A MMORPG to raise Public Awareness on Computer Crimes

COMP4801 Intermediate Report

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Submission Date: 19th, January 2019
Abstract

Following the recent decade of technology improvement comes the trend of digitalized lifestyle, which people store the majority of public and private information in forms accessible by the Internet. Due to the lack of cybersecurity knowledge, criminals have committed various attacks against these data, causing property lost and privacy leakage. This project, therefore, aims to translate difficult cybercrime concepts into a massively multiplayer online role-playing game (MMORPG), which is expected to be more understandable and attractive to the majority of the public.

Acknowledgment

I would like to express my very great gratitude towards Dr. Chim for his valuable feedback and positive support during the planning of this project. His active response to our questions and willingness to offer us additional information is greatly appreciated.

I would also like to give my special thanks to my teammate and my family for the inspiring ideas they offered to me throughout difficult times.

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Abbreviations

MMORPG: Massively Multiplayer Online Role-Playing Game
CCU: Concurrent Users
PUN: Photon Unity Networking
API: Application Program Interface
GPU: Graphics Processing Unit
PVE: Player Versus Environment
PVP: Player Versus Player
NPC: Non-Playable Character
1. Introduction

This section introduces the topic in two separate parts. The first paragraph provides background information about cybercrime, which leads to the inspiration for designing an appropriate method to raise public awareness of cybercrime. The next part briefly explains the reason for selecting MMORPG as the media for the above design.

1.1. Cybercrime

The usage of digital devices has become one of the major activities in modern daily life due to technology improvements over recent years, which has not only stimulated the digital economy but the cybercrime industry alongside, which is estimated to acquire over 1.5 trillion US dollars on an annual basis (Table 1). Whilst the public has been aware of a few famous ransomware crimes, such as the WannaCry attack, these incidents only possess 0.06% of the full scope, which is insufficient for the educational purpose of raising public awareness on cybercrime through actual incident exposures, as suggested by researchers [2]. The study also mentioned the student group of age 18 to 30 being the most vulnerable target, possibly related to the relatively heavier reliance on social networks and internet services. In order to efficiently improve overall awareness of cyber-secure behaviors, we try to design an effective training method based on common interests of the target group, which is mainly students within the 18 to 30 age range.

<table>
<thead>
<tr>
<th>Crime</th>
<th>Annual Revenues*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Illicit, illegal online markets</td>
<td>$860 billion</td>
</tr>
<tr>
<td>Trade secret, IP theft</td>
<td>$500 billion</td>
</tr>
<tr>
<td>Data trading**</td>
<td>$160 billion</td>
</tr>
<tr>
<td>Crimeware, CaaS (Cybercrime-as-a-Service)</td>
<td>$1.6 billion</td>
</tr>
<tr>
<td>Ransomware***</td>
<td>$1 billion</td>
</tr>
</tbody>
</table>

*totals are approximate  
**Revenues derived from trading in stolen data, such as: credit and debit card information, banking log-in details, loyalty schemes and so on  
***Revenues derived from extortions based on encrypting data and demanding payments

Table 1: The annual cybercrime revenue estimates of 2018, showing a large portion of threats aiming at personal information and digital properties [1]
1.2. Gamification

Based on the target group mentioned in the previous paragraph, this project uses gamification to convert the concepts of self-defending against computer crimes into a game of MMORPG genre, which has an average distribution of players’ age similar to the computer crime victims, in order to attract users [5]. MMORPGs have been known for their large player base which can partially resemble functionalities of societies in real life, therefore researchers often perform experiments or use data from games of this genre to study people’s social behaviors. It is expected that this characteristic can increase the credibility of in-game cybercrime incidents to simulate actual exposures.

The choice of using games also provides the ability to visualize abstract and complex concepts for the majority of non-specialist audiences. In terms of game mechanics design, the project focuses on the transition from cybersecurity knowledge to in-game battles, as studies have shown a better concept delivery in battles compared to quests [3]. With proper design strategy, the project should be able to encourage players to evaluate their personal cyber secure level, then improve with concepts taught in the game.

1.3. Outline

The remaining of this report begins with the materials that inspired the game design. Afterward, the objective of the project is explained in terms of short and overall goals. Selected software and tools are then covered in specification before moving on to the elaboration of methodology and current results. Finally, the report is concluded with future plans and anticipated difficulties along the progress.

2. Inspiration

The project picks up inspiration from two worldwide famous games. The first game is Watch Dogs 2 (Fig 2), which was recognized as one of the forerunners in the game industry that introduced technology concepts through action games. It has been praised for its
character and story design, featuring a hacker protagonist with abilities to control various devices to assist his actions based on a measurable strength, which was the number of followers that supported his action and agreed to share their devices for his processing power needs. During the game design stage, the project will be referencing from this game to create a balanced storyline with similar goals of concept visualization. The second game is World of Warcraft (Fig 3), a fantasy MMORPG game that has survived over 14 years and holding the most popular online game record until this day. While developing MMORPG related features, the project will take into account the user interface and quest designs, combined with the game’s modern background to create a smooth transition of technology and fantasy, which will help improve our original design.

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Fig 1. Screenshot of Watch Dogs 2, showcasing drone control and identity framing abilities
3. Objective and Scope

The main objectives of this project are listed in this section. In order to help clarify the scope of this project, it also mentions other goals that are related to the game but not in the scope itself.

3.1. Short-term Objectives

The goal of this project is to raise public awareness of personal cyber secure behaviors by confronting various computer crimes in the MMORPG simulated environment. Considering that the target audience is not exclusively students, the project aims to create a proper gaming experience for all ages, with some exceptions of more age-specific incidents as challenges that set aside the main storyline, which allows different age players to decide optionally. Overall, concepts of all chosen topics, including procedures of committing and defending these crimes, will be interpreted as interactable game objects and mechanics, simplifying the learning process for all players.

3.2. Long-term Objectives

In the long term, this project defines and follows an expandable structure in order to maintain feature updates over time, which enables the game to introduce new types of
cybercrimes and keep players interested. Ideally, this will allow the game content to respond to rising new threats and spread out any defensive methods against preventable attacks in the future.

The testing of this project will mainly focus on game contents and user experiences including battle mechanics and themes, with the purpose of equipping players with sufficient knowledge to protect themselves from cybercrime in the real world. Therefore, we are not planning to host a large-scale multiple server structure for high-intensity player tests. Nonetheless, we will still aim for an optimized single-server game with a minimum of 10 CCU when running the product test.

4. Specification

This section describes in detail the software and tools for this project, followed by explanations of the reason of choice. In order to keep track for debugging process in future developments, version numbers are also specified.

4.1. Choice of game engine

The platform for game implementation is the Unity 2018.2.14f1 version, which will not be further updated during the scope of this project, considering that Unity updates often affect existing functions and may cause unexpected errors if the code is not adapted to any core feature adjustments. The Unity engine is chosen for its rapid growth in the game development industry recently, along with access to a variety of online community sources and additional development tools that can support specific requirements.

4.2. Extensive tools

One of the extensions we are using is the Photon PUN service. By using Photon’s provided API, we can simplify the implementation of multiplayer-network on the Unity engine. Considering the minimal scale of test players in the project, Photon is sufficient in maintaining an expandable multiplayer framework and can enable more implementation
effort on contents and mechanics design. In terms of theme and asset creation, additional tools including SketchUp and Blender is used for creating the core 3D assets, while the rest of the majority is supported by Unity’s online asset store.

5. Design, Current Results, and Future Directions

The first subsection discusses the game content design, which is essential to initiate the implementation of most game system and mechanics. On the other hand, the second subsection provides details on more generic implementations for the rest of the game. The last subsection shows results of current findings in seeking for suitable cybercrime topics, and how these findings will be handled in the next phase of the project.

5.1. Game content

The section of game content design contains the decision criteria of the cybercrime topics that are used in the game, the core gaming style and theme, and the game mechanics involving the current storyline designs.

5.1.1. Topic acquiring procedure

This subsection describes the procedure of acquiring suitable cybercrime topics. First, a few potentials that have higher risks of occurrence are identified. Each topic is then evaluated based on a given standard which considers the feasibility and difficulty of matching its concept to common role-playing game elements. Topics that can be used for designing in-game operations on technical devices are awarded extra points, for the reason that they can educate players in the way people actually operate on real-life devices, which can deliver a more realistic message, supporting the project aim of simulating exposure to actual cybercrime.

5.1.2. Core feature

After observation of popularity in games with fictional themes, we have decided to develop around the feature of traveling back and forth between a futuristic reality and fantasy
virtual world. The decision of a future game background allows usage of realistic in-game objects, for instance, computers and servers, to present more solid knowledge in software and hardware fields, leaving space for visualizing abstract concepts in a fantasy theme, which resembles the digital world where cyber actions take place.

To implement this feature, we planned to set a flag for each environmental object which determines its visibility to each player depending on which world the player is currently in. After studying the Unity GameObject mechanism, we separate this approach into two parts, namely shader and collider modification. When transitioning from world to world, shader modifies the object transparency which reverses visibility when GPU renders the camera view on-screen. Collider is only modified when world transition involves changing the shape of an object touchable to the player. For instance, a barrier can be set in one world that only allows players in the other to pass through, which can be used to visualize hacking actions.

5.1.3. Player classes

Character classes from common RPG games will be slightly adjusted to fit into several specialties in order to highlight the uniqueness of different roles in the game world where every player is a hacker. This design of intensive hacker population can then create a game world with frequent cybercrime occurrence. One of the essential features in MMORPGs is the design of quests and dungeons that require team collaboration. To simplify the team formation process, these classes can be further categorized into three roles.

“Damage Dealer” is the main damage source, with a more aggressive skill set that enables the player to perform various cyber attacks. On the defensive side, players who picked a class in the “Tank” role can obtain more protection skills to nullify incoming attacks, whereas the “Healer” role outstands in fixing the damage done by previous attacks.

5.1.4. Game mechanics

The player experience can be divided into two modes, namely Player Versus Environment (PVE) and Player Versus Player (PVP).
In the PVE mode, one main storyline will be designed to guide the player on a path of character development while reviewing famous incidents in the history. It is expected that the player will witness the consequences of ignoring the threats post by cybercrime, leading to the goal of the story that emphasizes the importance of self-protection while using smart devices. As mentioned in the previous section, the player will be given a mission to confront enemies with overwhelming strength in a team of 3 to 5. Players will learn that some cyber crimes cannot be countered alone and that many threats can penetrate through security if the cooperation is incomplete. Several incidents will be used to form the climax of the story.

The PVP mode, on the other hand, grants players the ability to initiate attacks towards players of different factions. Several aggressive types of cybercrime will be introduced through this mode, encouraging players to memorize related concepts in order to defeat other players and fulfill their ambitions.

5.2. Generic MMORPG designs

This section contains details of code designs that are either implemented or scheduled to be done in the future. The main focus in this part is to replicate features generally shared by most MMORPGs, such as character controls, enemy behaviors, and object selection.

5.2.1. Character Movement

There are two approaches to enable character movement in the game, this section first elaborates both approaches, then discuss how they are embedded into the game system.

Using the physics engine in Unity, one can simulate real-world collision by assigning colliders to the character and surrounding objects, then assign rigid body to apply forces, such as gravity, that calculates magnitude based on a modifiable mass value. Figure 3 shows the testing of a player movement prototype using the default player model provided by Unity. Instead of calculating the dynamic shape of the moving character, a capsule-shaped collider is chosen which sacrifices accuracy in exchange of a relatively little computational load.
Fig 3: Showcase of character movement in the physical system, the collider of the character is highlighted in green outline

The second approach operates around Unity’s AI module, using the NavMesh system to read in meshes, a group of 3D vertices that form the shape of an object, for a set of environmental objects. The NavMesh system then applies the “Baking” procedure to generate a walkable panel, which allows the AI module to calculate the best path between any pair of points on this panel. Figure 4 shows the same settings in Figure 3 replaced with the NavMesh system and several objects added to display the obstacle avoidance feature of this system.
Fig 4: Showcase of character movement in the NavMesh system, the generated navmesh is highlighted in blue

One significant difference between the two methods is that the NavMesh system lacks a proper solution to implement jumping, whereas the physics system requires self-implementation of a more complex pathfinding function. As a workaround for this issue, we plan to preserve the physics system for players since pathfinding is not used by player-controlled characters and a higher mobility can provide a better overall user experience. By contrast, we have decided to maintain the NavMesh implementation in Figure 4 for Non-Playable Characters (NPCs). After observing NPC behaviors in World of Warcraft, a larger slope angle is being set to increase flexibility in vertical movement, which presumably enables NPC to approach the player for battle engagement or initiating dialogues.

It is worth noting that an additional method is considered for player movement. We are working on an implementation to shift to the physics system when the player jumps mid-air and resume NavMesh once landed. If we can achieve a satisfying smoothness with this hybrid alternative, the current physics system will possibly be replaced in the future.
5.2.2. Camera Positioning

Unlike many other game types, MMORPGs tend to have more freedom over how players can customize their interface and camera positions. Figure 5 demonstrates the design of our player camera, which is attached to a camera hand on one end of the camera arm object. Upon initialization, the camera controller script searches for the player’s character model and resets the transform component as a child object of the character, enabling the camera to follow and rotate with the character maintaining a distance which is the length of camera arm by default. The mouseScrollDelta value then records the scroll wheel movement in each running frame, adjusting the camera hand along the arm direction accordingly to fulfill the zoom-in/zoom-out function.

*Fig 5: Structure design draft of the player camera*
Future improvements on the camera controller script will further add in options to adjust the magnitude of the camera angles while pressing down the left mouse button. Once the character movement is finished, an update will be made to the right mouse button to enable a more intuitive and precise alternative for rotating the character.

5.3. Progress of topic search

To begin with, we have browsed through posters and advertisements produced by the Hong Kong government and police force. The observation in these sources revealed urgent needs of educational programs regarding social networks [4]. Additionally, we noticed repetitive mentions of tips regarding reinforcement of one’s password security. In the future, we will expand this topic further and evaluate the possibilities of interpreting the principles of cryptography for non-specialists. In addition, other issues related to social networks, such as privacy invasion and cyberstalking, will also be listed for consideration in upcoming stages.

Analyzing the revenue distribution of cybercrime from Table 1, we acquired the topic “Phishing”, which involves in many incidents that sum up the majority of revenue share. Phishing is a hacking technique widely used to steal valuable information during Internet browsing. A Malicious program first pretends to be from reliable sources such as famous companies, after cheating the target into providing information regarding important accounts, the hacker is able to access the account and gain profit by any means. Defending against phishing requires internet users to be able to identify false information. Since the disguised forms of Phishing evolve over time, the educational programs should as well update users frequently in response to new technologies, which suits the long-term objective of this project. Therefore, the following of the project will focus on producing an adapted version of phishing identification and current standards for verifying the trustworthiness of internet source.
6. Difficulties

Currently, the development process has been aligned with the original plan. No significant difficulties require the project to revise the schedule. This section will only discuss uncertain issues that have been noted during the making of future plans.

6.1. Low Feasibility of Illegal Market Issue

Even though illicit market trading is the top issue in the revenue list (Table 1), we cannot draft a feasible transition of this topic to be included in the game. Presumably, illegal marketing may be more technically easy to non-specialists, inferring that the majority of digital device users do not necessarily demand explanation to understand this topic. Nonetheless, once the Mall system is introduced, we can still attempt to preserve this as a minor topic by combining illegal marketing with the Mall system to offer players a cheaper platform for purchasing in-game properties at their own risk of getting fake product or traps randomly.

6.2. Migration of Codes

The current programming work is tested separately. One teammate studies Photon’s multiplayer network and the other develops the movement and camera system. While the network code is written with multiplayer structure in mind, the movement system and camera controls, for the purpose of efficient prototyping, are currently designed from the perspective of a single-player RPG. The current schedule is able to tolerate minimal modification workload when migrating the two implementations, which has yet to consider more complex adaptations related to the limits and rules of the Photon network itself. It is essential that we setup the Photon server soon in order to start migrating early on.
7. Conclusions

The report has provided a description of the game concept and game mechanics. A detailed justification is made to explain the concept of gamification and why MMORPG is chosen as the media. The research up to this point has covered the draft and prototype design of the game. Topic searching is nearly finished, therefore the next phase will be focusing on more in-depth research of the acquired topics. After studying its related theories and rules, a written design will be submitted with the information translated for non-specialist readers. Overall, despite the team spotting a few difficulties in future development, the preliminary result is on track, and we are looking forward to work on the remaining of the project.
References


Appendices

Appendix A. Game Background Design

- In the 22nd century, technology has advanced to a point that nearly every citizen is connected to “Societal Reactive Facilitation System (SRFS)”, a centralized social network system that manages people’s daily lives by providing assistance to its users with well-rounded public facilities which can be found in every corner of the city.

- Each citizen holds an identity that can be recognized by the system, which can be used to purchase items or use public transportation...etc.

- A kind of wearable device ARGUS is widely used by all citizens, which can grant them an Augmented vision and many functions that it is as important as smartphones in the current times.
  - Professional users (such as the hackers) will additionally install a set of advance gears that can further increase the Augmented Reality to a level of MR/VR, professionals usually call this the Avalon (or CyberWorld/Cyber-Dimension).
    - The user status in Avalon is closely related to the level of gear they have since any action in the cyber-dimension is a huge burden to computational power.
    - Abilities can be obtained by computer knowledge (learn mind control once you pick up the knowledge to manipulate sessions) and/or better gears (once you start having GPU, you will learn the ability to “see through” -- which is, mark enemies on map...etc.)
  - Avalon users tend to hide their true identity, therefore a unique magical fantasy theme has been used since the very first generation of Avalon users (they have a taste for this kind of genre).

- The Avalon is dominated by Hecklr, a group of highly professional hackers who commit serious cybercrimes without leaving any trace. Despite the effort of the police force, none of these hackers has ever been caught or identified, rumors say that they
often show up in the cyber-dimension to give orders to other groups that have surrendered and work for Hecklr.

○ Lore: More details on Avalon and its pioneer Merlin
  ■ Codename: Merlin
  
  Merlin is the name of the mysterious creator of Avalon, who had a taste for medieval lore and legendaries of The Knights of the Round Table. As of today, Merlin is nowhere to be seen, but many believe that he is still alive.

  ■ It is said that the sacred place of Avalon is heavily guarded by the green knight, who shows no mercy to outsiders who dare to step in. This is probably the most possible place to look for the Hecklr members...or any hints of Merlin’s whereabouts...

● The player was a victim to one of Hecklr’s crime events. After being framed by Hecklr as a cybercriminal, you were sentenced to jail. One night, someone sneaks in a brand new ARGUS and helps the player to create a new identity. This voice then guides the player step by step to collect the gears that can help you enter Avalon for the very first time. In the end, the player needs to make use of his/her brand new abilities with the assistance of this anonymous helper, successfully break out of prison.

● The player then meets up with this helper and finds out that they belong to a secret organization authorized by the government to track down members of Hecklr. It turns out that most of the members of the organization share similar stories. The player then accepts the mission as an undercover agent and together with the crew, they will try to dig into the Avalon and reveal the secrets of Hecklr without exposing their true purpose.

Appendix B. Story Script of Chapter 1

--------Scene 1--------

[Scene: Inside the criminal photo shooting room]

[Zoom in to that close shot of the character’s face]
--------Scene 2--------

[Scene: Inside the jail, character walking to his/her one cell]

Voice-over: Why did I ended up here? It’s all because of those hackers. Someone hacked my ARGUS and use my identity to do some illegal thing that I am not willing to do. And the police didn’t let me explain at all.

[Scene: Cell door being closed]
[Camera shoot from the outside of the cell]

Voice-over: That’s the short version of my story.

[Glass door closed.]

Voice-over: Now, I have to stick with this cell for my entire life.

[Camera switch to security camera of the cell]

Character kick the bed

Character: Errrrraaahhhhh!!!!!!

Character sit on the bed

[Character walk to the glass door and swipe the glass with the finger]

[Some information shown up on the glass]

[ Criminal 0415 ]

Sentence : 300days

]

[A glitch appeared on the screen]

[ Criminal 0415 ]

Sentence: Execution in 5 days

]

Character: Wait… What?

[Character start to knock the glass]

Character: Hey!!! Anybody here? Guards!!! Something’s wrong about my sentence!! HEY!!

[The whole facility blacks out]

[After a few seconds, everything starts working again]
[Character noticed a tiny flash of light coming from the corner of the cell]

[Player starts controlling the character]

(Player walks towards the light and finds a box covered in optical camouflage)

Player: What is this? An ARGUS?

(Mission: equip ARGUS)

A voice A comes out from the ARGUS: Ha! Told you he wouldn’t notice the box!

Another voice B: Alright! Dinner’s on me...screw that camouflage...

Voice A: Uhmm! (Clears throat) Hey you! Yes, you! Act normal! There is no time to explain, I am here to get you out. Follow my lead if you want to live!

Player: Okay, what should I do?

Voice A: First, I need you to activate your SRFS!

Player: What is that?

Voice A: Haha Nice joke. You got me. Knock it off! (Silent for a few second)

Wait...Seriously!? You don’t even know SRFS? Okay, listen. SRFS stands for Societal Reactive Facilitation System. It provides an augmented visible interface to users and we all need it to access facilities around the city. (Sigh) Nevermind, just follow my instructions and you’ll figure out how to use it. It’s pretty easy to learn.

(Mission: activate SRFS on your ARGUS)

[AR vision appears]

(Player follows the instructions step by step and gathers the materials from prison’s control room)

...

(Mission: initiate process to enter Avalon)

[World Transition -> Avalon]

(Player creates character model)

Voice A: Hmm…Not bad for a beginner, huh?

[A appears in front of player as a cloaked figure]

A: Yeah, it’s me. Don’t be too surprised. (Walks around for a bit) …This form here (Points at himself) is all I can get through, I don’t have much time left, so let’s make this quick…

(A gives a brief tutorial on basic controls in Avalon)

A: …See that shield over there? (Points) Shut that thing down with everything you’ve got. See you on the other side, rookie.
[A disappears]
(Mission: defeat the defense matrix of the prison’s security system)
....

--------Scene 3--------
(Following the guide on the map, the player arrives at the entrance of a secret passage)
[Player gets into a secret facility]
A: Welcome welcome! Welcome to our facility rookie. I am the director of this department. You can call me Loki. Here, let me show you the way so you don’t get lost in here.
[Loki starts walking around the facility and player follows him around]
Loki: 6 years ago, an anonymous hacker group rose and start to commit a lot of serious cyber crime across the world. They call themselves Hecklr. No one is able to figure out who they are, or even get near them. We have been spending 4 years trying to chase them down, but still got nothing. Our close relationship with the government makes it…a bit DIFFICULT to get our hands on Avalon. Starting from last year, Hecklr starts using other citizens’ identity as disguises to misdirect the police, then wiping out these innocents by faking their sentences. You are the fifth victim of their doings. So we grab the chance and take our move.
[Loki and player get into a room with 4 people standing inside]
Loki: We secretly rescue you all without being noticed by Hecklr. Together, we formed a hacker organization to go against Hecklr. We are…Tyr.
(Loki raises his arms)
Loki: Welcome to the crew.
Loki: From now on, the old you shall remain executed to the outside world, and you are reborn as a member of Tyr. We will remain undercover on the dark side, and by ANY MEANS, accomplish the one and only objective: Take down Hecklr.