Individual Final Report

A 3D Game to Raise Teenagers' Awareness on Cybersecurity

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Abstract

The Internet is more popular and easier to use everyday. More users start using the Internet. Teenagers is a group that has the largest percentage of Internet users. However, there are lots of traps that cannot be ignored. This project aims to educate teenagers about Cybersecurity through a 3D game such that they would not fall into the traps. This paper included a full picture of the game. Game design, limitation and future improvement were included in this paper.

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Introduction

The Internet is a crucial part of the world nowadays. There are 4.39 billion uses in January 2019 [1], which is more than half of the world population. The Internet allows people to communicate with others, shop online, find resources, entertain, and do many other things. Although it is convenient and useful, it brings risks. People may be aware of some large scale incidents including leakage of clients' data of Faster Payment System, Cathay Pacific or TransUnion [2]. However, they seldom notice those small scale or personal data breaches.
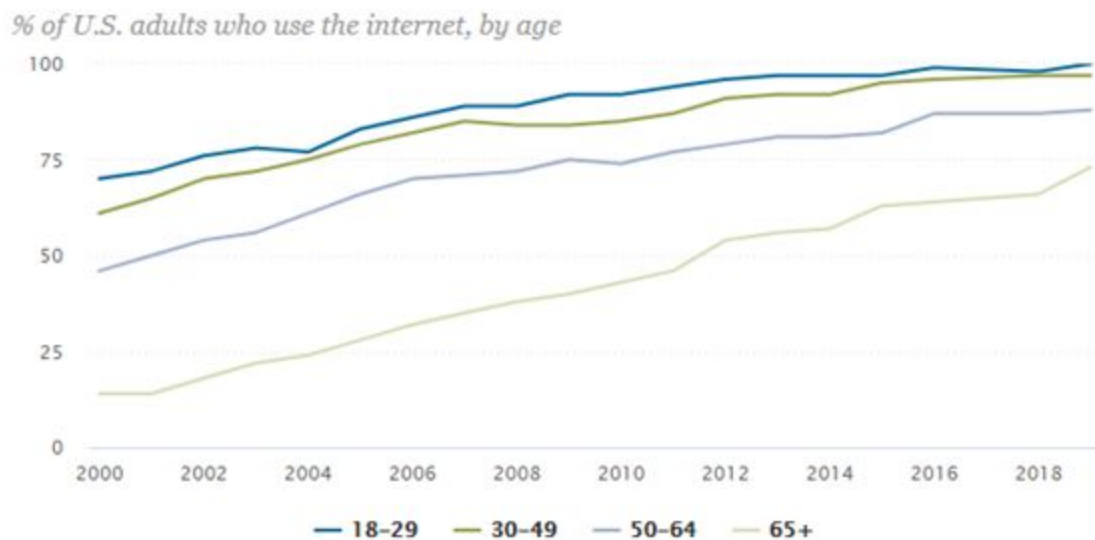
Figure 1. Internet use by age in United States [3]

As shown in Figure 1, the number of internet users increases when the age goes down. In 2018, the internet users in age group 18-29 reached 100%. It is believed that the percentage of teenage Internet users would be as high as age group 18-29.

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]. There is a need to educate people about cybersecurity. As most of the teenagers are Internet users, it is certain that the effectiveness of targeting teenagers would be greater than that of other age groups.

This project raises the awareness of teenagers towards cybersecurity through games as teenagers love playing games. It is believed that teenagers can learn a lot of knowledge towards cybersecurity through this game. Then the teenagers can use the knowledge to stay away from cyber crimes and prevent cyber crimes before it happens.

The following of the project plan would first state the current situation regarding cybersecurity games. Next, it would discuss the main message we would like to include in the game. Then, it would describe the game in detail. Finally, it would discuss possible future improvement.

Background

There are several results when searching for cybersecurity games. The following will discuss two of them as examples.

Figure 2. Screenshot of "Targeted attacks: the game" [6]

Figure 2 is a screenshot from the game "Targeted attacks: the game" where players' action is needed for the first time. Players act as the CIO of a company in the game. The game requires players to watch movies to understand the scenarios, then make choices to proceed. Different choices have different costs and risks. These will affect the upcoming story. The game talks about cybersecurity at business level. Real people participate in the movies to give a sense of reality. The game targets working people and is not suitable for teenagers learning. Players can

only watch, read and select in the game. This kind of playing experience is probably not attractive to players.
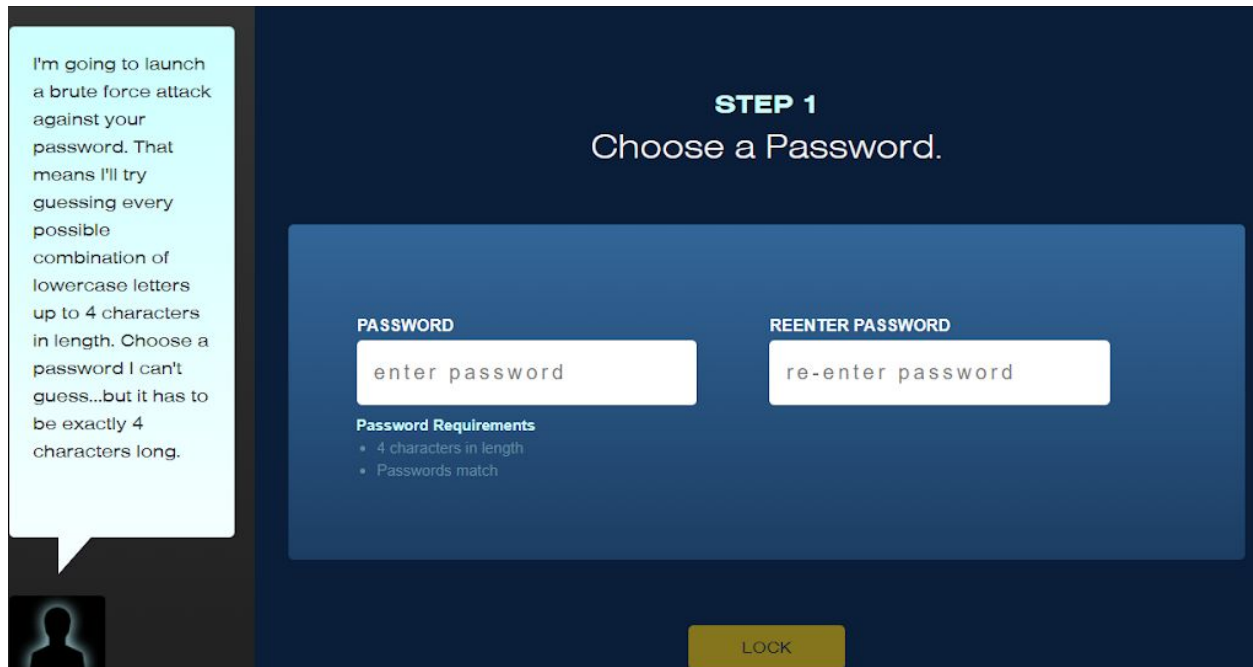

Figure 3. Password Cracking Challenge of "Cybersecurity Lab" [7]
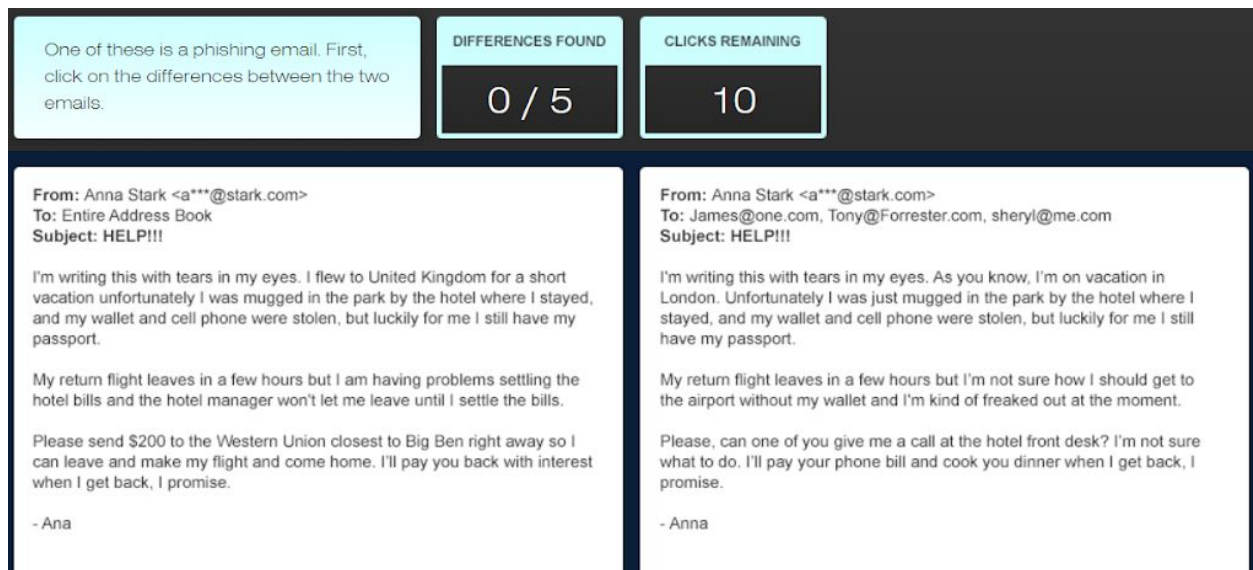
Figure 4. Social Engineering Challenge of "Cybersecurity Lab" [7]

Figure 3 is level 1 of the password cracking challenge in the game "Cybersecurity Lab. The person in black on the left side is the opponent who gives instructions. Players have to select their own password to prevent the opponent from guessing it. Then, players select a way to guess the opponent's password.

Figure 4 is level 1 of the social engineering challenge in the game "Cybersecurity Lab". In the challenge, players need to click on differences or simply identify suspicious places. Then, make a decision on which is the phishing one.

This game talks about cybersecurity at personal level. The instructions are clear and everyone should be able to finish it with ease. However, it may be too easy. Teenagers may get bored and quit the game before finishing it.

The above examples indicate some drawbacks of existing games. To alleviate such drawbacks, this project aims at developing a game that can deliver cybersecurity knowledge while providing sufficient challenges as incentive to finish the game. It is hoped that the game can be attractive to both learners and players to widely deliver the knowledge.

Objectives

Most cyberattacks need users to take action before they can successfully obtain information. It is hoped that a workable game is delivered while it can raise players' awareness on these kinds of attacks and take precautions to avoid falling into those traps.

Target Audience

Although everyone should learn about cybersecurity, adults are likely to have much knowledge than teenagers due to job training or experience. The target audiences are teenagers as they face the highest risks. The game will be in English for PC platforms due to time and experience constraints.

Scope of the work

Cybersecurity is a wide topic. There are different types of attacks targeting specific people, general public, companies, governments and other kinds of targets. There are measures to provide protection, prevention or avoidance. This project aims to help teenagers to use the Internet safely. Therefore, the focus is attacks on specific people or public, and measures applicable by individuals. Others attacks and measures are included as collectibles in the game as references for those interested.

Story of the game

The player is a newly graduated student. At the start of the story, someone approaches the players and offers a job. As the story continues, the player keeps on fulfilling the requests. Eventually, he understands that he is a part of criminal acts and decides to stop them. The story ends with the player turning himself in to the police as an alert that the criminal acts should not be done in reality.

Mechanics

The game progresses mostly with dialogue and minigame. Dialogue may trigger automatically, or in some occasions by interaction of the player. They are several minigames in the game representing hacking, breaching, and social engineering. There are 14 dictionary items included in the game as direct knowledge provided to the players. They will be unlocked automatically or by picking up collectibles.

Mini-games

There are three types of mini-games representing hacking, breaching, and social engineering respectively.

The first type of mini-game represents hacking by guessing passwords. The player would be in a small area such as the office or home. There will be hints in the area providing information on the password. The player is allowed to guess a number of

times. If the player succeeds, the next scene will be loaded within a few seconds. Due to story design, one of this type of mini-games must fail. Otherwise, the player can press a button to restart the mini-game if he fails.

The second type of mini-game represents breaching by mazes. The player would be in a randomly generated maze with a goal. The player needs to reach and interact with the goal within the time limit. If the player succeeds, the next scene will be loaded within a few seconds. The player can press a button to restart the mini-game if he fails.

The third type of mini-game represents social engineering by selecting options in a conversation. There are four options each time. Correct answers will proceed the dialogue. Wrong answers lead to immediate failure and can restart the mini-game.

Skills

There are 3 kinds of skills implemented in the game. Players would get ability points when passing quizzes on cybersecurity.

1. Chances

Each level will increase the number of chances in hacking mini-games.

2. Time

Each level will increase the time limit in breaching mini-games.

3. Option

Increase in option level supposes to reduce the incorrect option in social engineering mini-games. However, due to technical issues, it is not applicable and has no effect on upgrading.

Game Engine

In order to develop a game, a proper game engine should be used. There are two popular game engines: Unity and Unreal.

Unreal can provide a better game performance on developer detailed implementation. Unreal is generally better when developing a game with high visual quality with fine-tuning. It has a higher upper limit than Unity. However, to utilize Unreal, it requires a higher level of experience and knowledge. It is hard to achieve in a short time as beginners. On the other hand, Unity is easier to learn. Unity has its own asset store providing different resources including environment, characters and background. It is widely used by independent game developers or startup corporations.

By comparisons between these two game engines, Unity is more suitable for this project.

Aesthetics

The game uses 3D human models and environment assets. It is hoped that they provide a realistic game world.

Figure 5: Modern city environment [8]

Figure 6: 3D living room [9]

Figure 7: Toon characters [10]

Figures 5, 6 and 7 are packages bought and used in the project. Figure 5 shows assets of a city. Figure 6 shows assets of a living room. Figure 7 shows assets of characters. Since the creators of the packages are different, the styles of assets are different. Putting them into one game causes a little inconsistency. The inconsistency is a tolerable issue as it is minor and does not have negative impact for the purpose of the project.
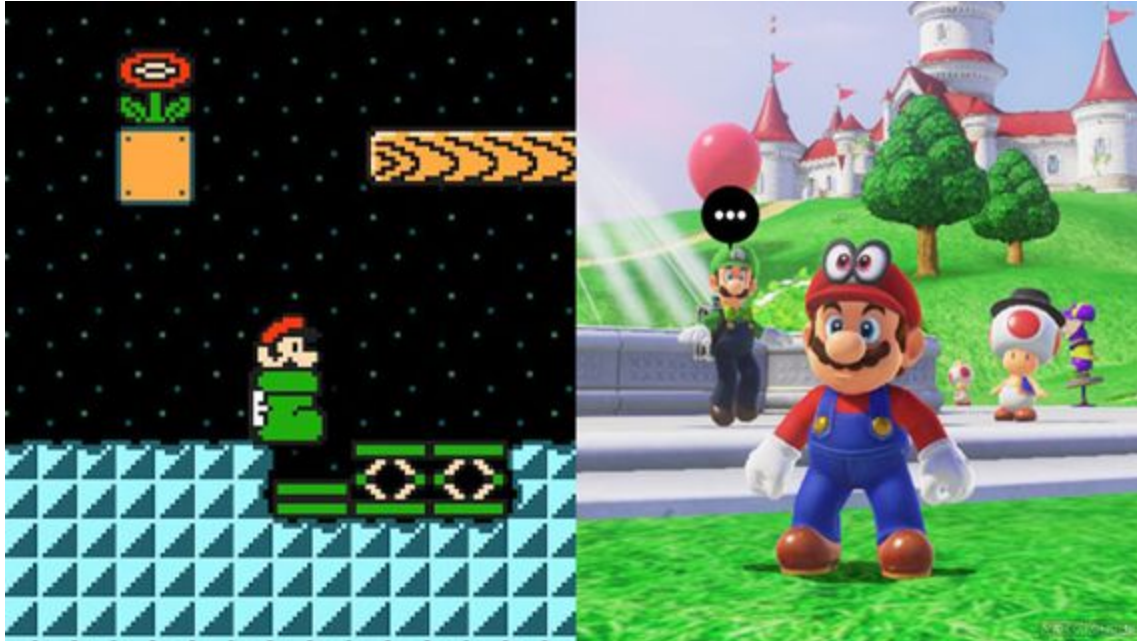
Figure 8. 2D vs 3D Mario [11]

As shown in Figure 8, there is a huge visual difference with 2D and 3D. 3D Games provide a higher quality of visual images, especially in model details. For a 3D game, it provides more possibilities in gameplay. 2D games provide simple control only while 3D games allow more complicated control options as the character in a 3D game can explore in more directions.

In the project, the mini-games are designed with features that 2D games cannot achieve. For example, searching in a maze.

User Interface

Figure 9. UI at initial status

Figure 9 shows the menu called by escape button. The default active tab is the dictionary tab. The content will be unlocked by collectibles or story progress. All contents will be locked at the fresh game and show as "????". The button at the bottom is for take quizzes.
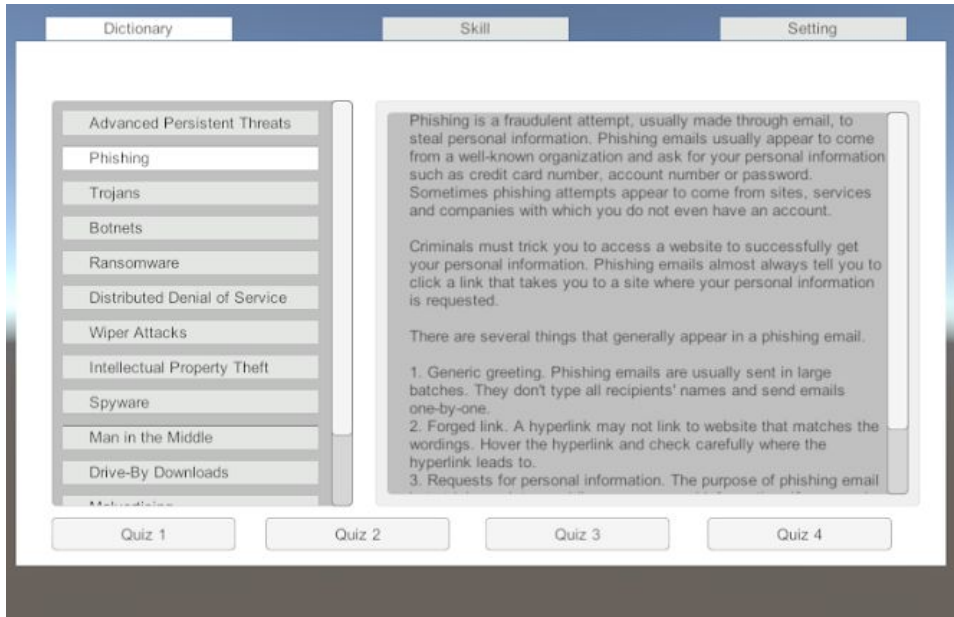
Figure 10. Unlocked Dictionary
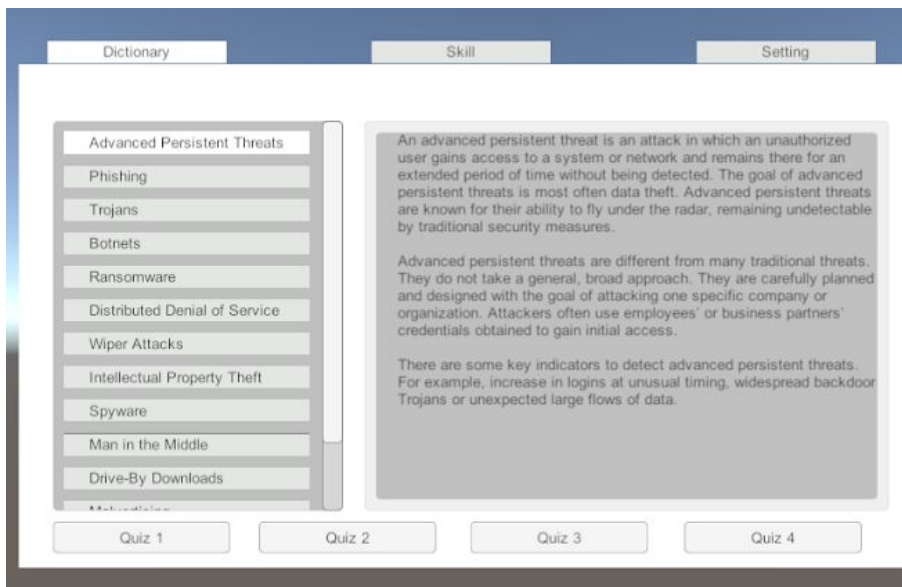
Figure 11. Dictionary details not overflow

Figure 10 shows the menu with all items in the dictionary unlocked. Left side contains selectable words. When players select any one, the right side will show the corresponding details. The right side will show the scroll bar if text overflows

the visible area. Figure 11 shows the shorter details and the scrollbar will disappear automatically.
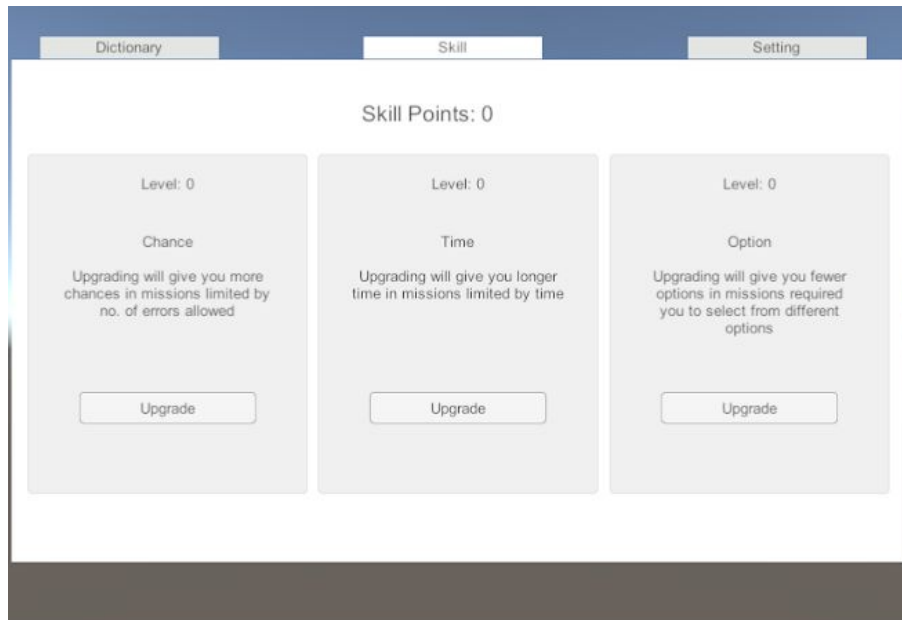
Figure 12. Menu with skill tab on

Figure 12 shows the skill part of the menu. Total skill points, each skill level and description are shown. Players can upgrade by pressing the corresponding button.
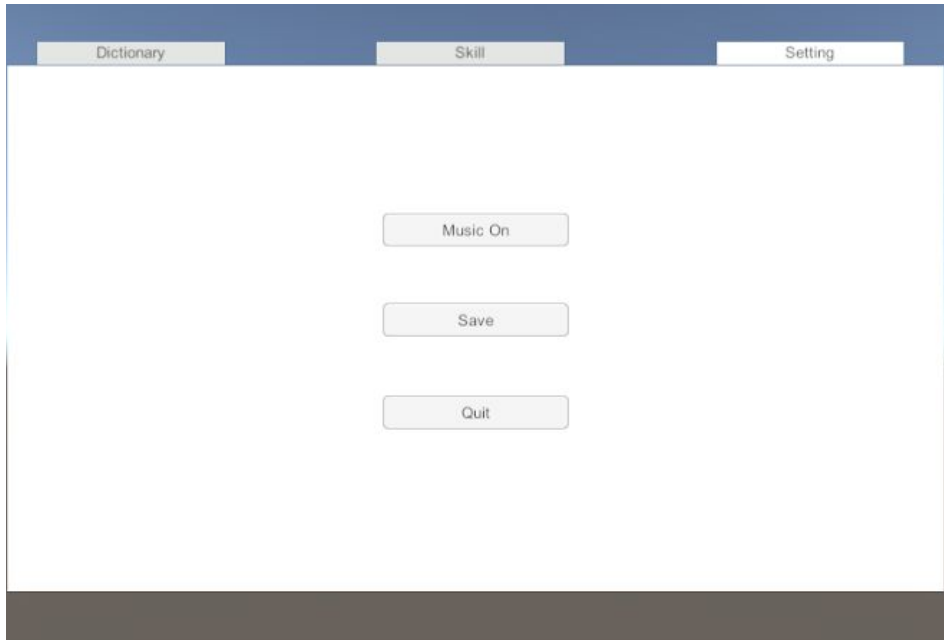
Figure 13. UI at setting tab

Figure 13 shows the visual when players click on the setting tab. The first button is for turning music on or off. The current status is shown on the button. The second button is for saving progress. The third button is the quit button. Clicking it will cause the pop up of the confirmation message. Selecting "yes" will close the application while selecting "no" will close the confirmation message.

Scripts

To make the game mechanics work, scripts are implemented. Followings are general descriptions of the purposes of scripts. The postfix of script, i.e. ".cs" is omitted.

GameControl: control main flow of the game such as start new game or load scene

Skill: skill related function such as obtaining skill points, upgrading, and display skill related information

Dictionary: dictionary related function such as unlock dictionary items, displaying details of items, disable lock items

Music: turning on/off music, control display in menu

SaveLoad: getting variable to write to permanent save, or setting variable retrieve from save

QuitGame: create confirm message when pressing quit button

QuizManager: maintain clear status of quizzes

CorrectAnswer: custom type represent a correct answer in a multiple choices question

Dialogue: custom type storing a set of dialogue

DictionaryItem: custom type represents all dictionary item

Info: custom type represents all information need to be saved

InteractableAction: custom type represent possible actions of interactables

Question: custom type represent a question with four options and correct answer

AutoDialogueTrigger: start dialogue automatically without any user input

AutoUnlockDictionaryItem: unlock dictionary item automatically without any user input

CameraFollow: control camera position and direction when player moves

Confirm: represent behaviors of a confirm message

DialogueManager: control the start, display, and end of dialogue

DialogueTrigger: store details of a set of dialogue and start dialogue

DictionaryContent: alter the display on activating dictionary tab

Interactable: decide which type of actions a interactable will do and call suitable functions

InteractMessageManager: show/hide interact message

Movement: player movement script, for testing purpose only

Notification: show/hide notification when dictionary item unlock

PreCondition: allow interaction to certain object after all condition fulfilled

Quiz: display for quiz consists of any number of questions, calculate score

ResetTimeScale: workaround for an inconsistent bug cause by game engine when loading previous scene

ReturnToTitle: behaviors of "return to title" button

SaveMessage: automatically destroy popup message after certain amount of time

SettingContent: alter the display on activating setting content

SkillContent: alter the display on activating skill content

SocialEngineering: start, display, end of social engineering game

Timer: simple timer used in mini-game

Title: behaviour of title

UserInput: getting user input, compare with answer and decide actions

Combining Maze, MazeCell, MazeCellEdge, MazeDirections, MazeGameManager, MazePassage and MazeWall implements an automatically random generated maze with adjustable size and random start and goal.

DialogueTriggerEditor, InteractableEditor determine which variable can be seen in the inspector.
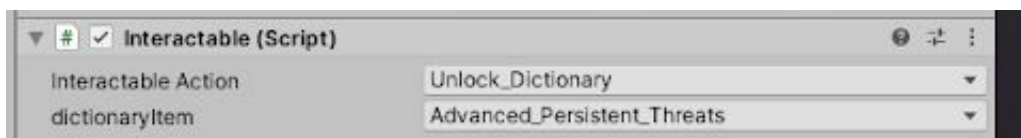
Figure 14. Interactable with action unlock dictionary
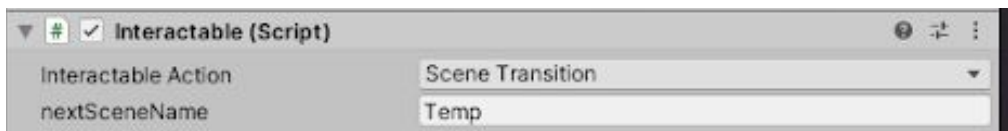
Figure 15. Interactable with action scene transition

Figure 14 and 15 show the function of two editor scripts. By controlling shown variables, developers will not need to input unnecessary values.

The script controlling player movement comes with the bought package "Toon character pack". Small modification is made in order to disable player movement in certain situations.

Limitation

The team is not professional story writers or content makers. The storyline, dialogue, game content do not have thorough refinement. The dictionary descriptions are purely based on sources and may not be the best available. While the team tries to provide the best content possible, it is limited by experience, talent and time.

For a similar reason, the game is not long. The number of mini-game is small as it is hard to come up with distinct and meaningful mini-games.

Future Improvement

While a workable game is delivered, there are a lot of improvements that can be made in the future.

First, part of the skill system, i.e. option level, does not apply to mini-games. Developing a way to alter the difficulty of social engineering mini-game provides the meaning of the skill.

Next, the skill is applied in a static way, which means that each level increases the same amount of time or chances in any game. A dynamic increase based on the difficulty of the game should enhance the importance of the skill system.

Third, the content quality is not optimal. These contents include the questions and choices in quiz or social engineering mini-game, and the detailed description of dictionary items. Increasing the quality of the content will deliver knowledge of cybersecurity effectively.

Fourth, the player controller that came with the bought package is hard to use. In certain scenes, it may be hard to reach destinations or interact with objects as slight movement is difficult. Modifying the controller or replacing with a custom controller will likely provide better playing experience.

Conclusion

The game describes some means and ways of criminals getting sensitive information unlawfully. Although the game's length and quality may not be enough, it delivers cybersecurity knowledge to some extent. It is hoped that it will serve as a starting point for a game of larger scale.

It is often argued that game actions done in game may affect the actions in reality. Sometimes causes of violence cases or even murder cases are argued as games. Although playing games definitely affects players, the affection is not necessarily bad. A properly designed game can alert players about what should or should not do. Self reflection of the past and changes in the future can also happen. This is also the target of the project. Although the target may not reach at the moment, it is hoped that future improvements will be one step closer to the target.

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Appendice

Appendice.A Story Script

Episode 1:

~~Scene 1~~

???:

So... we are in need of someone to do this task.

???:

I have a perfect candidate in mind.

???:

Alright. Let's give him a chance to prove whether he is capable.

~~Scene 2~~

???(B): Please don't disappoint me. Mwahahahaha.

~~Scene 3~~

Computer:

You Have Received A New Email!

Congratulations on graduating. Have you found a job yet?

I know you haven't, would you like to join us?

WE NEED YOU.

We are looking forward to your reply.

~~Scene 4~~

Computer(???):

Seems like you have made up your mind

~~Scene 5~~

???:

This is your first target.

Just follow your order, all will be explained in due course.

Usually he is working in the meeting room with his notebook computer.

I want you to install this software to his computer.

Report to me when done.

~~Scene 6~~

Reach location to enter meeting room

~~Scene 7~~

Hacking mini-game

Episode 2:

~~Scene 1~~

???:

Well Done. The program I asked you to install is a backdoor software.

It creates loopholes in his computer to provide you access.

Obviously, your next job will be accessing his computer.

Perhaps you have a question in mind: what makes our target deserve this?

I suppose I will entertain you, this guy anything but innocent.

He is a cadre of a criminal organization.

What you are doing is simply collecting evidence to prove their criminal actions.

???:

You are waiting for Tommy to go online.

~~Scene 2~~

Computer:

Tommy is online now, it's time.

~~Scene 3~~

GameInstruction

~~Scene 4~~

Maze mini-game

Episode 3:

~~Scene 1~~

You have been monitoring Tommy for nearly a week.

You found out that he is always communicating with Jeff.

So, you report the relationship between Tommy and Jeff to your boss.

~~Scene 2~~

Computer(???):

Now you have collected some information on Jeff.

Jeff is apparently a partner of Tommy.

That means they are likely working in the same environment.

If you can get access to Jeff's email, then you can probably gather more evidence proving their crime.

However, Jeff only works with his desktop computer at home instead of a notebook computer.

So you cannot do the same trick to him as last time.

You will need to get in touch with Jeff directly to get some hint about his password.

Tommy loves drinking so you may find Tommy near the liquor shop.

We will wait for your good news.

~~Scene 3~~

Jeff:

Hi, do I know you?

Continue with social engineering game

Episode 4:

~~Scene 1~~

Jeff:

I know where you are from.

If I am not wrong, you were contacted by someone through email stating that I am part of a criminal group, right?

Well, old habits die hard.

They are just using the same method to deal with traitors.

Actually, there is some truth to it. I did committ crimes in the past, only under their orders.

Yes, I was once working for them just as you are, but I know better now.

The guy who contacted you is one of them, the true mind of the organization.

At some point we know what we did and I don't want to work for them anymore, neither do Tommy.

Did you really think your little sleight of hand can fool two experienced cyber hackers?

Tommy discovered the backdoor software you installed in his computer long ago.

Instead of waking a sleeping dog, we decided to lure you out to have this private chat.

Yes, this is all part of our plan.

You may wonder why, this is because we need your help to end all of this.

While you still have his trust, you are the key to the whole scheme.

From my experiences, if you continue to work for them, yes you can catch me and Tommy, but you will not stay safe for long as he will betray you very soon.

They are just treating their agents as tools.

Would you like to join us and end this atrocity once and for all?

I am sure great minds think alike.

But first of all, we need to prevent anyone from being suspicious of us, let's pretend you know nothing and do your job as told.

I will contact you in the near future.

~~Scene 2~~

Computer(Jeff):

We are closing in on the guy contacting you and we have a rough idea now.

~~Scene 3~~

Jeff:

This is Dr. Chan. I think you know him, right?

He is a professional in the field and also your supervisor.

We couldn't narrow down to him before your appearance.

Why would anyone know you.

You are just a fresh graduate and didn't even get your first job.

So now everything falls into place.

You were his students and he knows you have the ability. That's why he chose you.

Episode 5:

~~Scene 1~~

Computer(Jeff):

Our plan is simple, we will bait Dr. Chan to my office and let him hack my computer.

I have prepared a fake email account and password.

In the fake emails, I will mention the criminal records of Dr. Chan on my computer and a meeting with Tommy next week.

As it is directly related to him, I believe that he will not send you but come by himself.

Therefore, all you have to do is to give him the fake account information for him to see the set-up emails.

~~Scene 2~~

Computer(Dr. Chan):

Well done, then I will take care of the rest,

Your effort has not fallen onto deaf ears.

I will contact you later to join us officially. Welcome to our group.

~~Scene 3~~

Computer(Jeff):

Seems like the plan is running smoothly.

In order to protect my computer, I want you to help me utilize your cyber security knowledge. Can you come over?

My office is in the opposite of the princess hotel and next to the motel.

~~Scene 4~~

Reach location to enter Jeff's office.

~~Scene 5~~

Memo(1):

A string of 10 characters is written on it.

Memo(2):

It is a conversion table.

Memo(3):

It is a string of numbers.

After all memos are clicked found

Guess I have grown old. I should be more careful on handling my password. Thank you so much for your help. I set up a secret camera in the corner of the office so that we can record Dr. Chan's criminal acts. Let's wait for him to come.

~~Scene 6~~ (Dr. Chan Angle)

Door(Dr. Chan):

Jeff, I will not let you expose my records.

~~Scene 7~~ (Dr. Chan Angles)

Hacking game that must fail

~~Scene 8~~

Time shift back a bit to me and jeff in office

I:

Let me guess, your password is xxxxxxx, right?

Look at how shocked you are, seems like I am right.

It is no surprise that I can figure it out. You need to be more aware of password security.

Although you are an expert in hacking, you are too careless for your own good.

A good password should be long and not include any birthday or vocabulary.

Besides, it should consist of both upper and lower letters, even better if you put in special characters too.

Now you know what makes a strong password.

Don't forget to change it once a while as well to be safer.

After you change your password, your hint here will not lead Dr. Chan to your password.

~~Scene 9~~ (Dr. Chan Angles)

Door(Dr. Chan):

I am so close. I will not give up. Not now, NOT EVER.

Episode 6:

~~Scene 1~~

Computer(Jeff):

We have successfully recorded Dr. Chan's malicious actions but I think we still need more evidence to pin him down.

Just now I have received an email, probably a phishing email from Dr. Chan.

Originally, we would not open it to prevent our computer being hacked but now we still need more evidence.

So I have got another plan, I will use another phony computer to read it and let him hack that instead.

While he is hacking, I want you to catch him.

If you can successfully apprehend him, combined with the previous recordings and my criminal records in hand, there will be no escape for him.

~~Scene 2~~

Computer(Jeff):

Seems like he is trying to hack my computer now. We don't have much time before he gets away. Hurry up.

~~Scene 3~~

Game instruction

~~Scene 4~~

Maze game

~~Scene 5~~

Computer(Jeff):

Thank you so much for your help.

Finally, all's well that ends well, everything is over now.

I have delivered the information to the police.

I think they will be contacting me in a few days.

As the criminal records include a strong relationship between me and Dr. Chan, I will most likely be taken into custody too.

Maybe it is a chance for me to turn over a new leaf.

If lives give us a second chance, I will not be a hacker.

How about you? I am sure you have your answer already and I respect that.

~~Scene 6~~

I:

Why did I even join the group in the beginning? For justice?

But what has been done and I am no different than a criminal.

Why did I learn about cyber-security?

Was it for committing crimes?

Maybe it's time for me to think about my future clearly.

Hello? Is it 999? I would like to turn myself in.