COMP4801 Final Year Project

A 3D Game to Raise the Teenagers' Awareness on

Cybersecurity

FYP19040 Interim Report

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Abstract

With the rapid increase in the numbers of cybercrime occurrences, educating the general public, especially the teenager group, about the concept of cybersecurity proves more important now than ever. In response to this need, this project proposes a 3D VR game to serve as an educational tool to raise the awareness of general public on cybercrimes. HTC Vive set will be used to provide the VR environment needed, and Unity game engine will be adopted to complete the 3D setting. Currently, all the basic FPS survival game capabilities have been implemented, and future work will be conducted to incorporate VR settings and develop supporting features. These future work include modelling of more weapons and enemies, as well as implementation of leaderboard function and login system.

Acknowledgement

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Abbreviations

Three-dimensional: 3D

Virtual reality: VR

Operating system: OS

User interface: UI

1 Introduction

The following section introduces this report. Firstly, a brief background on cybersecurity will be given. The motivation of this project and related inspirations are also presented below, followed by an outline of the report content and structure.

1.1 Background

Over the recent decade, the general public have started relying on digital devices at an increasing scale due to the rapid technological advancements. With the increase in dependence on digital devices, escalation in the numbers of cybercrimes has also come along. Millions of people have been victims of cybercriminals without even noticing, as suggested by the fact that there were almost 700 million people suffering from cybercrimes in 2018 [1]. Currently, cybercriminals generate revenues of $1.5 trillion annually, and this statistic is anticipated to continue growing, with the total damage of cybercrimes costing $6 trillion annually by 2021 [2]. Among these many victims, teenagers is suggested to be the major age group that is fueling this growth, as they usually have the highest amount of exposure to non-evaluated applications, which are usually the sources of cybercrimes, making them the most vulnerable [3]. In view of the above situation, raising the awareness of the general public, especially the teenagers, on cybersecurity proves more important now than ever.

In order to efficiently explain and teach the teenager group about the concept of cybersecurity, game is chosen as the way to convey the message, particularly 3D VR game. VR is the concept of simulating human experience that can be similar to or completely different from the physical reality. 3D environment and VR both possess advantages for learning over other types of games, mostly because of their visual,

auditory and spatial elements which result in better recall for players on what they have learnt [4]. Moreover, the immersive setting created by them helps learners involve emotionally into the game due to realism, hence enhancing the learning experience further [5].

In the aspect of 3D game, the fundamental concept of this project is inspired by the 3D game "Watch Dogs" after reviewing its idea of introducing hacking technology into a game (see Figure 1). Its protagonist, who is a proficient hacker, will make use of cyber-abilities such as identity framing to achieve various tasks, and in the process it actually reflects how powerful or dangerous misuse of digital data could be, hence bringing up the importance of cybersecurity. On the other hand, in the aspect of VR game, the type of this project is inspired by the VR game "Rec Room" (see Figure 2). It features a VR world in which players could navigate around a social sandbox of places, and in different places players may engage themselves into various mini-games. After reviewing its mechanics, many would understand why VR game could provide a more immersive environment than other types of game. With the help of devices such as HTC Vive, players' physical movements actually translate into the game, causing them to feel like they are really interacting inside the virtual world.
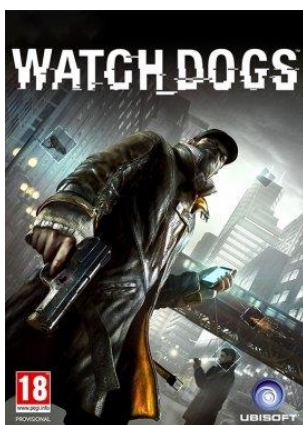

Figure 2: Rec Room

Figure 1: Watch Dogs

1.2   Objective and Scope

The objective of this project is to teach the general public, particularly the teenager group, about the nature, types and adverse effects of cybercrimes if they do not maintain a better cybersecurity. Consequently, it should be able to help players better detect the occurrence of cybercrimes and protect themselves, or even protecting others from suffering from these crimes, and eventually combatting cybercriminals together.

This project will feature a 3D VR world in which player will be acting as a cyber-police. The sole aim of the player is to survive as long as possible under the ferocious attacks launched by all kinds of cyber-criminals and gain as many points as possible before he/she dies. Different types of cyber-criminals will be modelled as different enemies. For instance, hackers that launch malicious code injection (the exploitation of computer bugs that are caused by introducing malicious code into a vulnerable program to change the course of execution) will be modelled as cyber soldiers with rifles that can shoot out malicious code in the form of lasers. On the other hand, different security tools will be modelled as different weapons for the player. For example, firewall, which refers to a combination of hardware and software that isolates an organization's internal network from the Internet, will be modelled as a virtual wall that blocks the path of the enemies for a fixed period of time. At the start of the game, player will have default weapons such as blasters and toxic masks to kill or defend against enemies, but as the game progresses and player kills more and more enemies, he/she will gain points and the difficulty level will rise. As the level rises, more and more enemies will be spawned, but at the same time, player will start to be able to pick up upgraded weapons such as the firewall mentioned just now to enhance their survivability. Once the player's health reaches 0, he/she dies and the game ends.

First of all, the target audience of this game is teenagers, ideally aging from 12-18, as they are the most vulnerable age group towards cybercrimes. Secondly, it will be a single-player game. Furthermore, as this game also incorporates 3D and VR elements as mentioned above, HTC Vive set will be utilized as the VR equipment to realize the VR setting while Unity will be employed to manage the 3D aspects. Last but not least, a number of the most prevalent cybercrimes, such as man-in-the-browser attack and cross-site scripting, will be adopted as the models of enemies. However, in the long term, more and more types of cybercrimes will be added in so as to keep players updated with the current development of cybercrimes and better equip them against newly emerging ones in the future.

1.3   Report Outline

The remainder of this paper is organized as follows. Firstly, Chapter 2 details the methodology used in this project, including a description on the VR equipment used and game engine adopted. Following in Chapter 3 is an explanation of the current progress, which includes the modelling and implementation of enemies. Then, the difficulties encountered during the development of this project will be listed in Chapter 4, such as the modelling of different characters and development of path-finding system. Next, the future work plan is given in Chapter 5 as the development tasks of final product are illustrated. Lastly, a short conclusion is provided in Chapter 6.

2   Methodology

2.1   *Equipment and Set-up*

This project will make use of HTC Vive set as its main tool (see Figure 3). By using HTC Vive Headset, a VR environment could be simulated for players to interact with. On the other hand, HTC Vive Base Stations will help with the motion tracking of players while HTC Vive Controllers will aid players to control their in-game characters.

Figure 3: HTC Vive set

2.2   *Game Engine*

This project will be using Unity as its game engine. Unity is a cross-platform game engine that is supported by more than 25 different platforms, which virtually means that most of the OS could run Unity games. Moreover, Unity supports both 3D and VR games, therefore it is perfectly suitable with the theme of this project. However, as Unity VR games that make use of HTC Vive set only support Windows OS [6], Windows Platform will be used as our development platform this time. Last but not least, C# will be adopted as the scripting language for this project as Unity only supports C# language currently.

2.3   *Supporting Features*

A leaderboard function will be implemented to compare and show each player's highest

score over the course of gaming to increase the incentive for players to play the game. The competitiveness introduced by this function will be used as a driving force for players to continue equipping themselves with cybercrime knowledge. On the other hand, a database system will also be implemented to record the scores of every player, and Firebase will be used in case of actual implementation.

3 Current Progress

This section details the work that has been done throughout the early development stages. As of today, all the basic FPS survival game capabilities have been firmly implemented. Firstly, the virtual game scene of the project will be illustrated. Then, the implementation of the FPS character that will be controlled by players will be described, followed by the modelling of different enemies. Last but not least, the enemy manager will be mentioned as a closing for the section.

3.1 Virtual Game Scene

The prefab materials for the game scene were imported from the Unity Asset Store. With several design attempts and careful arrangement of these prefabs, the scene is constructed to embrace both cyber and industrial atmosphere, so as to allow players to grasp a realistic feeling that they are really surviving in a virtual cyber world (see Figure 4). It incorporates a lot of tunnels and shelters to enhance the sense of multi-level; moreover, barricades are introduced to increase the complexity of the map. In the later stages of development, more features will be added into the scene to continue perfecting it and provide a more immersive experience to our players.
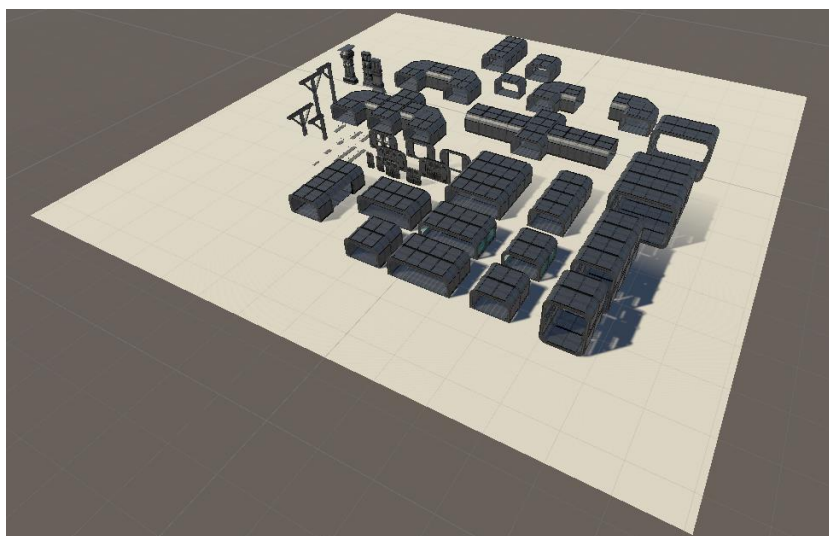

Figure 4: Virtual Game Scene

3.2 Player FPS Character

A FPS in-game character for the players with full set of movement controls such as normal walking by "WASD" keys, jumping, sprinting and crouching have been implemented (see Figure 5). There is also a roster of weapons for the character to choose from and utilize, including revolver, shotgun and rifle. The associated animations for the weapons have been created, and animator controllers for controlling the transitions between these animations have also been completed. However, as this set of weapons is only for the early stages of testing during the development of the character, it will most probably be replaced by weapons that are more suitable for the cyber theme in the future.
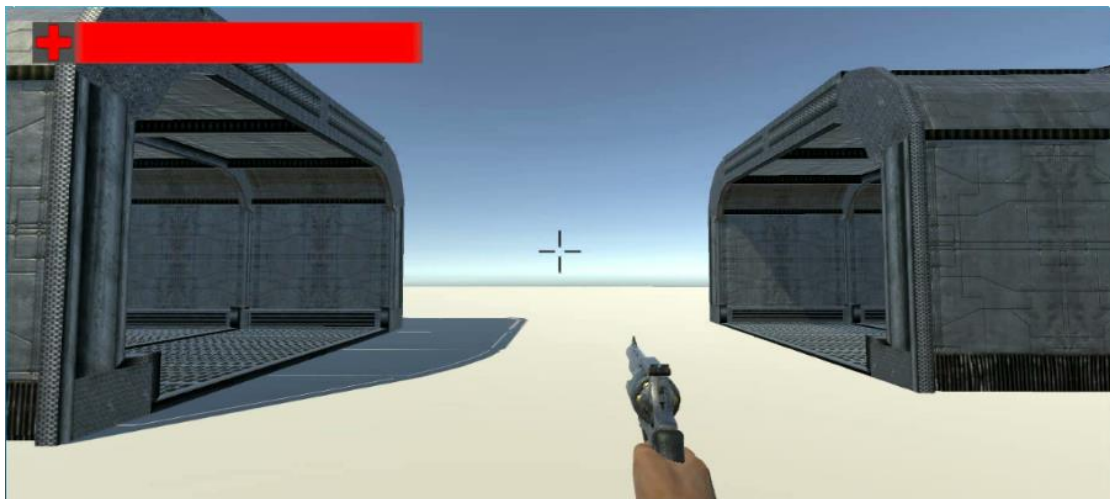

Figure 5: Player FPS Character

3.3 Enemies

Cybercriminals that launch man-in-the-browser attack (a form of Internet threat that infects a web browser with Trojan horse malware by taking advantage of the vulnerabilities in browser security to modify web pages or transaction content) have been modelled and implemented (see Figure 6). They are modelled as cyber soldiers with horse masks to symbolize both the hacker and the Trojan horse. Same as the player

character, all movement controls and animations have been implemented, and their attacks are simple head-butts that utilized their long heads. Furthermore, they have proper path-finding mechanism to auto-chase the player all around the map.

Figure 6: Man-in-the-browser Enemy

3.4   Health System

Health system has been implemented for facilitating the interactions between player and enemies. A health bar UI has been created to show how much health of the player has been deducted when enemies damaged the player. When the health bar disappears, it means that the player's health has reached 0 and that he/she has died. With this same health system, enemies' health could also be properly monitored such that players could kill the enemies by reducing their health to 0.

3.5   Enemy Manager

An enemy manager has been implemented to auto-spawn enemies in designated spawn points and respawn them according to the difficulty level after they have been killed.

4   Difficulties Encountered

4.1   Characters Modelling

As I had limited experience on modelling 3D characters for Unity, creating custom-make characters using software such as Blender significantly increases the workload. After several trials with unsatisfactory modelling results, combination of different models acquired from the Unity Asset Store and Mixamo website to construct desirable character models has been adopted. This method successfully constructed the model of man-in-the-browser enemy, which combined the cyber soldier model from Mixamo (see Figure 7) with the horse mask model from Unity Asset Store.

Figure 7: Cyber Soldier model from Mixamo

4.2   Path-finding Mechanism

During the development of path-finding system for the enemies, the first approach adopted was to embed a script that made the enemies constantly facing the player and

running in that direction. This approach was soon replaced as it would cause the enemies to bump into walls and be stuck there. Second approach was to add NavMeshAgent into the enemies and set the destination to be the player. This is a more mature approach that most of the path-finding mechanism in Unity usually choose. However, after choosing the objects that would be navigation static and baking the NavMesh area, enemies could not get into tunnels to chase the player. After some research, I finally discovered that the agent step size was too low for the enemies; therefore, the step size was raised and the enemies were eventually equipped with proper path-finding mechanism to auto-chase the player in the virtual world.

5   Future Work

Since all the basic FPS survival game capabilities have been implemented, implementation of VR settings will be the core focus in the coming month. In addition, current set of weapons for the player will be replaced by more suitable ones, therefore modelling of new weapons will also be completed in the weeks to come. Moreover, more kinds of cybercriminals, such as computer virus and cross-site scripting, will be modelled and implemented on top of the current type of enemies to increase the diversity of the game. Lastly, supporting features such as leaderboard function and login system will also be researched and incorporated in the future (see Table 1).

Task	Deadline
Deliverables of Phase 2 (Elaboration) ● Detailed interim report	2 February 2020
Development of final product ● Implement VR settings ● Model new weapons and enemies ● Incorporate supporting features	24 March 2020
Final testing and amendments	31 March 2020
Deliverables of Phase 3 (Construction) ● Finalized tested implementation ● Final report	19 April 2020
Final presentation	20-24 April 2020
Project exhibition	5 May 2020
Project competition (for selected projects only)	3 June 2020

Table 1: Project Schedule

6   Conclusion

Cybersecurity is an issue that has been proven more important now than ever due to the ever-growing trend of cybercrimes in recent decade. This paper proposes a 3D VR game for learning essential knowledge about cybercrimes in a contented way with details on its methodology, development schedule and others. Virtual game scene has been designed and incorporated, and characters modelling have been completed. Continuing the development, path-finding system for enemies to auto-chase the player have also been researched and implemented, while the implementation of VR settings is still ongoing.

In spite of the limited roster of weapons to be chosen by players currently, more new weapons and enemies are to be modelled and implemented in the coming month such that the diversity of the game could be enhanced. Moreover, with the incorporation of VR settings completed in the coming month as well, a captivating 3D VR survival game will likely be realized so as to provide a fascinating gaming and more importantly, learning experience to the players.

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