td>28-31 Jan</td>
</tr>
<tr>
<td>1-28 Feb</td>
</tr>
<tr>
<td>1-15 Mar</td>
</tr>
<tr>
<td>16-31 Mar</td>
</tr>
<tr>
<td>27-31 Mar</td>
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<tr>
<td>1-13 Apr</td>
</tr>
<tr>
<td>16-20 Apr</td>
</tr>
<tr>
<td>2 May</td>
</tr>
<tr>
<td><strong>Future</strong></td>
</tr>
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Table 2: Timetable of the future plan

The future plan is scheduled (see Table 2). This is a new version after discussing with the supervisor and working. There will be two more major tests in January and April. Improvement of data handling of competition part and graphics will be scheduled on February and March respectively. New features will be added such as online voice-chat room if possible. VR and AR will be implemented in the future. Players will be invited again to test and give the reviews in March. Final project presentation will be held on April. Last but no least, the project exhibition will be held on May.
7 Conclusion

This game is developmental and experimental project. After the development of this game, at least 10 guests will be invited to test the game. This game will be the first somatosensory dragon boat game which is designed for all ages to experience a different type of gaming and the traditional sports of China. Unity and C# is used for development. It is currently the first somatosensory dragon boat game providing PVP and trainings features. In the future, different languages will be implemented and more new features such as new boats and skill tree system will be supported.
References


