



**COMP 4801**  
**Final year project**

**Final Report**

A 3D Game to Raise Teenagers' Awareness on  
Cybersecurity

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# Abstract

With the gaining popularity of technology, there are more and more Internet users. Teenagers is by far the largest group of Internet users. However, with the increasing internet usage, there are lots of trickery and deception that comes with it which cannot be ignored. This project aims to educate teenagers about Cybersecurity through a fun and interactive 3D game, such that they would not fall into any cyber traps. This paper includes a full picture of the game developed. Mechanisms, storyline, game design, results etc. are included in this paper.

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# 1. Introduction

## 1.1 Project Background

Internet plays an important role around the globe. According to the Digital 2019 reports from Hootsuite and We Are Social, there are 4.39 billion users in 2019 [1], which is more than half of the world population. Internet allows people to communicate with one another, shop online, find resources, be entertained, and many other things. Although it is convenient and useful, there are hidden risks. People may already be aware of some large scale incidents including leakage of clients' data of Faster Payment System, Cathay Pacific or TransUnion [2].

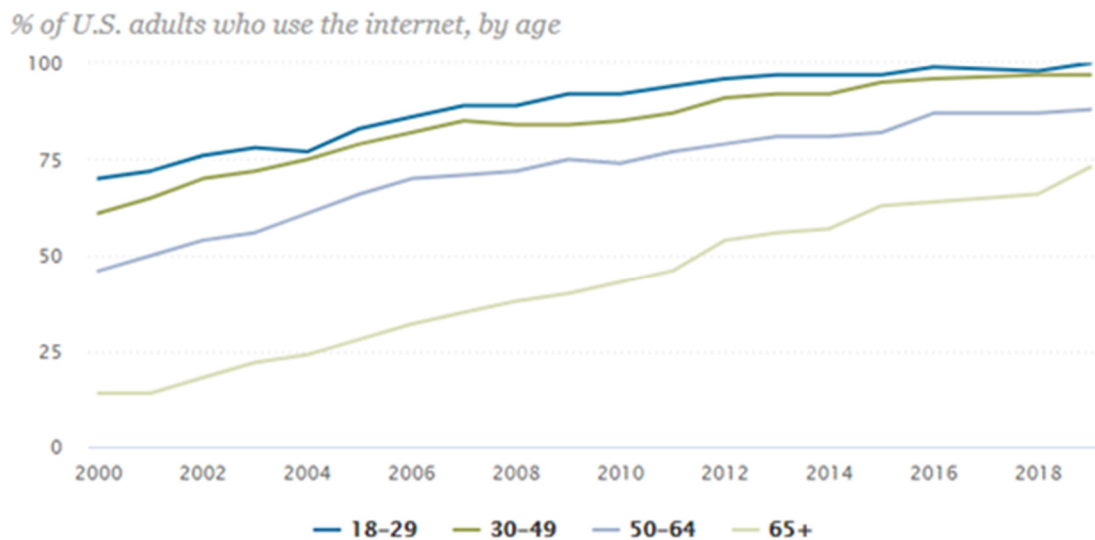


Figure 1. Internet use by age in United States [3]

As shown in Figure 1, the number of internet users increases with increasing age. In 2018, the internet users in age group 18-29 reached 100%. Though not shown in the graph, it is believed that the percentage of teenage Internet users would be as high as age group 18-29.

## **1.2 Project Objectives**

This project aims to raise the awareness of teenagers towards cyber security through interactive games. Through the course of this game, teenagers can gain more knowledge about cyber security. Subsequently, by making use of the knowledge learnt in our games, they can avoid falling into the traps of cybercrimes.

## **1.3 Target Audience**

This project is targeting teenagers. A report provided by Pew Research Center shows that 90% of teenagers play video games [4]. It shows that video games are attractive towards teenagers. It is proved that playing games is an effective way to learn [5]. Since there is a need of educating people towards cybersecurity, and most of the teenagers are Internet users, it is certain that our game will post great effectiveness towards teenagers.

## **1.4 Scope of the work**

This project focuses on providing cybersecurity knowledge through a captivating story of hacker to teenagers. Further details would be discussed in later parts of report.

## **1.5 Contributions**

Most of the text-related work is done by me while I also take part into writing scripts especially in the maze generator. Besides, I am responsible for designing what assets to use in the scenes and construct the scenes according to the story. Chong is responsible



of most of the scripts. So our works distributions cannot be clearly divided as we would help each other.

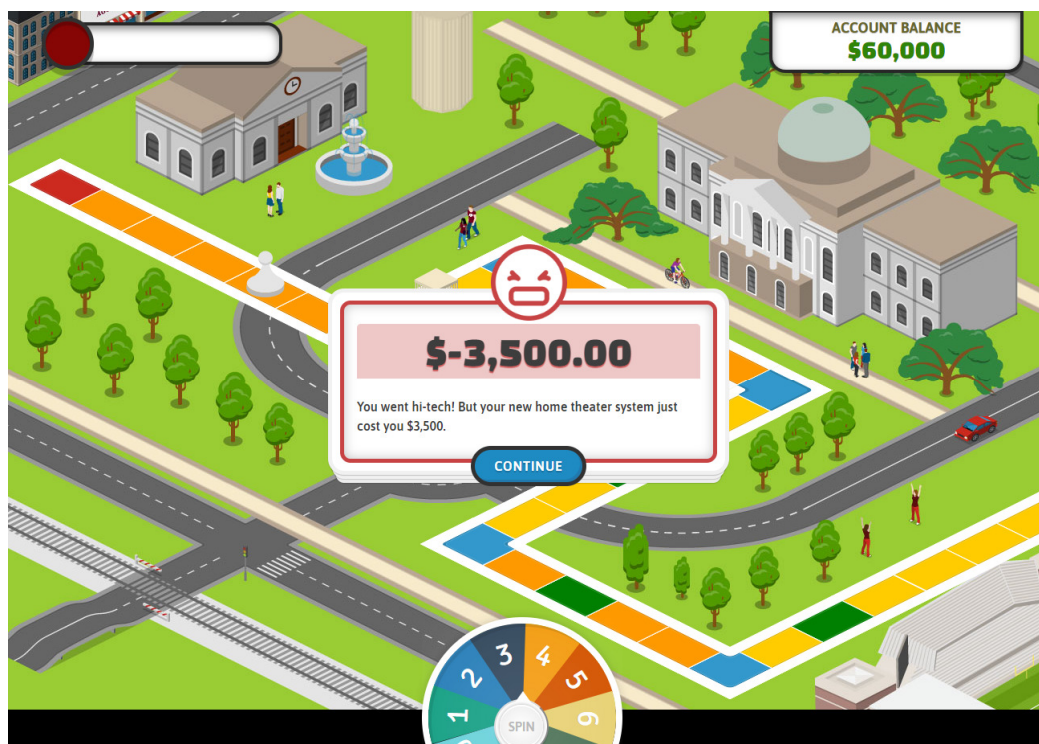
Items	Bin	Chong
Mini-game 1 - Hacking	50%	50%
Mini-game 2 - Breaching Firewall	90%	10%
Mini-game 3 - Social Engineering	50%	50%
Menu	0%	100%
Skill Page	0%	100%
Story & Dialogue	90%	10%
BGM	0%	100%
Scenes Design	90%	10%
Arrangement of Gameobjects in story scenes	90%	10%
Scripts implementation	20%	80%

*Table 1. Work Distributions*

# 2. Project Background and Literature Review

## 2.1 Current Situations

There are some cybersecurity-related games available on the Internet.



*Figure 2. Screenshot of Aggieflife*

The above is showing a Web online board game developed by Division of Information Technology in Texas A&M University. This game can be played on any devices that can access the Internet. As shown in Figure 2, the player have to spin wheel and move the chess according to the result. Then the player may need to answer some cybersecurity-related questions. The advantage of this game is that it each game is short. A few ten minutes can finish a game. However, the short game-play also cause a game to end aruptly when the player is just focused on it.



*Figure 3. Screenshot of Cybersecurity Lab*

Figure 3 is showing the Cybersecurity Lab which it is an online game developed by NovaLabs. The player participate in different kinds of mini-games to obtain scores. This game provides a good reference on how to link mini-games with cybersecurity which this project makes reference of it.

## **2.2 Origin of the Project**

The motivation of this project is the wide popularity of the Internet. The number of Internet users keeps increasing. It is a situation that cannot be imagined ten years ago. However, there are uncountable cases of cybercrimes happening every day. Besides, it is undeniable that some teenagers are addicted to the social media. Whenever the topics seem interesting, they will just click on it without thinking. It is not hard to worry that one day they will be tricked into clicking some malicious websites and meet cybercrimes. There should be someone teaching them the knowledge and I would like

to contribute to it so I started doing this project.

This project is desirable as cybercrimes are everywhere. On average, there is a hacker attacking someone every 39 seconds [6]. The importance of awareness against cyber security should not be underestimated. If one does not be careful, there will be more victims.

# 3. Project Methodology & Results

## 3.1 Game Engine

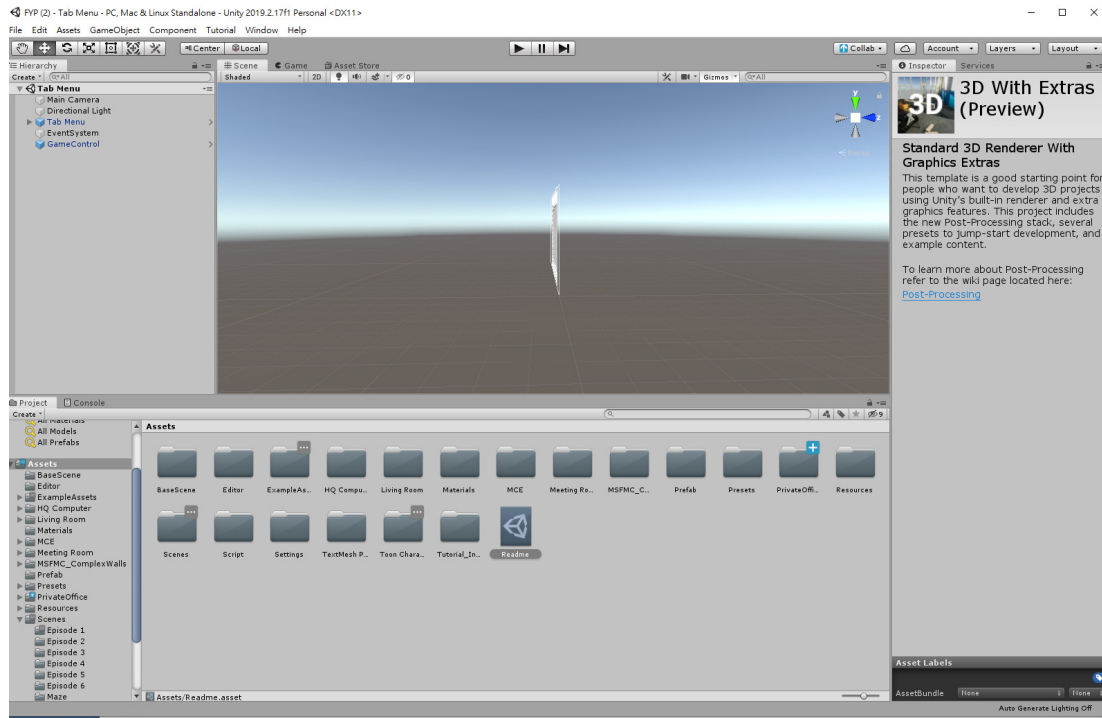


Figure 4. Screenshot of Unity Engine

Unity is chosen to be the game engine to develop the game. Unity is the most popular game engine around the world now. It includes a big assets store and plug-ins which provide a higher chance to find suitable assets.

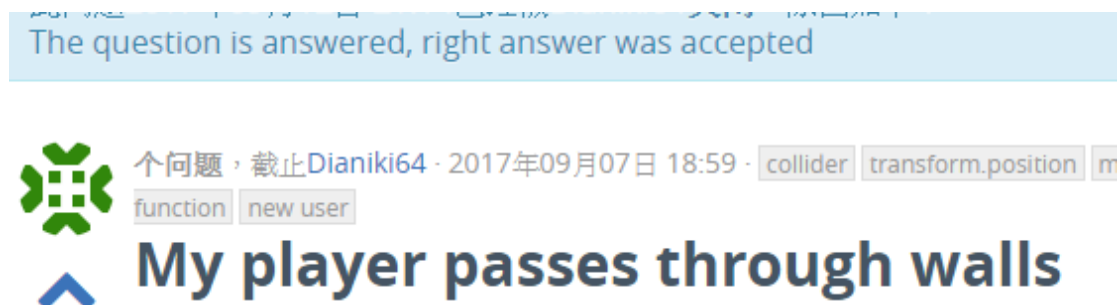


Figure 5. Screenshot of answered questions

Besides, with the popularity of Unity, some questions met while using the game engine can be found with ease as it was raised by someone previously just like what Figure 5

shown which shorten the time of finding solutions. As beginners of Unity, there are a lot of questions encountered that can be solved easily if the existence of some specific functions is known. Therefore, the popularity of Unity is indeed an advantage, since no matter how simple or complicated the question is, there would most likely be a solution or alternatives available online as there are other users who met the same problem.

## **3.2 BGM**

The Background Music of the game is downloaded from FesliyanStudios [7]. Although there are some more choices of BGM but they cannot be used due to copyright issues. There are a few criteria to make a suitable BGM for our game. First, it is a game related to cyber world, the style of music should be close to electronic or digital. Second, our audience are teenagers implying it should be brisk, so not classical music. Lastly, the atmosphere of the melody should induce excitement as the players are committing crimes in secrecy.

## **3.3 Story**

The main character (player) is a fresh graduate which was targeted to be a hacker. One day he received an email inviting him to join a hacker group. However, there was a test for the player to see whether he was capable to join them. The player was assigned to hack the computer of a person, named tommy. The player was told that tommy is a member of criminal group. With ease, the player hacked tommy's computer by injecting a backdoor software to tommy's notebook computer via an USB and was able to connect his computer using player's own computer (As my group mate is requiring the player to have knowledge on most commonly used password in 2019, to shorten the

time of guessing, the password of tommy's computer is abc123)

As the player hacked tommy's computer, he found out that Tommy was always communicating with another person called Jeff. After reporting to the anonymous the existence of Jeff, the player was told that Jeff is a partner of Tommy that means both of them belong to the same criminal group. So the next job of the player would be hacking Jeff's email. Since Jeff uses desktop computer and only works at office, it is difficult to inject virus to his computer, so email was chosen instead. The player was told that Jeff love drinking so the player went to the liquor shop to find Jeff and got his email through social engineering.

By the time the player met Jeff, Jeff told the player he knew who sent the player to him. Jeff knows that the anonymous is framing him and tommy to be a part of a criminal group as it is the usual practice of the anonymous group to treat their traitors. Jeff said that he committed crimes in the past but it was solely due to the anonymous' orders. That means that the anonymous group is a criminal group, not them. The reason why the anonymous sent the player to them is that Jeff as well as Tommy wanted to leave the group.

Jeff said that Tommy discovered the backdoor software before your access to his computer as they are professional hackers. Yet Tommy still let the player do it because Jeff and Tommy wanted the player to help them. In order to do that, they pretended to have a close relationship to lure the anonymous to send the player to Jeff.

According to Jeff, if the player continues to working for the anonymous, the player will be able to catch Jeff and Tommy eventually but then, the anonymous will pass the

player's information to the police which the player will be jailed so that no one can leak their information. Now that the player is under the order of anonymous that means the player still have the anonymous' trust, that is why Jeff invited the player to end the atrocity. As they need to prevent anyone from being suspicious of them, the player pretended to know nothing and got Jeff's email through social engineering.

After the player went back home, Jeff contacted the player through email and say they are closing in on the guy contacting the player (the anonymous) and they have a rough idea now. Jeff said that Dr. Chan, the professional in hacking and supervisor of the player in University maybe the anonymous. They could narrow down to him due to the appearance of the player, as the player is just a fresh graduate and not even had his first job, so he should not be known by a lot of people. Dr. Chan is the only reasonable suspect who knows the player's ability as he chose him.

By then, the player started planning how to trap Dr. Chan with Jeff. They aimed to bait Dr. Chan to Jeff's office by showing off the criminal records of Dr. Chan Jeff owns and set a camera to capture his actions of hacking Jeff's computer. In the meantime, Jeff invited the player to his office and make use of cyber security knowledge to protect Jeff's computer. After the player arrived, he found out that although Jeff is a professional hacker, he doesn't have much sense on protecting his own password so the player teaches some basic knowledge of choosing a password to Jeff. Then the hint of old password is kept in the office to trick Dr. Chan.

The player provided a fake email account and password to Dr. Chan and Dr. Chan said he will do the rest. In the fake email account, it was stated that Jeff will not be in office in a specific time which was used to tempt Dr. Chan to show up at that and Dr. Chan



really did. As the password was changed, Dr. Chan failed to hack Jeff's computer.

However, Dr. Chan did not give up easily. He sent a phishing email to Jeff's email account. This time Jeff and the player got another plan. They will set up a decoy computer to be hacked, during Dr. Chan's hacking, the player dived into the Network and caught him red-handed. At the end, they succeeded.

Dr. Chan was going to be arrested by the police. Jeff told the player that he may also be visited by police as the criminal records show a strong relationship between him and Dr. Chan so he cannot escape. Jeff then stated if lives give him a second chance, he would not be a hacker and asked the player the same. The player reviewed the whole matter from the beginning, realizing reasons why he learnt cyber-security were not for committing crimes, he dialed 999 to turn himself in.

### **3.4 Playing of the game**



*Figure 6. Screenshot of Main Character*

The player will be act as the main character as shown in Figure 6. The player will follow the story as described in section 3.3 and travel through different places. There will be different mini-games for the player as well throughout the story. The details of the mini games will be discussed in later stage. During each scene, the player is free to move within the predesigned map. There will be various shining points in every scenes. When the player walk near those shining points, a window will be pop-up asking the player to press E to interact, pick up etc. It is related to different functions like starting a dialogue or picking up the memos to unlock cybersecurity terms in dictionary.

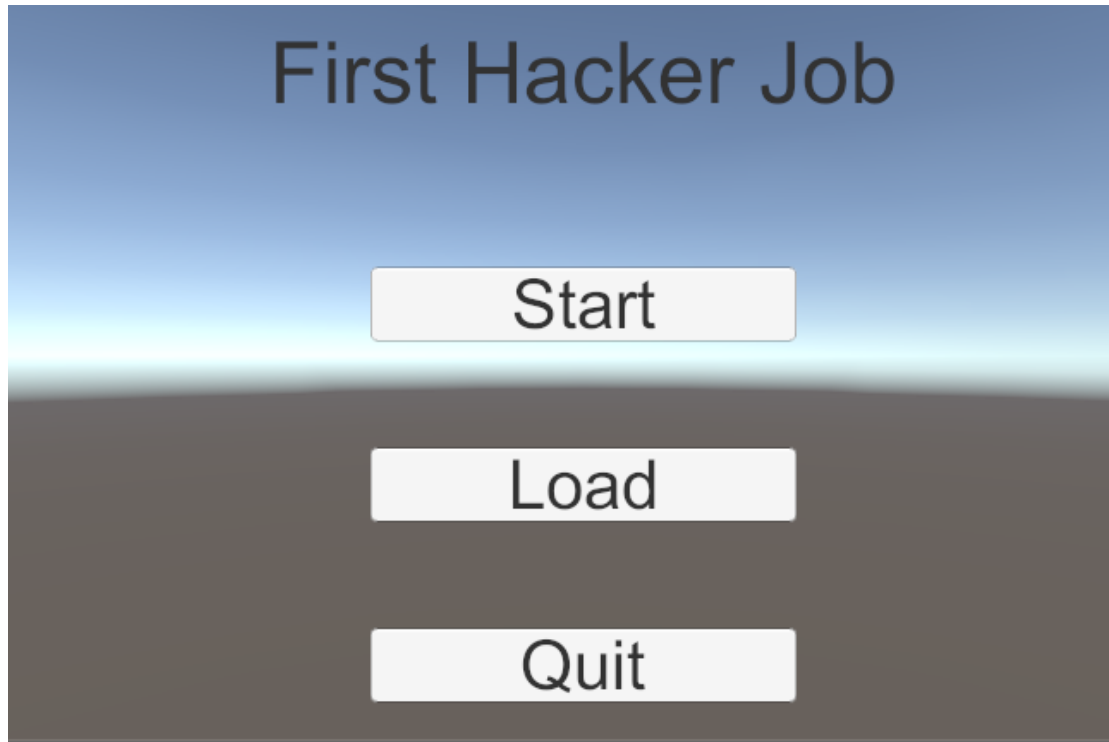


*Figure 7. Screenshot of Dr. Chan*

Besides, in specific parts of the story, the player is required to act as Dr. Chan (Figure 7) and play a mini-game.

## 3.5 Scenes

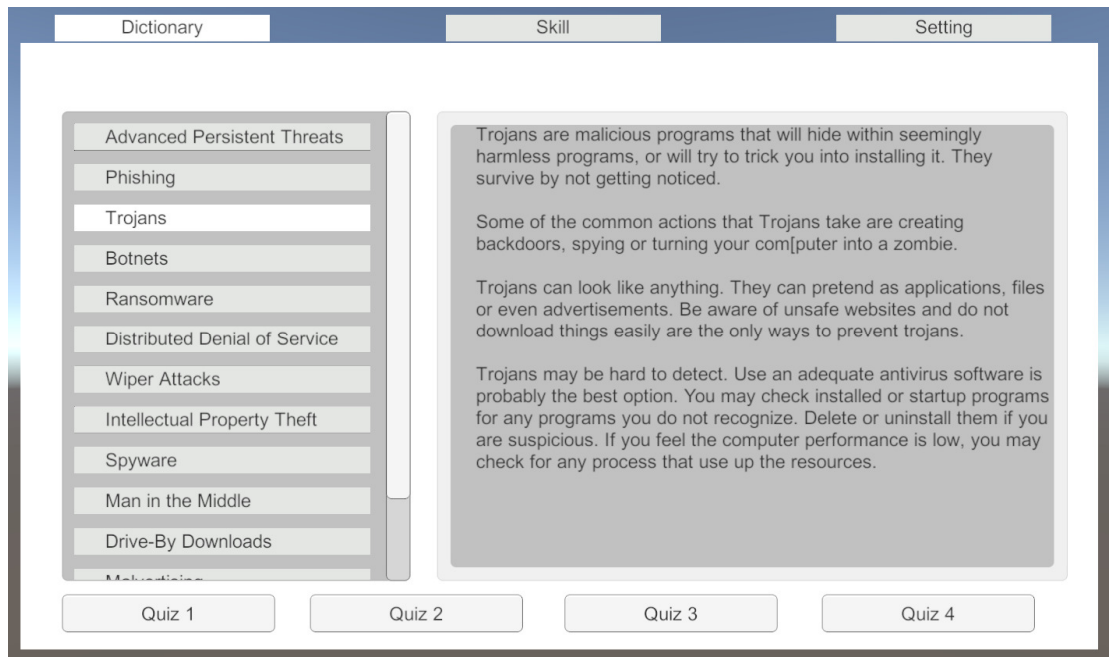
### 3.5.1 Title Page



*Figure 8. Screenshot of Title Page*

In the title page as shown in Figure 8, there is a title “First Hacker Job”. The start button will initiate the story at the beginning. That means the player will start from episode 1 scene 1. There is a load button to let the player continue at the scene they stopped last time.

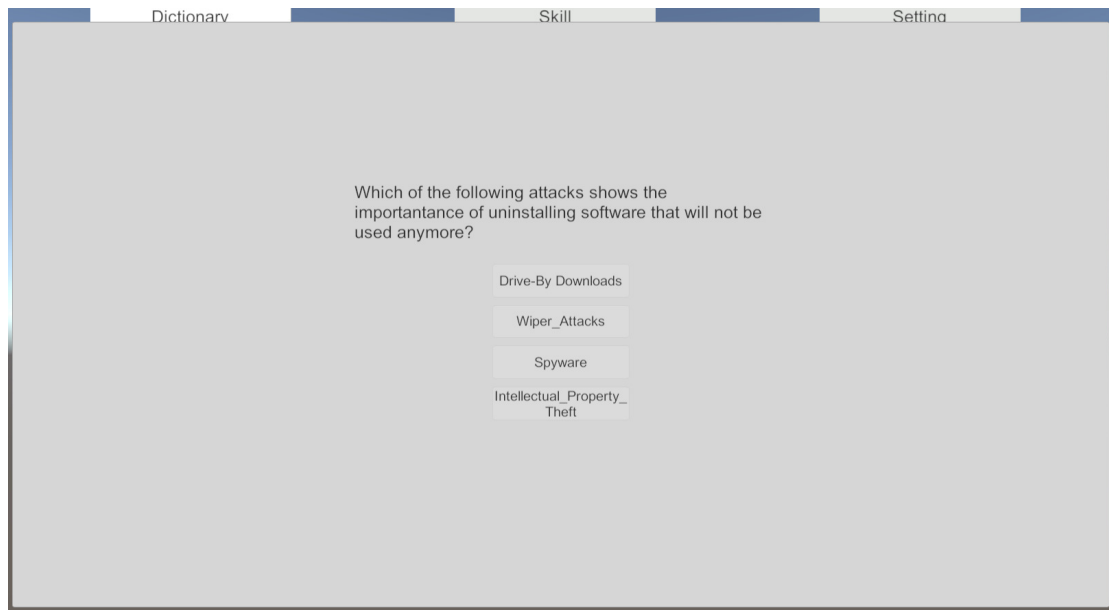
## 3.5.2 Dictionary



*Figure 9. Screenshot of Dictionary Page*

As mentioned in section 3.4, the player can pick up memos. The memos will unlock the items in the dictionary as shown in the left part of Figure 9. Moreover, after finishing each episode of story, the player would unlock one dictionary item. When the users click on a dictionary item, a description of corresponding cyberattacks will be displayed in the right part of the screen. If the player has not yet unlocked the corresponding dictionary items, it will be displayed as “????” and even when clicked on, the description will not be displayed.

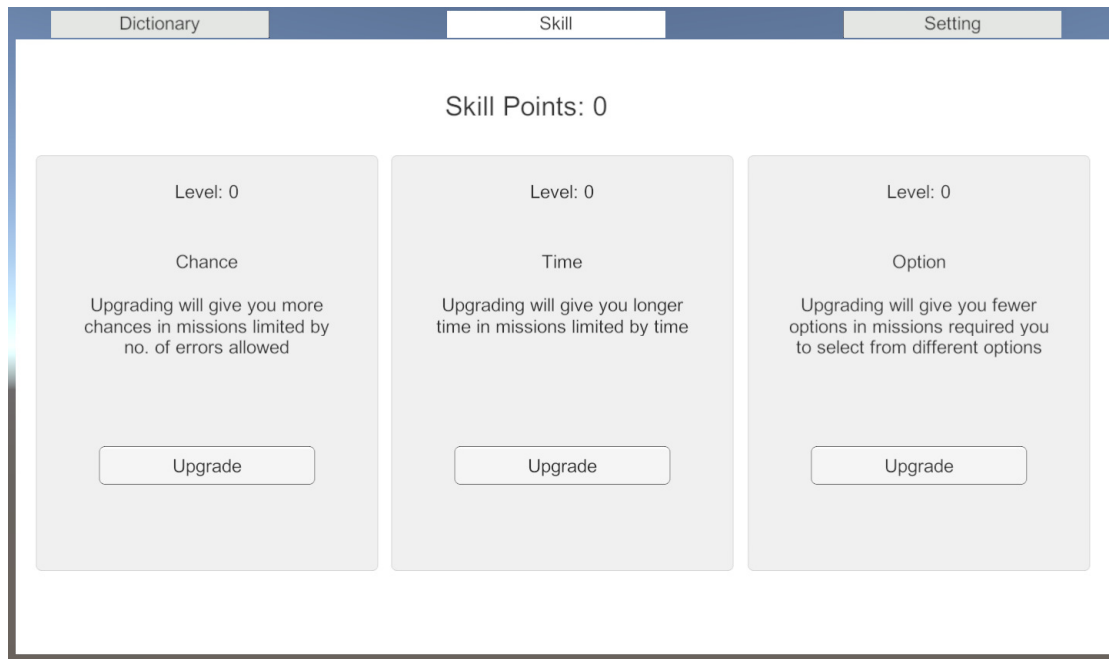
### 3.5.3 Quiz



*Figure 10. Screenshot of Quiz Page*

Whenever the player click on the Quiz button listed in the bottom of Dictionary Page (Figure 9), the player will enter a quiz as shown as Figure 10. When the player get a certain percentage of correctness, they will be awarded one skill point which can be used to upgrade skill levels in skill page which would be discussed in next section. The quiz can be attempted as many times as possible. However, the skill point will only be awarded once for each quiz. So there will be a total of 4 skill points being awarded.

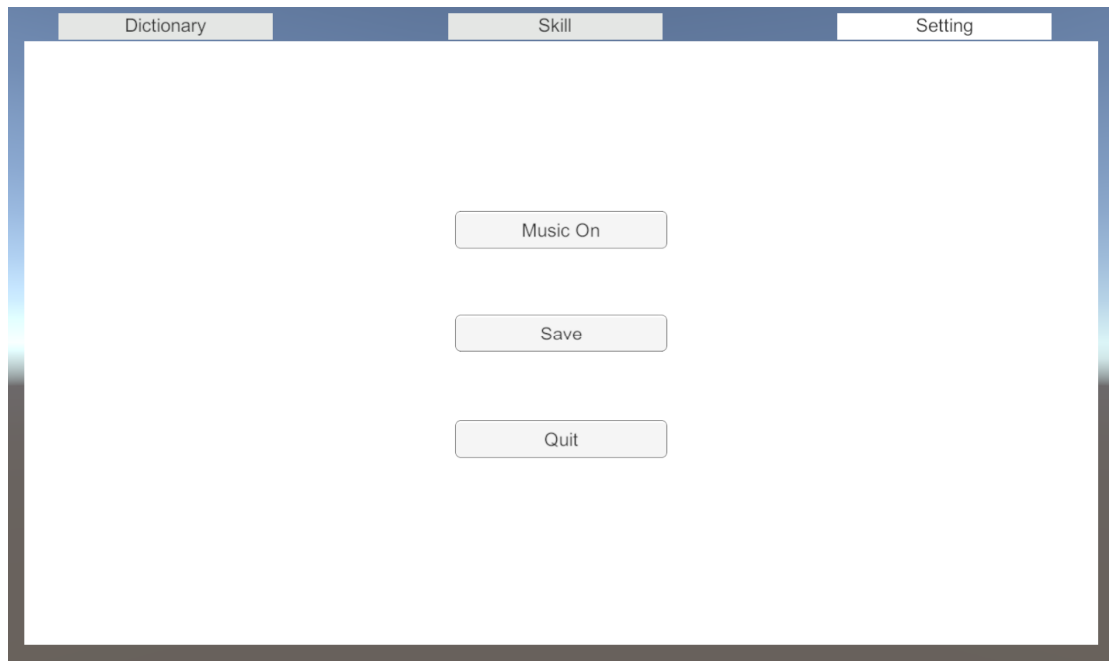
### 3.5.4 Skill



*Figure 11. Screenshot of Skill Page*

Supposedly there are three skills available for players to upgrade. Chance: While the player is guessing the password, each level of this skill will provide player with 2 more chances. Time: While the player is playing mini-games, each level of this skill will provide player with 2 more minutes. Option: While the player is playing social engineering, fewer options will be given for player to choose which increases the chance of getting the correct answer. However, due to technical issue, the option skill is not implemented.

### 3.5.5 Setting



*Figure 12. Screenshot of Setting Page*

There are three options in setting page as shown in Figure 12. The music on/off button is used to control the playing of background music. The save button is used to save the current progress of the player and let the player continue at the same progress next time the player loads the game. The Quit button will quit the game.

### 3.5.6 Mini-game 1 – Hacking

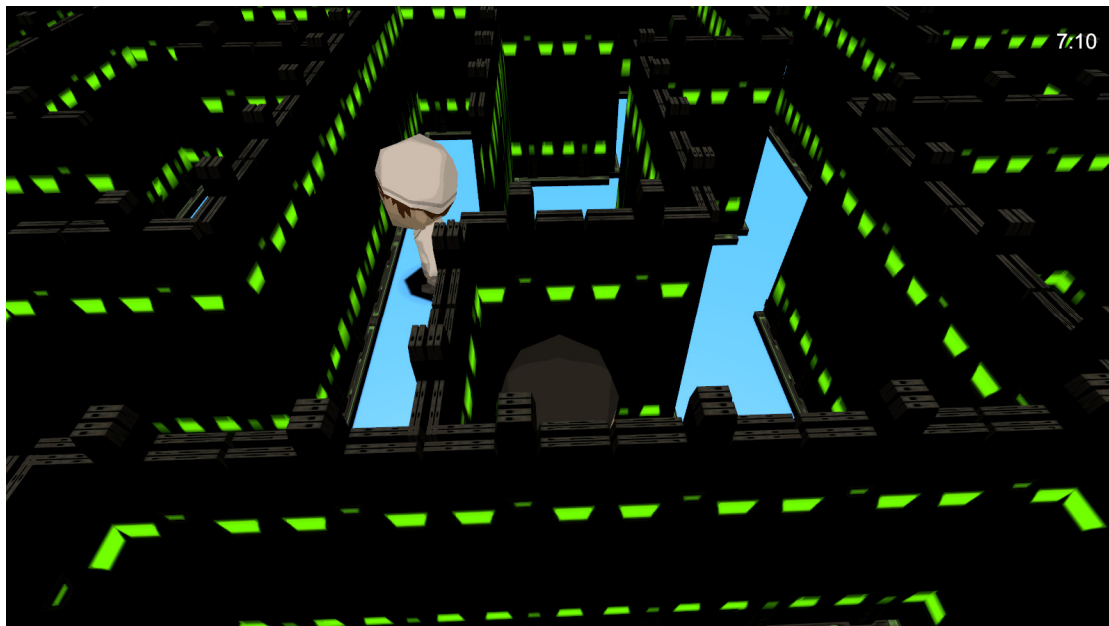


*Figure 13. Screenshot of Hacking Game*

In the hacking game, the player is free to move in the room. There will be three small shining points and one big shining point. The small shining points correspond to three hints of the password. The big shining point correspond to the computer, the player needs to guess the correct passwords to the computer base on the three hints given within limited chances as shown in Figure 13. Originally, the hints would be generated randomly. However, it is not implemented due to technical issue.



### 3.5.7 Mini-game 2 - Breaching Firewall



*Figure 14 Screenshot of Breaching Firewall*

When the player enter this game scene, the maze generator will generate a 15\*15 maze first. After generating the maze, the MazeGameManager will automatically generate the player instance and a goal instance and put it in the maze randomly. The player need to find out the goal object and interact with it within time limit. Further details would be discussed in section 3.7.4 Maze Generator.

### 3.5.8 Mini-game 3 - Social Engineering

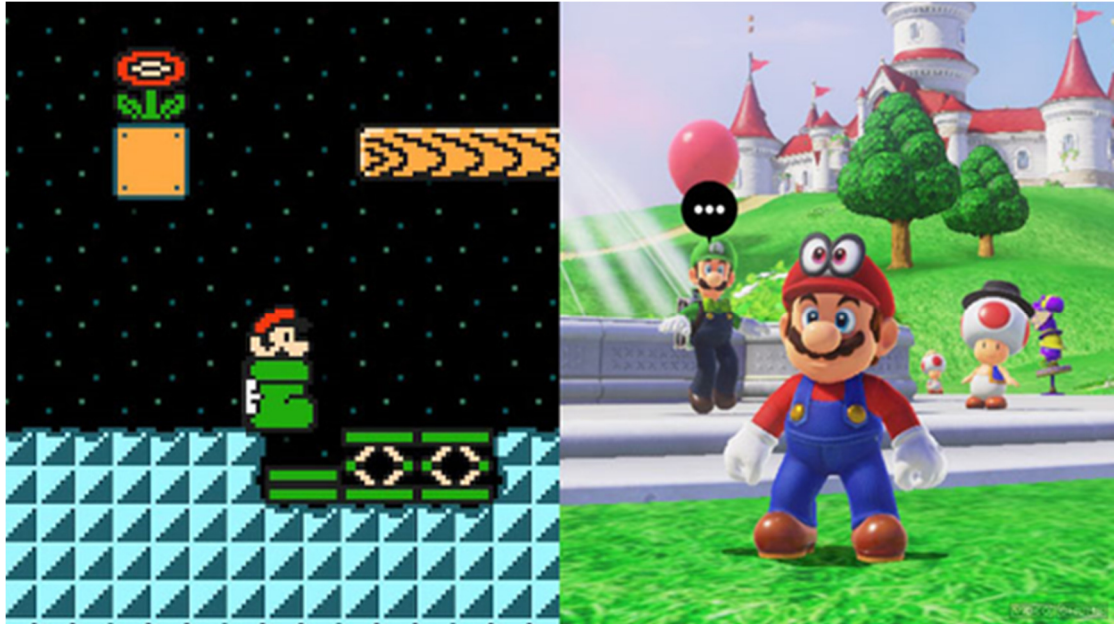


*Figure 15 Screenshot of Social Engineering Game*

The player will enter a quiz like format as shown in Figure 15. The player needs to get the correct answer every time in order to pass the game. Originally the gameplay would contain more variations. For example, there would be 4 options in the first question, and every option will lead to a different question and options respectively, branching diverse possibility. However, it is not implemented due to technical issue.

## 3.6 Aesthetics

### 3.6.1 3D VS 2D



*Figure 16. 2D vs 3D Mario [8]*

As shown in Figure 16, there is a huge difference in visual representation. 3D Games are providing a higher quality of visual images, especially in models' details. For a 3D game, there is more possibilities in gameplay. In control, 2D games only support simple control while 3D games allow more complicated control options as the character in 3D game can explore any direction.

In the project, the implementation of 3D gives more opportunities in designing the scenes as well as the mini-games. For example, the 3D maze would give the player more depth and thus a better experience when compared with a 2D one.

### 3.6.2 PC VS VR

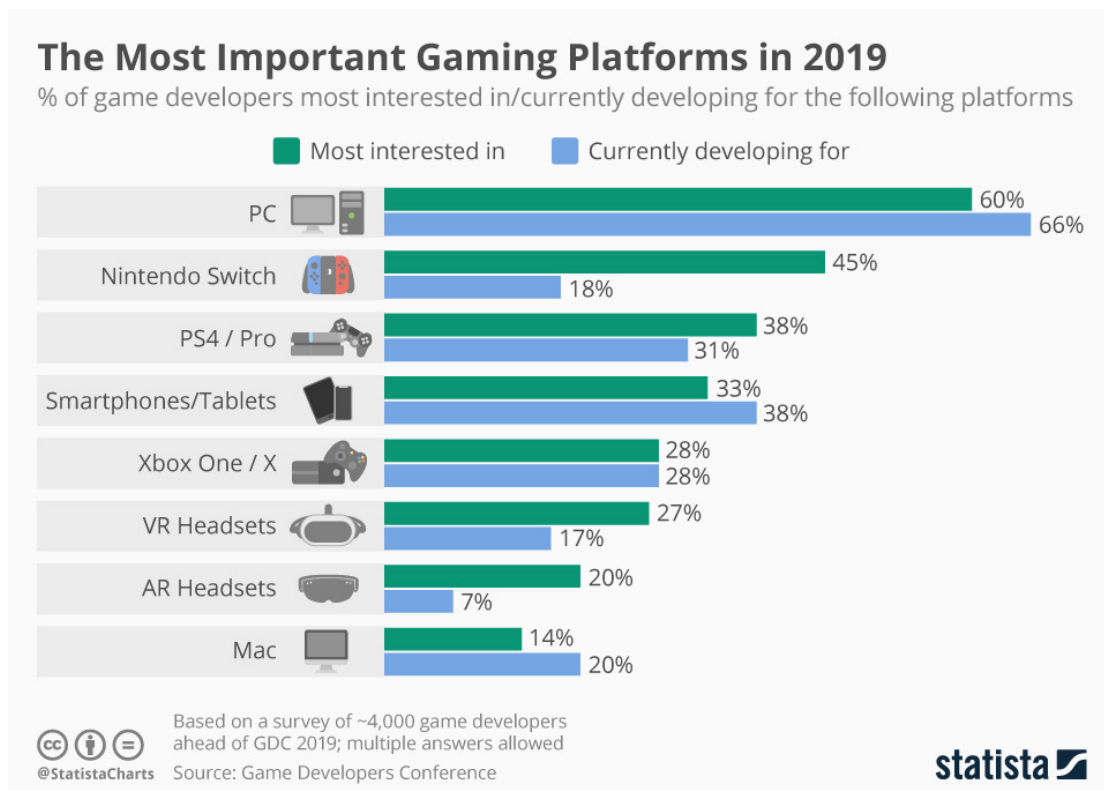


Figure 17. The most important gaming platforms in 2019 [9]

There was a time on deciding whether the project should be built on PC or VR. The game developed is expected to be played by as many teenagers as possible. From Figure 17, it can be seen that PC platform is still the mainstream of the gaming market. That is one of the reasons why the project is built on PC platform.

Besides, VR is not as common in Hong Kong compared to other countries. It is difficult for teenagers to convince their parents to purchase a VR headsets. Meanwhile, most of the teenagers can have access to a computer at home so a PC game is more accessible.

## 3.7 Some Key Scripts Description

### 3.7.1 Camera Follow



Figure 18. Screenshot for camera in Unity

First of all, the camera would be set at a position before everything runs. Then, the camera would move the same distance as the “player” object set in the script.

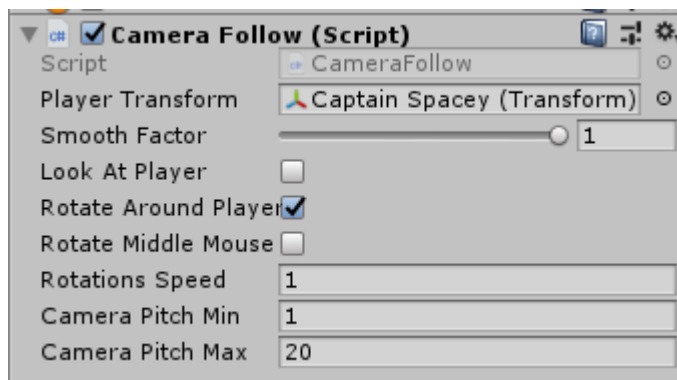
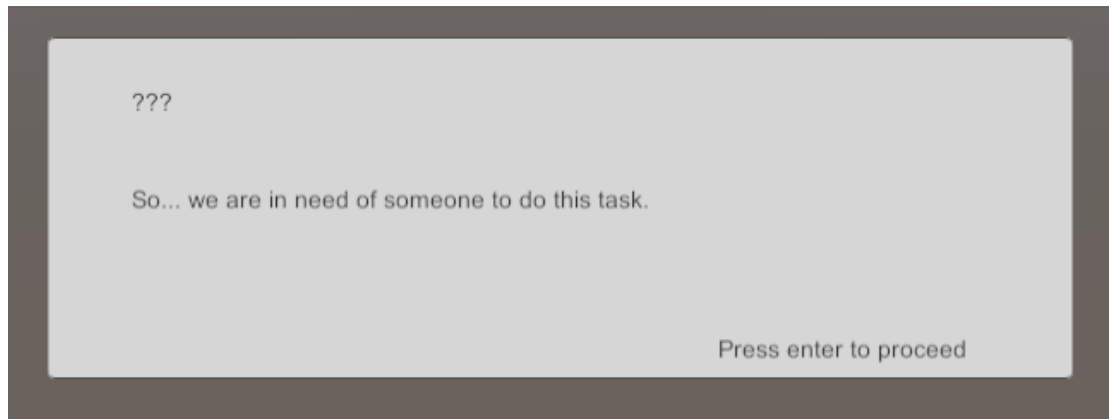


Figure 19. Screenshot of Camera Follow Script setting in Unity

The script supports the camera moving in x-axis and y-axis that means it can rotate by moving the mouse. The smooth Factor controls the smoothness while the camera is moving, the higher the smooth factor, the more frequent the camera will move in a certain period of time. The rotations speed controls how sensitive the mouse moving in relate to the rotation of the camera. The Camera Pitch limits the y-axis movement.

### 3.7.2 Dialogue Manager



*Figure 20. Screenshot of Dialogue in the game*

Dialogue is one of the most important elements in the game. It is the main gaming experience provider throughout the game. The dialogue manager is triggered by another script called dialoguetrigger. Dialoguemanager will take a set of dialogue as input and display the sentence one by one. After displaying all sentences in the set, it can be chosen whether to change scenes or not.

### 3.7.3 Unlock Dictionary Items



Figure 21. Screenshot of unlocking dictionary items in the game

As stated in previous sections, the player can unlock the dictionary items by interacting with the shining points in the scenes or completing each episode of the story. A unlock method would be called if the shining points are interacted. Besides, as there are some scenes containing shining points that unlock the same dictionary items, if the corresponding dictionary item has been unlocked before, the shining point will not be displayed while loading the scene.

### 3.7.4 Maze Generator

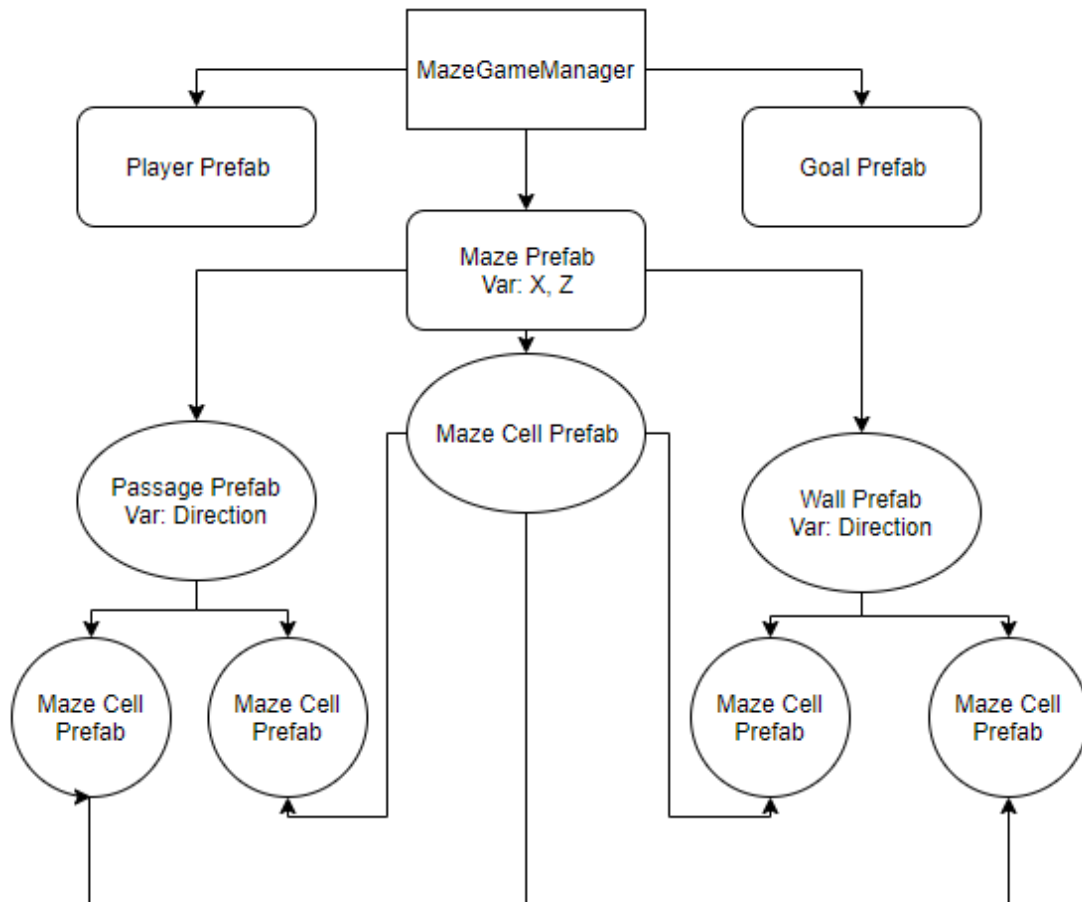


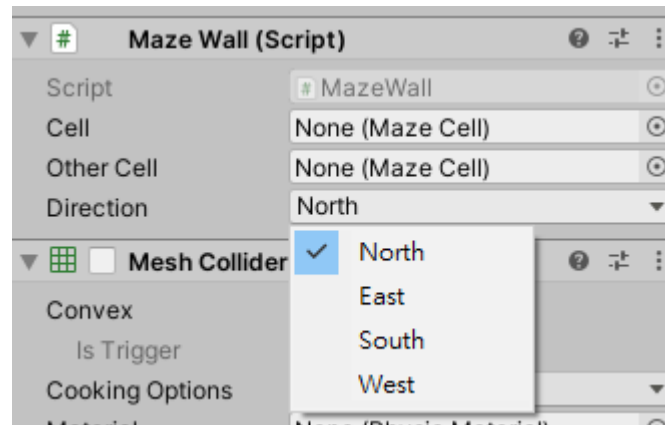
Figure 22. Flow chart of Maze Generator

To start with, this maze generator is based on tutorial given by Catlike Coding [10]

Basically, The Mazegamemanager is utilized to combine all the elements together. As

mentioned in section 3.5.7, the Player Prefab and Goal Prefab refers to the player and the goal respectively.

The Maze Prefab will take Maze Cell Prefab as input and pass it to both Passage Prefab and Wall Prefab to perform their functions.



*Figure 23. Script of Maze Wall*

One Passage / Wall Prefab instance simply means, from the “Direction“(North, East etc.) of “A” Cell is “B” Cell. If it is a Passage Prefab that means it is walkable from “A” Cell to “B” Cell. If it is a Wall Prefab that means there is a wall between “A” Cell and “B” Cell.

In order to achieve randomness of maze generated, a back-tracking method is used. To make it less confusing, the following progress described is a simplified version. First of all, taking input x and z (the width and height) of the maze, it will randomly pick one point from it and put it into an active list. Then randomly draw a direction and “walk” one step to the cell next to it and mark it as Passage (store in Passage Prefab) and put it into active list. Then it proceeds to get the last element in the active list and keep repeating the process until the whole maze is walked.

However, there are cases that it “walks” in a circle, meaning it will eventually meet a mazecell that has already been marked as Passage. In that case, these two cells and directions will be marked as Wall and a wall will be placed between them.



```

private void DoNextGenerationStep(List<MazeCell> activeCells) // Check if the move is possible and retriving/removing cells
{
    int currentIndex = activeCells.Count - 1; //Get the last cell's position in the array
    MazeCell currentCell = activeCells[currentIndex]; //Retrieve the last cell
    if (currentCell.IsFullyInitialized) //If all neighbout is filled, remove it from active list
    {
        activeCells.RemoveAt(currentIndex);
        return;
    }
    MazeDirections direction = currentCell.RandomUninitializedDirection; //Randomly draw a direction that is not yet have neighbour
    IntVector2 coordinates = currentCell.coordinates + direction.ToIntVector2(); //adjust the direction
    if (ContainsCoordinates(coordinates))
    {
        MazeCell neighbor = GetCell(coordinates); //Check if neighbour exist
        if (neighbor == null) //If not exist
        {
            neighbor = CreateCell(coordinates); //Create a cell
            CreatePassage(currentCell, neighbor, direction); // make it as a road
            activeCells.Add(neighbor); //add it to the active list
        }
        else
        {
            CreateWall(currentCell, neighbor, direction); //If exist, make a wall to block the road.
            // activeCells.RemoveAt(currentIndex);
        }
    }
    else
    {
        CreateWall(currentCell, null, direction); //Make a wall if it is the border.
        // activeCells.RemoveAt(currentIndex); //Remove it from the active list.
    }
}
}

```

*Figure 24. Script of “Walking”*

Back to the active list, as we are creating a closed maze, all cells should have 4 neighbors except it is at the border. So if the cell attained all its neighbors already, such that no matter how we draw the direction, it is either Passage or Wall, we will remove it from the active list. The looping of “walking” will not end unless all cells get their neighbors.

# **4. Difficulties encountered**

## **4.1 Technical Problem**

As mentioned in previous sections, there are some functions that were planned to be implemented but did not due to technical issues. It is a common problem in game development, there are so many amazing ideas that were thrown out at the start of the development process. However, our team do not quite have the abilities and skills to implement all the complicated functions as our team do not have enough experience in Unity. We wasted so much time on complicated functions but still failed at implementing them at the end. So some simple solutions are used as alternatives which cannot provide the best experience to our players.

## **4.2 Time management**

As mentioned in the last section, a lot of time was wasted on functions that cannot be implemented at last which delayed our schedule a lot. Besides, the progress of each stages delayed a bit due to various reasons, for example our team was very busy in the start of second semester, and due to assignments and midterm tests. Because of these, the schedule planned could not be followed and kept being pushed back. As a result, there was less time for testing and handling complicated functions.

## **4.3 Communication**

It is a common problem that can be found in every group project. Both of us have different matters to attend to, so it is difficult to get some time to discuss with each

other as well as with the supervisor. Once my groupmate claimed that a specific function was easy to implement, in which I believed and left that part to him. However, after some weeks when I asked about the progress, I received a response that my groupmate not only forgot to implement that but there also was no time for dealing with it already. It could have been avoided if we could pressure each other more, but we were too focused on our own part due to time limitation. If there was more communication between groupmates, reminding of each other progresses, it can be prevented.

## 5. Future Works

There are a lot of improvements can be done in the future.

First of all, implementing the functions designed originally. Due to the technical issue and time limitations mentioned in last section, some functions were not implemented. So the first thing to improve in the future would be implementing these functions.

Second, fixing some bugs. Due to time limitation, there is not much time for testing so it should be some bugs that are not discovered. So debugging would be an important process in the future before adding any new elements to it.

After finishing what was planned, new elements can be added to the game.

First, sub-quest can be added to the game. For example, a short story about Jeff or Tommy can be added to let the players know more about them to be more immersed in the game as the main story is about the main character only. The player is not familiar with these supporting characters. By adding the story of them can provide richer experience to player.

Second, more cyber security knowledge can be included in the dictionary. There are unlimited number of cyber-attacks on the Internet right now. The knowledge included in the game now are only a small part of it so there is room of improvement on the coverage.

Third, different BGM can be added to the game. There is only one BGM included in the game right now which is not enough. There should be BGM that are more suitable in specific scenes to let player be more engaged to it. The player would easily get bored by listening to the same BGM the whole game.

Fourth, more effects can be added to the game. For example, while changing scenes, if a fade in or fade out effect can be added, the player would not be confused while changing scenes as the current practice is using a sudden change of scenes without any effects. The player might not know what happened. If transition effects can be added to changes of location, the gameplay would be smoother.

Fifth, more mini-games can be added to the game. The player would easily find the game monotonous if only the three mini-games are included. By providing more variations of mini-games, it would also grant more room for designing new storylines.

## 6. Conclusion

This project hope to raise teenagers' awareness on cybersecurity through an interactive 3D game in light of the increasing number of Internet users while most of them do not have much knowledge towards cybersecurity.

The game "First Hacker Job" was developed with a main storyline, mini-games and cyber security knowledge. It is expected that this game can equip players with useful knowledge to stay away from cyber traps in the future while providing entertainment to them as well.

This project gives our team precious experience as it is not easy to develop a game from scratch. There are many factors needed to be considered before implementation. Otherwise, it will waste a lot of time like what our team did. Being a player and being a developer have completely different perspectives. This project proves to our team that a scene player plays for one minute require over a dozen hours of development.

There are lots of improvements can be done in the future. The product at this stage is just a starting point. It is hoped that the game can be further developed in the future.

# 7. Assets Used

Modern City Environment

<https://assetstore.unity.com/packages/3d/environments/urban/modern-city-environment-64253>

Toon Character Pack

<https://assetstore.unity.com/packages/3d/characters/toon-character-pack-6698>

Private Office [Room]

<https://assetstore.unity.com/packages/3d/environments/private-office-room-115305>

Living Room Interior

<https://assetstore.unity.com/packages/3d/environments/urban/living-room-interior-72221>

Office Meeting Room and College Interior

<https://assetstore.unity.com/packages/3d/environments/urban/office-meeting-room-and-college-interior-82804>

HQ Computer

<https://assetstore.unity.com/packages/3d/props/electronics/hq-computer-93276>

MSFMC - Complex Walls/Gate

<https://assetstore.unity.com/packages/3d/environments/sci-fi/msfmc-complex-walls-gate-52702>

## 8. References

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