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Location Stalker:

A Serious Mobile Game to Raise Awareness Towards Location Privacy

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Abstract

The society is becoming more and more digital, and for the younger generations growing up today, there are fewer factors that separates their physical life and their life online. It would make them technologically superior to the generations before, but at the same time, also more prone to security and privacy breaches with their always-online lifestyle. Furthermore, research has shown that teenagers and young adults generally have less training in dealing with privacy risks, and that is concerning considering the number of threats there are out there. In this thesis, the privacy issues of location privacy are the focal point of the problem. This is the privacy risks that concerns sharing of ones geographical location information to the world.

The main goals of this thesis were to design a serious mobile game, that would help increase the awareness towards location privacy, especially amongst younger people. The game should be able to balance fun and an enjoyable time, with a good educational gain from playing it. The game has been designed to use collaborative and competitive gaming elements in order to create a more engaging gaming experience. In addition to just raising the awareness, the game also has an objective to teach the players about location privacy threats and aims to educate the users on how to protect themselves and let them learn by playing a realistic, but an exaggerated story, based game, which puts them into the relatable scenario for learning.

An evaluation of literature reviews from the relevant, related works in this research area has been conducted. The analysis was done on different genres of serious games, games with location-based elements, multiplayer games to gain insight on how to make a game competitive and engaging, and more. The information learned from the literature reviews has been applied to the game design.

The work resulted in a design for a mobile, multiplayer serious game that raises awareness towards location privacy. The game lets the players experience location privacy threats, and in after the process of living in the stories, the game aims to educate them on these scenarios, and how to prevent them from happening to you.

Problem Description

Nowadays, teenagers are growing up with modern technologies incorporated in their daily lives that their physical lives are almost fused in with their social media lives. With so much information being out in the internet, the privacy of personal data could always be at risk. The current trend of mobile social networks are still increasing, and the users are sharing more information than ever before. One specific popular trend is the use of location-data in Geo-Social Networks and other mobile apps. With your location information in the wrong hands, the risks can be high for privacy leakage horror stories. It is especially dangerous if a person's information is leaked while he or she does not know the consequences of it.

The focus of this thesis will be to research the possibilities of changing how lightly location privacy is being taken. The idea of designing a mobile serious game to raise awareness towards location privacy will be explored. The goal is to design a serious mobile game that promotes awareness towards location privacy, while providing a fun and engaging learning experience for teenagers and young adults.

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Chapter 1

Introduction

1.1 Motivation

The use of geo-location in mobile applications and social media is still trending upwards. The technology and the information geographical data sparks new ideas for innovation and creates useful features for current applications. With the increasing features and opportunities, the risk for harmful privacy data leaks increases with it. There have always been risks of personal information being exposed to social media usage, but with personal location-data being in the wrong hands, it is more dangerous than most people may think.

Teenagers and young adults make up a user group that is prone to be exposed by privacy infringement risks in social media [1]. The youth's knowledge of general information security is already concerning. They are growing up in a digital world, where their parents might have no experience with growing up in the digital era. Adults have a safer approach and are generally more aware of dangers when it comes to privacy and the internet. Young people tend to become naive and forget there are privacy threats and dangers in online technologies, as it has been regular everyday activities their whole lives. They have access to everything they might want in the palm of their hands, and it has been like that for as long as they can remember. In 2018, NorSIS (the Norwegian Center for Information Security) conducted a study on the digital society and concluded that the human and the technology is in the process of becoming one [2]. In 2017, the year before, NorSIS organized a study on Norwegian teenagers and adults. The research was about training in information security. The study explains that in the last two years, only 28.4% of the youth has received training in the topic, as opposed to adults, which are 52.4% [3]. This shows that the youth generally are more prone to privacy risks and breaches, not only by having less training in the subject but also while being one of the groups with the most exposure and use of technology and social media.

location privacy is a sub-genre under the whole privacy umbrella. Since the use of location-

based systems and applications have started to increase, the privacy concerns grew with it. The danger of having your geographical information leaked to unwanted individuals and corporations could be frightening. There are harmless and annoying consequences like advertisements and spam, but there are also more dangerous ones like stalkers, kidnappers, or even murderers. An incentive of this thesis is to raise the awareness of these threats and help people become more knowledgeable in their choices in the usage of location-based systems.

Video games have been an important this generation's teenagers and young adults. To help raise awareness towards location privacy, a goal of this thesis is to use the technology in mobile gaming as a learning tool to design a Serious Game to teach location privacy awareness. Serious Games are games that are created with a goal of not being only entertainment, but also for educational, motivational, encouragement and enlightenment reasons. The thesis will explore different genres and methods of creating these serious games.

1.2 Research Questions

Awareness of location privacy is an issue that is consistently becoming a more important topic in the digitalized world. There are a considerably good amount of sources online to educate oneself and learn about privacy issues such as location privacy. The problem is that these usually are in the form of a long article, books, papers or an encyclopedia. Research has shown that teenagers and kids are more prone to privacy threats [1], and have generally less training in the topic than their adult counterparts [3]. A problem that this thesis wants to solve, is how to engage teenagers and young adults to learn about and be more aware of location privacy issues. Using a serious mobile game to help raise awareness about location privacy is a good way to engage the users, and will be the goal of this thesis to explore. The ambition of the serious game designed in throughout this thesis is to make young people aware of the location privacy dangers and motivate them to be more conscious about the issues of location privacy.

1.2.1 Main Research Question

The main research question for this thesis is:

- How can a serious mobile game be designed in order to raise awareness towards location privacy issues?

The main goal of this thesis is to design a serious mobile game to raise awareness of location privacy. In order to reach this goal, the users have to understand the issues and threats. To accomplish this, the game has to promote the dangers in a serious and realistic way. The serious game should provide a context the players can relate to, and should find ways to draw the players attention. Another objective the game has is to teach the players about how to deal with these dangers, therefore, it is important to explore the different

ways a serious game can be educating. One part of a serious game is to be entertaining, but it also has to be educational. The balance between these two factors must be found. Under the research questions, there are sub-questions that will help to answer the main research questions.

1.2.2 Sub-Questions

- **RQ 1:** How can a mobile game teach the players about location privacy?

In order to raise awareness towards location privacy, the users must be educated about the problems. There are many aspects of location privacy. The game can teach the players about the risks, or how to assess benefits and disadvantages. This research question will guide the thesis to explore ways to use serious gaming to teach information.

- **RQ 2:** What type of game mechanics can be used to raise engagement?

There are many ways a game can raise the engagement levels of the players. It could be by using interesting mechanics or by adding an attractive story, or something else. The thesis will explore ways to motivate the players to play the game and make it more fun.

- **RQ 3:** How can the game keep the balance of having fun while reaching the learning goals?

A serious game is a game that educates or raises the awareness of a player, while they are playing a game and having fun. There should be a good balance between having fun and learning, so the thesis will explore further in detail on techniques that will help the game raise the engagement while being educational enough.

- **RQ 4:** How can the game help users protect themselves against location privacy threats?

There are many threats and risks of location privacy, and one of the goals of being aware towards location privacy is to be aware of the dangers, which the serious game should help educate. The study must explore various ways a serious game can educate the players on this topic.

1.3 Research Method

In response to the research questions, the research method used was an iterative design process with two user test iterations. As a result, a preliminary prototype of a serious game being created, with mobile gaming and a goal of raising the awareness towards location privacy in mind. The process was tested and evaluated with players from the relevant user groups. The evaluation was done after each iteration with the research questions as a main focal point of discussion.

A co-design workshop was conducted with a group of teenagers. This was a preliminary study in order to get insight into their knowledge and awareness level of location privacy.

The workshop resulted in increased knowledge of the user group, and idea concepts that are based on their thoughts about privacy.

To gain knowledge in the area of research, a literature review was conducted. The literature was analysed with the research questions in mind, and how to design a serious game in order to fulfill those requirements. In the literature review, a set of different sub-genres in serious gaming were considered and analysed. The results from the research were positive and negative aspects of each relevant game types and would provide a guideline for concept creation for the game idea.

One goal of the research in related works was to find important game mechanics or game aspects that would increase engagement and learning potential. As a result, games with a collaborative or competitive aspect creates a more engaging experience for the players, therefore, a multiplayer, serious game was a priority when creating the game concept. Another important result from the related works was that the storyline of a game. The story catches the players attention and can create a relatable story that connects the player with the topic of location privacy. This helps with raising awareness.

After gaining knowledge of how to design a game concept. The concept was made and tested on players from the user group iteratively. After each test, there was a discussion session in order to receive the feedback more in depth, in addition to the observations made during the test.

The results of the iterations were used to evaluate the serious game design on positive and negative aspects, advantages and flaws with the research questions requirements in mind.

1.4 Outline of the Thesis

In chapter 2, the problem definition is elaborated. The definitions of privacy and geo-location privacy will be presented with concerns and threat risks related to the topic. Relevant scenarios from real life will be presented and discussed. Serious games are introduced in this chapter. The high-level requirements for the thesis are described in the end. **In chapter 3** a co-design workshop is conducted with teenagers for idea generating purposes. The process is described. **In chapter 4** the related works are researched, and literature reviews are being analysed. The chapter reviews relevant types of serious games that could help to answer the research questions. **In chapter 5** the game is designed. The process is described, and the game concept is presented. **In chapter 6** the first pilot test of the game is conducted. This is a paper prototype test in order to confirm if the concept is viable or not. **In chapter 7** a more refined prototype is created, a user test is conducted here as well. **Chapter 8** is the discussion section, and lastly, **Chapter 9** is the conclusions of the study.

Chapter 2

Problem Definition

The real world is getting closer and closer to be overlapped with the world online. The society is well on its way to becoming even more digital. Many tasks that traditionally were manual work, have now become automated and digital. Today's teenagers are growing up in a digital world. They have access to tools that can give them endless opportunities online. But with the possession of such great powers, comes great responsibility. Even though the changes to the digitalized society is trending in a positive manner, it does not only come with opportunities, futuristic innovations, and automated tasks. The technology comes with privacy and security risks and issues, and it is important to become aware of the danger that lies out there in the online world. With the way the society is progressing and becoming a digital world, there is no way to distinguish the technology and the human according to a report from NorSIS (The Norwegian Center for Information Security) [2]. The technology is so integrated into the daily life of this generation, therefore it becomes even more important to gain knowledge about the risks and dangers attached to it.

Social media consumption takes up a big part of the everyday life of a regular teenager in today's society. The youth have been using computers, smartphones, and digital tools their whole lives, and often, do not separate themselves between the digital and the physical world. In a previous report from NorSIS, they were researching the privacy knowledge of the general public of Norway's citizens. The results showed that adults generally have a higher awareness of the privacy risks online due to higher training about the topic. Meanwhile, teenagers have a lower percentage of training compared to adults which conclude in a lower knowledge base while thinking they are fully aware [3]. The reason that teenagers have poor training in this topic, is a result of minimal guidance and engagement about the topic. Dubestemmer.no is a Norwegian teaching resource online with the main goal to teach children and young adults to be more aware of privacy issues, and raise knowledge and the skill to reflect about these concerns while using digital media [4]. The resource is really well made, and they are covering many important issues about the topic. "PrivaCity" is a Master's thesis written by the NTNU students Berger and Saethre in 2017. In

that thesis, they raised the issue about learning about personal data and privacy through dubestemmer.no could be ”too traditional and formal” in regards to educational perspective. The idea of using serious gaming to teach the topic of privacy and information sharing for more engagement from the youth was explored by developing a chatbot game. [5].

Privacy issues in social media today does not only involve personal information like name, age and your description anymore, but there is also so much more information about each person online that they may not even notice themselves. One example is geo-location privacy, which will be the main privacy issue of this thesis. The teenagers' knowledge of general privacy is already this weak, are they aware of the privacy risks concerning their location-data? Referring back to ”PrivaCity”, this thesis will build further upon the idea to develop a serious game to better engage the teenagers. The main goal is to explore the specific area of geo-location privacy using a mobile game to teach the topic.

In a 2017 case study about teenagers' usage of Facebook. The paper revealed that one of the reasons teenagers specifically are vulnerable to privacy concerns, is because of the settings menu is too advanced, cluttered and poorly designed in regards to usability [1]. In November 2018, the Norwegian Consumer Council (Forbrukerradet), filed a complaint against Google for exactly this issue. In a research report, they discovered tactics Google used to manipulate their users of Android phones into something that could lead to monitoring, or surveillance. They are accusing Google of using deceptive methods to design their interface and using misleading information in order to lead users in the direction of accepting to be tracked constantly. Google is using ”Location History” and ”Web- and App activity” to track their users. These settings are an integrated part of a Google-account, therefore, would make it really difficult to stay away from [6] [7]. Just to get a grasp of the number of users this issue concerns: Every Android phone has to use a Google account. In addition to that, a large part of the users with Apple's iPhones are also using Google's services, and they are all vulnerable to Google's tracking tactics. One thing is that these big corporations keep big amounts of your personal information, but there is also a chance that someone else with more harmful intent can obtain this information in order to use for malicious reasons.

2.1 Privacy

In order to fully understand the concept of geo-location privacy, an all around, a general description of privacy is needed. Starting with the definition of privacy: *Privacy is the right to be alone, or freedom from interference or intrusion. Information privacy is the right you have to control your own personal data and how it is being collected and used* [8].

While the general definition of privacy is the right to be alone, an individual's conceptualization of privacy could vary. In the PrivaCity thesis, Berger and Sæthre collected four different concepts of privacy: *Privacy as Control*, *Privacy as Boundary Management*, *Contextual Integrity* and *Privacy Calculus and Trade-Offs* [5].

Privacy as Control:

Privacy as control is defined as having the control and knowledge about the information of oneself. Privacy as control is the right and ability to limit, filter and control the use of your personal data [9][5]. Privacy as control is also the ability to dictate not only the quantity of data but also the quality of the information shared [10][5].

Privacy as Boundary Management:

Privacy as boundary management can be described as the ability to be selective in the access of your information to others. The boundary management depends on the continuously changing rules of data access and disclosure [5].

Contextual Integrity:

Contextual integrity is a concept about respecting the social norms of a situation. Sharing the information voluntarily is not an issue in this case. The issue is when the same information, is shared outside the context of the situation [11][5]. In a location-based situation, when sharing your geographical location to your close friends and family, the context is to be safe and let them know where you are for security reasons. Once this information goes out of this context, for example, if someone with malicious intent obtains this information, that would be a privacy threat to the contextual integrity.

Privacy Calculus and Trade-Offs:

In privacy calculus, the user itself weighs the risks and benefits of information sharing. The decision of either to share or not to share the geo-location-data to the world comes with advantages and disadvantages [12][5]. The judgements to make these decisions are a matter of weighing privacy trade-offs. This concept shows that it is not right to scare the users away from enabling location information, but rather teach them about the trade-offs. Why does this benefit you? How could this be a risk? The goal is to let the user have the final decision, but deciding responsibly after being aware of the risks and how to prevent them from happening.

2.1.1 Geo-Location Privacy

Since the popularity of location-based systems started to grow, it also raised serious concerns about its privacy issues. In the years of the 2010s, an increasing amount of location-data about technology-using individuals became available [13]. This information typically relates to the user's real-time location or an exact location they have been. Using this data, one can determine an individual's traffic patterns, daily travel routes, and points of interests. The user is vulnerable to revealing information that they may or may not be aware of. Some of these where they usually eat, where they study, or even more dangerous, where they live. By using specific location information, it could even reveal other sensitive personal information just by association. It could reveal one's health issues, affiliations or habits. Although usage of location-data raises various privacy concerns, it is not only negative. Developers have been increasingly using geo- location information to innovate and create ways to benefit from it. One can for example really quickly find nearby attractions and activities to do on vacation in a new place or find the closest sushi restaurants, or locate the nearest bus stop to your real-time location, or even find out where your friends are.

Even though there are really dangerous scenarios of location information leaks, the most common way to be exposed is by receiving a lot of advertisements and spam. A business can offer you a deal related to where you are, or where you have been. Once you have arrived in a new city for a trip, a restaurant near your hotel can offer you a place to eat lunch. Sometimes it can be useful, but often, even though there are usually settings to turn it off, it could still be annoying.

2.1.2 Geo-Social Networks

Often when location privacy issues show up, it relates to social media. A Geo-Social Network is a social network that provides a service which uses location information that associates with the users and their content [14]. These types of social networks use geo-location to provide features such as Facebook's geo-tagging of photos and statuses [15], or Twitter's location-based tweets [16], or Snapchat's usage of maps [17]. While these are developed as features intended for the users' benefit, it may as well become a threat if the information can get into the wrong person's hands and they can associate a user's identity with its sensitive data.

In a 2011 report named "Location-Related Privacy in Geo-Social Networks", they formed the location privacy threats into three categories: Location Privacy, Absence Privacy and Co-Location Privacy [14].

Location privacy is the most common one of the three. This means to reveal one's own location to others in the geo-social network. Risks of location privacy are associated with the user's identity and related sensitive information.

Absence Privacy is about how far the user is from a certain sensitive location at a given time. The reason why this is a threat is because a criminal who wants to take advantage of your location information, could calculate the amount of time the user would be away from a specific location. An example is a burglar who plans to rob the user's house while the victim is away. This is a violation of the absence privacy.

The third threat category is Co-Location Privacy. This considers a one user may observe concurrent presence of other users. The location information to retrieve from these types of threats would be by a user in the Geo-Social network by observing others, and that could lead to sensitive information about the relationship among the other users.

Privacy issues in Geo-Social networks could be more difficult to deal with than general location-based services. In social networks, the location information is exposed to a larger amount of people, where each of them could be an adversary.

2.2 Relevant Location Privacy Concerns

There have been some cases in the digital world that has raised a concern, or maybe even fear. In this section, there will be stories from articles, blogs, newspapers, and various

media outlets that express a worry that the technology available could possibly be, or already is, a dangerous privacy threat.

2.2.1 Snapchat and Snap Maps

Snapchat is a well known social media that has a widely used geo-location feature, which has a high possibility of a privacy violation. The Snap Maps. The feature arrived in 2017, and immediately raised an alarm among the users. So why could this be a threat to privacy? Snap Maps updates your current location every time you open the app [18] [19]. Even though the information is only available to your ”friends”, or more specifically, the people you have added to your friends list, you can never be too sure who could possibly do something malicious with this sensitive information. The adversary would obtain information about where you live, and where you are at all times. This could be a serious stalking concern. Referring to *Absence Privacy* written about in section 2.1.2, a thief could use the information about where you live to intrude the house while you are not home.

Snapchat claims to delete the location information after a short period of time. Although the exact amount of time is never mentioned [18].

A more extreme fear of Snap Maps is that it could be a tool for terrorist attacks. A terrorist could obtain information about social events all over the world. The group that is most prone to these attacks are soft targets, unprotected and vulnerable civilians in a large, open public space, for example, a concert [20].

Another worry is that Snapchat allows children under 18 to sign up for this service. The user just has to be over 13 to use Snapchat. There is a concern that these teenagers do not understand what they are signing up for. NorSIS has already shown that Norwegian teenagers have a minimal amount of training in the area [3]. The teenagers are not necessarily thinking about privacy issues when enabling Snap Maps, and that is a problem.

Snapchat is not a stranger to security breaches. In 2014, a huge data breach affected 4.6 million of its users. Hackers managed to scrape sensitive information like the users' usernames and phone numbers [21]. A couple of months later, another security breach happened. It was called ”The Snappening”. Hackers had obtained at least 100 000 stolen Snapchat photos, where many of minors, that they could end up posting online. Snapchat claims that their servers were not breached, but there were third-party apps that have been storing the users' photos [22].

2.2.2 Tinder

Tinder is a well known, worldwide dating app. A French journalist asked Tinder about her personal data, and they sent her 800 pages of information about her in their possession [23]. The motivation for her to try to obtain her personal information from Tinder was because of the GDPR, the General Data Protection Regulation. Every European citizen has the rights to receive any personal information a company has of them.

The 800 pages contained every detail of every conversation she has ever had in the App. What if this information was leaked? Or hacked? The hackers would obtain a dangerously amount of personal data on her, by analyzing and associating her conversations. They would have found out what type of men she preferred, where she was at any time, and who she went on a date with.

An older vulnerability of Tinder was that a security firm, IncludeSec, revealed a location privacy problem in that would let hackers accurately calculate someone's exact location by using high school math. Tinder fixed the problem and according to them, luckily no one was able to use the latest exploit before they fixed it [24].

2.2.3 Egypt Uses Grindr to Arrest Gay People

Grindr is a dating app catered to the LGBT community. Homosexual acts are illegal in Egypt, and in 2014, the Egyptian police were using Grindr to track down gay people with the goal of arresting them [25]. The use of social apps for surveillance and to track down citizens are a threat against their own privacy. This is also an assault against fundamental human rights, according to Humans Rights Watch [26]

2.2.4 Happn

Happn is another mobile dating app. Happn differentiates itself from the other dating apps by using geo-location in a different way. The way it works is by tracking your location, detect when you cross path with another Happn user by being within 250 meters radius of them. After crossing paths, the users will see each other's profile and some personal information. In order to use Happn, the user will need to log in with it's personal Facebook account, which would transfer all the personal information over to Happn in addition to non-stop real-time geo-location [27] [28].

2.2.5 Chinese Social Credit System

A social credit system (SCS) has been in the development in China. This is a system that collects and tracks important parts of a citizens life in order to create an overview of debts and social status. The system is an app-module inside the WeChat platform, which is widely used in China. The way the system works is that it lets a user know if there are debtors around you within a 500 meter radius. Personal data about the citizens inside this radius will appear, and you will see their name, their national ID numbers, their debt if they are on the blacklist, and even why they are on there. The system is said to be released in 2020 [29] [30]. The goal of the SCS is to monitor citizens that have been blacklisted, to ensure that they are not capable of any more fraud. The intentions behind the SCS are good, but one can argue that this is a violation of an individual's privacy in an unethical way. Public shaming has been common within the Chinese system as a punishment [31].

Surveillance is nothing new in China. The city of Shenzhen can be described as ”China’s Silicon Valley”, is the city where big tech companies like Huawei and Tencent has their headquarters. Here, they are monitoring jaywalkers. With the help of artificial intelligence and facial recognition, the traffic police are able to put jaywalkers under surveillance. If someone jaywalks, a camera will catch that, and display their faces on a large LED screen at intersections for public shaming. Not only that, but they will also receive a message to their phone about it, and an attached fine for doing it. Jaywalking has been an ongoing issue in China, and they are solving it with publicly shaming the offenders [32]. A month later, the cameras were able to catch drivers doing illegal activities using facial recognition technology as well [33].

2.2.6 Conclusion of concerns

In the whole section of 2.2, multiple stories of various location privacy risks, threats and violations are shown. These threats happen on the regular, and the articles presented are highly relevant to the digital civilization today, in the time of writing (2019).

Users of technology today tend to leave their location on for convenience purposes. Which is understandable, because there are a lot of benefits in letting apps and programs use your location. One can access various features more efficient, for instance, the nearest bus stop. The problem though, is when users allow all types of applications access their location without knowing why it needs it, or how they are potentially using (or misusing) that information.

These stories and articles do not only tell horror stories, but they actually happened. Many of them in recent times. They are relevant and realistic for a wide range of people and should be a good introduction to why the topic is important, and why the awareness of location privacy should be raised.

2.3 Intrigue with Serious Games

The motivation behind creating a game to raise awareness about location privacy is because often, a game is more engaging to play than an article is to read. Especially in the eyes of teenagers, who are already experts on using technologies in the daily life, for both utilities and playing games [34]. This is where Serious Games comes in. The primary goal of these types of games are not only for entertainment, but to educate or encourage behavioral change, raise awareness in an entertaining way. Furthermore, it can also allow players to experience a scenario that is rare, impossible, expensive, or even dangerous to re-create in the real world [35].

There are multiple ways to engage an end-user with Serious Games, with no right or wrong methods. It is not a binary problem. One can, for instance, create a story the player can follow in order to obtain the learning goals. Another solution is to create a mind-blowing, realistic 3D graphics to amaze the users is another, which is a really time consuming and

expensive process. One can also use a new, unproven, or a playful technology that might spark an interest in the users, which leads to higher engagement.

A challenge of Serious Games though is the fun aspect. Even though it is a Serious Game, it is still a game, and being able to enjoy and having fun while playing very important [36]. One could argue that this is the main point of Serious Gaming, being able to learn in a more engaging manner. The problem is to balance it. The pedagogical objectives should be clear and stay at a reasonable level where the game can stay interesting while the learning outcome reaches its goal. On the other hand, a Serious Game should not be too tunnel visioned into making the game ”too fun”, to a level where it affects the teaching aims in a negative way [37]. At some point during the development, the game has to decide where to draw the line between what the learning goals are, and how much ”fun” and enjoyable the game is going to be.

2.4 High-level Requirements

In this section, a set of high-level requirements are introduced. This chapter contains theory that describes location privacy and an introduction to serious games. These high -level requirements below are directly tied to the research questions in order to create a guideline for the game design with the goal of answering the thesis questions.

2.4.1 Awareness

The overall goal of the thesis is to design a game that raises the awareness of location privacy. The most important requirement of this section is that the game has to consist of elements which let the user know about location privacy.

This requirement is linked to the main research question, as well as RQ4.

2.4.2 Engagement

The players should be motivated to play the serious game. Users would not want to play the game if it was too boring. The game should balance between having fun, being engaging, and at the same time, reach the educational goals.

This requirement is tied to RQ2 and RQ3.

2.4.3 Learning

The players have to learn about what location privacy is, in addition to just being aware. The knowledge goal of this requirement is for the players to gain a basic understanding of the theory and the importance that they do know about it. The game should teach the players the dangers of location privacy.

This is a requirement that supports RQ1

2.4.4 Collaboration / Competition

Collaboration is a great aspect to have to help with engagement and learning. When players play together, the engagement levels increases. It also gives an advantage for learning purposes. Players can share knowledge with each other when collaborating. Competition creates a competitive atmosphere that can increase the fun and level of engagement.

This requirement will help to answer RQ1, RQ2, and RQ3.

Chapter 3

Serious Privacy Game Workshop

To start visualizing a mental image of the problem, a co-design workshop was conducted in collaboration with six 16 to 17-year-old Norwegian high school (videregående) students. The participants were studying high school IT and had an intermediate understanding of IT, technology, and online privacy. The purpose of the workshop was to generate mobile game ideas with a determined goal to raise awareness towards location privacy for teenagers by teenagers.

The workshop used was developed as a result of a former Master's thesis by Dag Frode Solberg, called Serious Privacy Game Workshop (SPRIGWORK) [38][39]. The planned outcome of Solberg's original workshop would be a general idea concept of a serious game, with a goal of raising awareness towards any privacy problem in today's society. In order to tailor the workshop to fit this research purpose even more, the workshop parts were modified to result in a serious **mobile** game, and the goal was to raise awareness towards **location privacy** rather than just general privacy issues.

3.1 Workshop Description

The workshop consists of four parts:

- Reality - Looking at privacy problems
- Meaning - Looking at how to raise awareness of a problem
- Play - Looking at what makes a game
- Technology - Looking at how a player interacts with a game

The four parts of the workshop are to open up with a big idea, and as the day goes on, the idea proceeds to narrow down and be more defined.

With **Reality**, the beginning of the idea brainstorming starts. In this step, the students were constrained to a number of various cards that described relevant reality scenarios where location privacy problems could appear.

The next step, **Meaning**, is locked to ”location privacy” as the problem the game has to raise awareness towards. The students had to choose an already existing game, and change the game meaning, but not the mechanics, so that the goal of that gameplay answer the problem.

In **Play**, the students had to develop an idea inspired by the last step, and change some game mechanics and traits so the game had to be its own game, but in the same genre.

The last step, **Technology** is where it is getting interesting. When Solberg ran the workshop, he had an overall goal to create an idea for a more general game. The goal of this workshop is to specify the game to be a mobile game, which narrows the student's opportunities to only choose mobile friendly technologies. This sparked some creativity in them as they had to flip and turn their idea to cater for mobile devices only.

3.2 Running the Workshop

Before running the workshop, a presentation was held. The topic was about general online privacy and essential knowledge specified to location information and privacy. This quick introduction gave the participants enough general knowledge about the field to start brainstorming relevant enough ideas.

Starting with the Reality step, the first thing the students thought about was hacking of location-data. A game scenario one of them aired out was ”A terrorist attack by hacking Snapchat's location information about the users”. Another one was using the sensors and cameras around a Smart City to stalk and monitor the citizens. These were great starting points with a lot of room for further concept development later in the workshop.

In the Meaning step, the students changed the story of two games. One was Watchdogs 2. This is a game where the player is a hacker. The plot of the new game is to hunt companies that abuse their information about the users. The other student group chose quite a different game to remix. They remixed a mobile game called Papas Pizzeria. The game plot is to collect information about the people who eat at the restaurants. They can place GPS chips in the food and track important politicians and celebrities who eat there. The information can later be sold to terrorists.

In the Play step, they were to develop a new idea from the last step, using the same mechanics were quite challenging. In this step, the participants were asked to draw a picture of a scene from the game. This exercise sparked a bit of creativity and gave them a visual image of the game. It also created more engagement and opened up for more crazy ideas.

In the final step, they had to choose a technology to build their game idea on. The only technologies given were mobile friendly ones, so they had to tailor their ideas to fit the mobile platform. Both groups chose the card ”Augmented Reality”. They felt Augmented

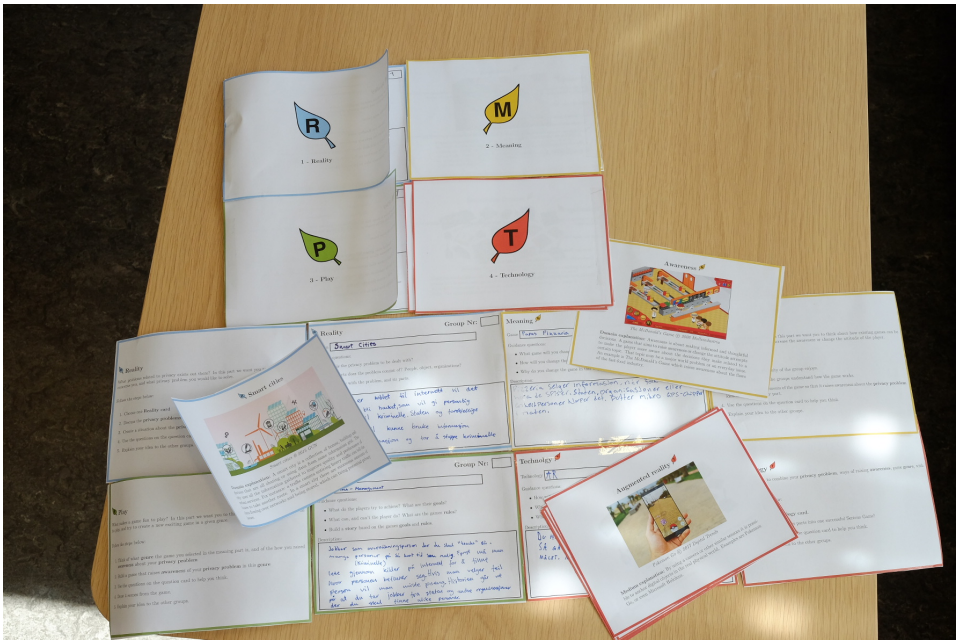

Figure 3.1: Running the SPRIG Workshop

Reality was fitting for their ideas, where one group chose to use it to display things to find through an AR view, after getting information, or ”missions” about where to go. The other group wanted to use AR to display information on things in real life that is ”hackable”.

After all the steps of the workshops, there were a little bit of time left. After observing them draw and brainstorm in the ”Play” step, the remaining time was spent on drawing more game scenarios. This time, from the finished idea. The drawings came out nice, and the goal was reached. Two useful game concepts were made, and they both served a purpose of having the topic of location privacy. As for learning, probably not so much. That is a job for the next chapters to further research the design of serious games, how to make them playable, and maximize the learning opportunities of the games.

3.3 Thoughts about the Workshop

The students thought the workshop was interesting and fun, and it was a good time spending a day working with it. Good game ideas were developed, and the researcher had the opportunity to work together with participants from the target group of teenagers and young adults.

The conversations with the participants resulted in a better understanding of their thoughts about location privacy and digital privacy in general. Although the group consisted only of

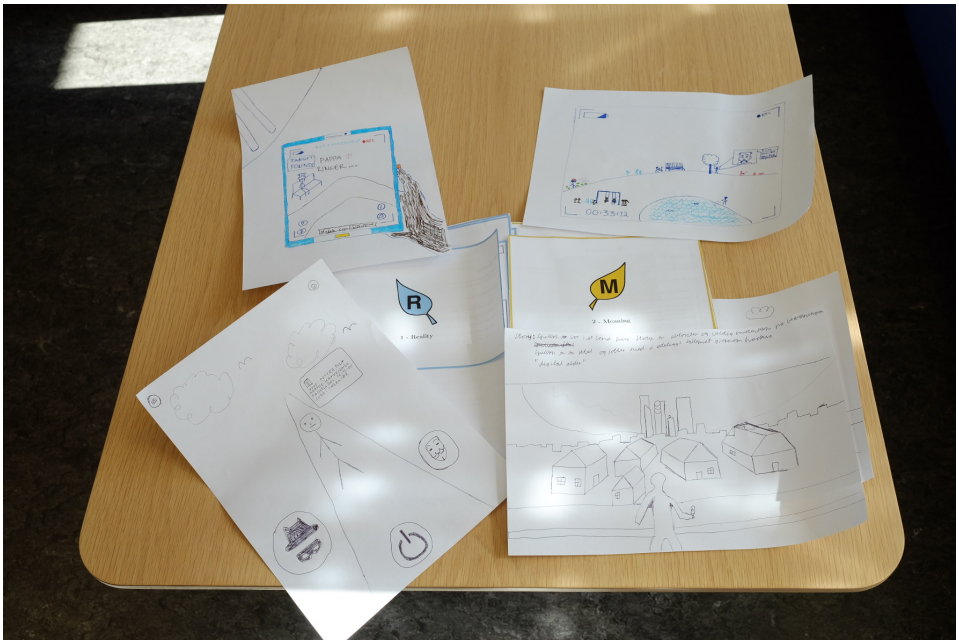

Figure 3.2: Drawings of the ideation results

six students, therefore the sample size was not big enough for a full data collection study, but it still resulted in useful information through discussions, thoughts, and observations.

When asked about if they were worried about location-based privacy, and their thoughts about the topic. One said that it was fine when the risks were being considered and understood. Someone else stated that it was not that important for ”regular people like him”, and it would be more risky for someone of a higher status, for example for politicians, celebrities or the royal family.

All of the participants were positive to be playing a game where you could learn about an important topic at the same time you are having fun. One important thing to notice, was that first of all, the game had to be fun and interesting to play. The information should not overload the gameplay. They rather play something fun and learn something, than to play something boring and being forced to learn a lot.

3.3.1 Discussion

This workshop was conducted in order to get a brief overview of teenagers' knowledge and interest towards location privacy and serious games. Though there were not enough participants in this workout in order to conduct a survey or a questionnaire, the observation and discussion were still useful in order to generate a couple of ideas and obtain a brief understanding of their thoughts towards location privacy.

A few takeaways from the ideas they generated and the discussions with them were:

- The game ideas they generated had a relation to a real life aspect. The story lines they thought of, came from own experience with either social media, other games, or the inspirations from the news.
- They were fond of new technologies and wanted to create advanced games.
- The main threat of privacy they knew of were hackers and terrorists.
- The fun aspect of the game is important, even more important than the learning aspect. They would not want to play a game that is not fun to learn a piece of information. They rather play something fun and receive some knowledge from it instead.
- Teenagers are aware that location privacy, and privacy in general can be dangerous. What they are not aware of, is what these dangers usually are, or how it can harm them.

The workshop was useful to conduct, and will be helpful in order to generate an idea for the serious game in the coming chapters.

Chapter 4

Related Works

Before creating the intended serious mobile game, it is important to have a good overview of the relevant knowledge within the research fields related to the project. In order to achieve a better insight in the important elements of mobile serious games, a literature review has to be concluded.

In this chapter, there will be an analysis of existing serious games in different areas relating to the goal of the thesis, to raise awareness of location privacy. The analysis will be based upon characteristics like how serious games handle learning goals and engagement goals. The ideas drawn from this literature reviews will be used to design the serious game in the next chapter.

As shown in section 2.2, there are many location privacy concerns highly relevant to the digital society in this day and age. Using these scenarios could help create a story close to real life that the game can follow. Based on the workshop conducted in chapter 3, one of the takeaways were that the teenagers created a game concept based on reality. A game story that can be relatable to the player, could also help make it easier to learn and connect similarities to one's own life [35]. Inspired by the work introduced in the problem definition chapter, the analysis done in the literature review will be based on crucial factors that will balance the levels of fun and engagement, and achieving learning goals. That is one of the most important aspects of a serious game [36].

4.1 Literature Review

4.1.1 Method

To search for the relevant articles, a methodical approach was followed in the searching process. When searching for material, the articles selected were then chosen based on

whether the title and abstract were relevant to the research topic or not. The articles were also considered based on who the authors were, how many citations they have, is the publisher a university? These questions were used as a way to briefly rate the quality of the work before spending more time researching it more thoroughly [40]. The material chosen were not all relevant, and the presented publications in this report are only the ones considered suitable for this thesis.

The articles and material chosen were obtained from various different online databases for research and educational content. The databases used for my search queries were: IEEE Xplore [41], ISI Web of Science [42] and Google [43] Scholar. These three databases were used to find all the scientific papers and research articles. In addition to these databases, various news sites and blogs were read in order to find non-scientific articles about relevant topics and stories from society and everyday life.

For the big and broad area of ”serious games”, the database was accessed with simple terms in order to obtain the most cited, highest quality articles for the more general topic. The searches were experimented with different words and combinations for the same concepts. Following are some example of the broad search terms:

”Serious gam*” **OR** ”education* game*” **OR** ”game* learning” **OR** ”serious game* design” **OR** ”serious game* mechanic*” **OR** ”educate gam*”

The * was added in order to obtain results with all of the variations of a word. In the example above, the term ”gam*” will return words such as gaming, game, and games, which results in a more efficient search.

4.1.2 Results

More specific terms were used in addition to the terms written above in order to obtain articles with a more specialized field of research. These were accessed to find a theory that supported the analysis of the games selected in the coming sections.

The most important area of research was location-based privacy. This is a more particular form of privacy that has its own set of threats. The concerns were introduced in the problem definition chapter in section 2.2.6, and one of the main goals of this literature review is to connect these concerns to the likes of serious gaming in order to create one that will help raise the awareness of the players towards the issue location privacy. To find relevant articles in this field, search the search terms that were used in conjunction with the broad terms were:

AND (”location-based privacy” **OR** ”geo data” **OR** ”geo location” **OR** ”privacy”)

AND (”mobile” **OR** ”phone” **OR**”)

AND (”collaborat*” **OR** ”multiplayer game*”)

These chosen resources were based on the relevancy of the title, the abstract, the authors, and the citation count. The results returned no serious games that had the goal to teach or raise the awareness of location privacy, therefore the location-based terms were edited

and detached from the ”serious gaming” base. The focus was now to move over to explore ”location-based gaming”.

(”Game*”) **AND** (”location-based” **OR** ”geo data” **OR** ”geo location” **OR** ”location” **OR** ”gps”)

This query resulted in a useful collection of research experiments on location-based gaming, which is a topic that would be relevant to consider. This also shows that there are a lot of studies of serious games, and also serious games and privacy, but not **location privacy**. location-based games are mobile games using the geo-data as a main focal point in the game mechanic. The game usually revolves around a map, where the game world spans over the physical, real life world.

The next specific query searched for, were serious games on mobile. The reason being that location privacy is most relevant concerning mobile devices. A phone follows you wherever you go. A serious game on a mobile device would make *sense* for the user. The player would relate directly to a story the game provides. At the same time, the privacy settings are right there on the phone, if the player decides they want to change it or not. Of course, there are advantages and disadvantages either way. But the goal is to make the users more conscious of their choices regarding location privacy. A mobile game could also be very broad amongst the genres. It could be a location-based game, or a first-person shooter game, or a chat-bot, or a digitalized board-game. There will be too many games to analyse them all.

With the collaboration query search, it is important to explore the possibilities of multi-player games and analyse the learning opportunities that follow. For learning and engagement purposes, having multiple players working and co-operating together can capitalize on communication and discussion. Often, being in groups leads to increased engagement and sharing of knowledge. Being in a social atmosphere can also make the experience more fun and engaging as well.

4.2 Serious Games

The topic ”serious games” is one of the primary focus areas of this project. As written in the problem definition 2.3, these types of games are not only for entertainment purposes, but also for learning and educational gains. In an article written by researchers from OATAO in Toulouse, the research was about using serious games to teach cultural heritage. They claim that a serious game can provide the users with raised engagement and can do that by using factors like story, graphics, interactiveness and usability and collaboration and competition. The educational part of the games implements pedagogical approaches by structuring the content and presenting it in an organized way. [44]. In the coming sections, various types of serious games will be introduced. They are going to be analysed based on the high-level requirements in 2.4. The main focus will be around engagement, learning, collaboration, the story and raising awareness. The goal of this literature review is to obtain a good body of knowledge with a variety of different types

of serious games. This information will help to design the serious game and creating the concept idea.

4.2.1 Serious Mobile Games

Assessing mobile games is important because the goal is to design a serious game that will be played on mobile platforms. In the analysis in this section, there will be an exploration of mobile games using different genres and methodologies to become serious games. The games have different end goals, but get there through being educational or promote problem solving exercises. The analysis will also consider the fact that the game is on a mobile device and the importance of it to the serious aspect of these particular games.

For the analysis of mobile serious games, an article written by researchers from the Department of Computer Science, Center for Advanced Research in Education (CARE) at the University of Chile will be reviewed. The research is about using mobile serious games to promote benefit collaborative problem solving in school among kids [45]. The article described four stages for problem solving [46]:

1. Understanding the problem
2. Designing
3. Carrying out
4. Evaluating the plan

For the collaboration, these were the principles considered [47] [45]:

1. Principles of positive interdependence
2. Common goals
3. Role identification
4. Assignments to a group
5. Interaction

The article introduced three serious video games. The first one was a real-time, mobile, strategy video game, where the players had to solve a problem of maintaining and developing four biological classes, where each had their distinct species. The players had to use various variables they received to develop and perceive each species, for example, reproduction and evolution. This is a game that teaches problem solving techniques with variables with a practical approach. The second and third games introduced were trivia games. The games used zoo and museum trips to create a learning setting for the children. The players then had to solve a set of individual and group tasks in the game while going to these places.

The study collected the data by using five different science classes. Out of the participants, 206 of students were in the experimental group, and 167 students assembled the control

group, these students did not participate in the actual project other than the data collection for comparison.

For their surveys, they created a scale to measure the students' own perception of their own problem solving and collaborative skills. In the results, they found out that the students from the experimental group that played their serious games were more willing to work collaboratively than the others. The experiment group also scored a slightly higher score in the problem solving tests, but not by as much as the collaborative skills [45].

In conclusion, their results show that by using mobile serious games for education, it can contribute to the collaborative and problem solving skills development. The knowledge gained in the literature review on this article has contributed to research question 1 and 2, which is about how to use mobile serious games to educate, and to raise engagement. The mobile games in this section shows examples of both. Mobile serious games should be considered based on the results of this article.

4.2.2 Location-Based Games

The use of mobile technology just keeps increasing, a smartphone has been a household name for many years, and the use cases one can use a smartphone for keeps expanding. In the last few years, the GPS data shared from the phone has been used more and more. Usually, they are being used for utility applications, like routing a map or finding the nearest bus stop or restaurant, but the technology is not only useful for utilitarian use. The gaming industry has also taken this source of information to its advantage in the last few years. One type of game, that uses geographical data as a main element of the game, is something called location-based games [48]. That means that the game world uses the real world as a map. The technology allows the players to combine real life movements with the game's movement.

A location-based game has a high potential to be used in a serious game setting. There are many location-based games out in the market at the moment, both for entertainment and educational purposes. The possibility of combining a virtual space and the real world creates new, creative ideas in serious games. The players now have the real world available as a gaming map, where they can do actions that they otherwise could not. The location-based games can create experiences where the players would see the world from another perspective, add gamification aspects, create a story which makes it feel as the players play as another character than themselves even though they are physically walking around.

In the situation of location privacy, a location-based game would help by creating a situated learning experience. The serious game can put the players in a scenario where they are being threatened by someone who has access to their private information.

There has been a location-based game that has been well known worldwide in the last few years. It is called Pokemon GO. Pokemon GO is a game for entertainment that combines location-based technologies with augmented reality. The reason why it is being considered here is the popularity of it. Researchers from the University of Tampere has done a qualitative research on positive and negative aspects of Pokemon GO [49].

From the positive results, the study reveals that the game made people go out more. It made people exercise and move around, and even explore a part of their town they would not have explored otherwise. Location-based games like Pokemon GO tend to have missions and accomplishments the players have to physically move to receive, the players felt that this is a healthy way to play a game and get some fun exercise at the same time.

Another positive outcome of the study was that the survey answers shows that the game made people more social. This relates directly to the collaboration/competition requirement for this literature review. People tend to feel that exercising and moving around with friends are more fun than alone. The game also consists of other game mechanics that give the players benefits when many people gather around the same spots. Pokemon GO and location-based games have the potential to become really good multiplayer and collaborative games.

The story of the game is also another positive thing that draws the player in. In this specific case of Pokemon GO, it is because a big part of it's user demographic is players that have grown up with Pokemon as a cartoon, game, and toys in their childhood. The median age, in fact, of the ones who participated in this survey, was 29 [49]. In this example, nostalgia plays a big role in the story attractiveness. To relate this to our problem, the knowledge players receive about different pokemon or locations, could be applied to other educational subjects or awareness elements.

There are a few negative aspects of the game as well. These are mostly technical, as newer technology or technology in untested areas can be quite frustrating some times. One reason, was that the servers were lagging, and could not hold up to the number of players that were playing at the same time. Another reason, is that geo-location-data is not one hundred percent accurate. This is not only in Pokemon GO, but location-based games in general. Another one mentioned is that rural areas have no activity in the app, which makes it unplayable. To make an overall problem out of this, in general, it is hard for location-based games to create a game world that is applicable to everywhere in the real world because it just is too big. The last big negative is the hazardous aspect of the game. It could be dangerous to have a game that is promoting to look down at the phone all the time while walking. Battery life is also a concern. Location-based games like Pokemon GO utilizes an always on display in order to play the game the way it was intended. This uses a lot of battery and can be a problem for games where the players have to play to finish a level or a mission [49].

To conclude, location-based games are interesting for learning and collaborating while playing. The players love it, but the technology still has a couple of flaws, for example, the accuracy and the dangers. The location-based aspect of people walking around is very relevant to raise awareness to a problem like location privacy. The idea should be explored. Either by creating a location-based game, or a game with a location-based aspect.

4.2.3 Collaborative Games / Multiplayer Games

Many of the games and articles reviewed above have already been collaborative or has collaborative aspects in them. Collaborative learning is an educational scenario in which

there is more than one student participating in the process of reaching the learning goal [50]. In this section, the collaborative element of serious games will be discussed more clearly. In an article on raising awareness on the scientific approach in archaeology, they plan to reach the goal by designing a multiplayer game with a mixed reality [51]. The social, collaborative aspect is one of the requirements, and also a main focal point of this literature review. As mentioned in 2.4.3, playing with others in a social context can help one understand, learn and share knowledge easier.

The multiplayer game to raise awareness towards archaeology approaches has goals close to the goals of this thesis' goal. To raise awareness towards an important issue using a serious, collaborative, game. Therefore, the literature is worth analysing.

The article wants to immerse learners in a digital environment to enhance the learning experience. To help them get there, they want to apply manipulation and modelization in the game that could be applied in real life objects. The game world will be an MMORPG (Massively Multiplayer Online Role-Playing Game [52]), which would rely on collaboration and interactions amongst players for a motivational boost. A game aspect they used to help keep the strong motivation, was to organize the players in to guilds, and give them group tasks and quests they had to solve. The individual activities also played a role to serve the overall group goals.

In an article about promoting collaborative learning in digital game-based learning, they introduced the relationships of groups in multiplayer serious games [50]. They split the groups to "intragroup" and "intergroup" relationships. In short, the intragroup uses positive interdependence to create one big group where everyone collaborates to solve the problem. In intergroup relationships, there is competition between the groups, and the players are collaborating within their own groups.

Intragroup relationships should be considered for collaborative games because they promote co-operation and the sense of belonging an important part for motivation and engagement in multiplayer games. The article has shown that designers should explore intragroup collaboration as a mechanism for learning. If used, the designers should also think about the in-game communication aspect of the game, and make that as easy as possible [50].

Their research on intergroup relationships also turned out positive. This type of learning is a little bit different from intragroups. This creates a competitive atmosphere between the players. This promotes collaboration in their own groups, but sports-like competition against other players to see who comes out as the winner. This learning mechanism is based on gamification and reward systems because the game ends with winners and losers [50].

4.2.4 Board-Games and Party-Games

Board-Games and Party-Games are important for this literature review to explore, because these types of games, often include multiple mechanics to raise the engagement and encourage collaboration and/or competition. In board- and party games, the game is usually

played in real life, face to face. The discussions would happen easier and quicker, and it will have the physical aspect available as well.

An article by Zagal and Rick from the Georgia Institute of Technology introduces an idea that for collaborative games, multiplayer computer games are usually complex to analyse in-depth, and they suggest using board-games instead [53]. A board-game could also work as a fast and easy lo-fidelity, prototyping method for a pilot test or a first iteration concept test. An idea to think about, could be to digitalize a board- or party game. One can keep the simplicity of a board-game, but create a mobile game, in order to let it be played from everywhere.

A party game called ”Mafia” is a discussion-heavy game [54], which uses both cooperative and competitive elements. This is a game with intergroup relationships, where there are two sides. The mafias versus the innocents. Only the mafias know each others' roles, the rest of the group are all clueless. The goal of the game is to collaborate and communicate in order to defend yourself and not being suspicious of being a mafia.

Why does this game have the potential to be a mobile serious game? One can keep the same simplicity of a party/board-game, and move that over to the mobile space. The game mechanics already have a commitment to collaboration and competition with a strong communication aspect as the key element of the game. One argument against it is that the story does not do anything to raise awareness towards location privacy.

4.3 Discussion

After looking through the literature review, there are many ideas that come to mind. The higher requirements were that the goal should be a serious game on a mobile device, that was going to have a story to raise the awareness of the players on the topic of location privacy. The higher requirements also contain elements such as the game should have collaboration or competition aspects, and it should be engaging to play. In addition to raising awareness, the game should also teach the players general knowledge about the topic as well.

One approach to teach location privacy could be to use a location-based game. The positive aspects of that would be that it feels more real in a location privacy setting. Many people already know about or have played the location-based game Pokemon GO, which makes the game mechanics easier to understand. The walkaround part creates a more collaborative social game, in an intragroup relationship. The game will also promote a healthy lifestyle and exercise, which is not a goal in this project, therefore irrelevant. This idea also has negative sides to it, where the technology can't give a one hundred percent accuracy on the information. This especially applies to move subjects randomly spawning subjects. The availability does also take a hit with this idea. The game map has to be constrained, and the game speed and pace can also be limiting, depends on the game concept. Battery life on the players' devices can also be limiting for the playing time. Usually, a always on display for the location-based game uses a ton of battery. For an intergroup,

competitive game, for example, a game where the players have to chase each other around while collaborating through text could be slow paced with a lot of waiting.

A mobile game version of the party game ”Mafia” could also be a candidate. It has its strength in collaboration and communication, which promotes raised engagement. The game has an intergroup relationship where the players can both collaborate with their teams and compete with the opponent. To raise awareness towards location privacy, the whole story and roles can change to cater to a relevant theme that fits with location privacy threats. The game could also just be inspired by Mafia's communication aspect and add it's own game mechanics. The game would also be easier to test, as the pilot prototype can be a paper prototype as a board-game. The game would also be more available, and be possible to be played from everywhere. With this game design, it needs to add a strong storyline in order to promote location privacy as an overall theme. It does not have the natural ability to connect location privacy with real life as a location-based game. A solution could be to design the game so it tries to simulate a real life situation by placing the players in a location-data threat setting.

Chapter 5

Game Design

In this chapter, the game design of Location Stalker is presented. The game description and learning goals are described, and the functionality and design behind the user interfaces are presented. The game design is a final decision made after considering the arguments made in the discussion section from the related works chapter 4.3

5.1 Game Description

In this section, the overall game concept will be described. The dynamics and mechanics of the game will be covered, as well as the story and overall goal of the game.

Location Stalker is a multiplayer, party game created with an intention to be played on a mobile device. The gameplay is based on communication, cooperation and collaboration between the players and are played with a minimum of eight players to fill all the roles needed. The overall story is that two or more of the players will play a secret role as hackers, while the others are either a detective or just innocents. The goal is to find the hackers and kick them out, through chatting and accusing each other. The game rules are based on a party game called ”Mafia” [54] with some modifications presented more in detail later in this chapter.

The game will appear as a simulation of a location-based scenario from real life. The players will get a feeling that someone is monitoring their location through a story scenario while playing the game. The overall goal is to raise awareness of location privacy in the hopes of triggering these feelings inside the players. The game aims to give the players an understanding of what threats there are out there, and who the victims are. Another goal of the game is to, through collaborating and playing together, the players can play with more engagement and can see different perspectives of the dangers of location privacy.

5.1.1 Target Group

The target audience of the game is primarily users in the ranging age group of teenagers up to young adults. This is the group that has shown the least knowledge of the risks relating to this topic, according to studies by NorSIS [3]. These are also the user group that will be the main testing group when user testing the idea and game.

The target group is also a justifying reason for choosing a game to be the platform to present the goal to raise the location privacy awareness. Most teenagers today already play games or have experience through multiple years of using smartphones and apps [3], therefore the argument of creating the game idea for mobile was strengthened.

5.1.2 Game Dynamics

Location Stalker is a multiplayer game designed with an intention to let the players collaborate and discuss through an exaggerated role-play scenario in order to not only have fun, but also become more aware of location privacy threats and dangers. The story provided through the game is very magnified and fantasy-like, maybe in the likes of a worst case scenario with some truth to it.

The set of game rules are inspired by a game called Mafia [54]. Mafia is a party game usually played in real life among friends. Mafia's story presents a conflict between the Mafia, and the innocents. It usually has three playing roles, with potential for adding additional roles if needed or wanted. The basic roles are *innocents*, *mafia* and *police*. Since the story for Location Stalker has a purpose of raising awareness towards location privacy, the roles and story are also changed to push towards this goal. Instead of the threat as a mafia, the threat is now a *hacker*, and the police role has been changed to *detective*. The final goal for the hackers is to have as many remaining hackers as remaining innocents, that is how the hackers win. The innocents, however, win when they have managed to reveal both hackers. How they are able to get through the stages will be described more in the following "Game Rules" section.

The game loops around two phases, night and day. The main function of the night time is to give the hackers the ability to attack one of the other players, that player is out of the game. During the day time, the players will have to agree on lynching, or kicking one of the players, that person is now out of the game. More about the phases is also to come in the following section, "Phases".

The game also includes a game map. This is the game element that acts as an illustration of movements in the real world. The game intends to simulate a real world scenario by making the players' characters move from their home to their workplace in order to create a lifelike simulation to connect the location-information aspect to the game. By doing this, the players get can see the location-data in an animated form that can help highlight what a potential threat can see.

5.1.3 Learning Goals

The main goal of Location Stalker is to raise the player's level of awareness to the threats of location privacy. Through playing the game, the game hopes to educate the players in what location privacy is, what the threats are, why and how it could be dangerous, and some simple ways to avoid being threatened.

At the start, the players will get a really basic introduction to what location privacy is, and throughout the game, the story itself will give them a scenario lets them have a feeling of being in a simulated location-based game situation. By doing this, the game aims to let the players connect the story to the real world, therefore making them more aware of the dangers while relating to their own lives. An example could be that, when you decide to share your location-information to anyone, they will be able to track down your location, find out personal information about you, your family and everything that is revolving around your life. That is scary.

During the game, the storyline will present location privacy threats every time the hackers are attacking someone. These examples, though exaggerated, are alerting the players' minds and suggesting different ways of threats that could be relevant in a real life scenario. Some consequences may not be as life threatening as others, but they are all a result of a location privacy breach.

After the game ends, the players will receive a session for reflection to tie all the information together. This should not be too in depth, which can cause a disinterest with the players. Just enough information to understand the threats, and how to avoid them by relating the scenarios to their own lives. This is where the mobile part of the game makes a difference. By having the game on a phone, it hits closer to home and makes the information easier to relate to, because most location privacy threats are due to phones and mobile devices sharing private location-data.

5.2 Game Rules and Phases

This section will describe the rules and the roles of the game in detail. The game consists of two phases and the roles mentioned briefly in the Game Dynamics section. The game will go through loops of these day and night phases until the game is over.

The game includes a game map, where the main function is to give the players an illustration of movements in a world where location-data is shared and sensitive, private information could be available to the wrong people. Between the phases night and day, the players' characters will use this game map to move from their house to the workplace. One of the workplaces on the board is the police station, the hackers can use this to their advantage. There are always multiple people working at the police station, but one of them has to be the detective. The hackers now have the leverage to be in a position of power by being the attacker.

5.2.1 Roles

The roles in this game were also mentioned briefly in the Game Dynamics section. There are two teams. The hackers on one side, versus the innocents, on the other, which contains detectives and regular innocents. The roles are randomized each game, and no one can determine who will play which role.

Once the game starts, the roles stay hidden, except that the hackers now know each other, and the detectives also know each other. For the hackers, the goal of the game is to discuss and convince the whole group that they are not the threat and try to accuse somebody else. The good hackers are the ones who can debate while not sounding too suspicious. The innocents will have to figure out who the hackers are, and in the process, they could very well accuse one of their own, because no one will know who the hackers are, except for themselves.

To balance the game out, there are detectives involved. These players will receive the ability to reveal the role of one player each round. At night, right after the hackers have chosen whom to attack, the detectives can co-operate and pick one of the players to reveal. Only they will get to know the role. If the detectives reveal one of the hackers, they can now use this to their advantage to accuse that person. The trick is, they have to angle it in a way without revealing their own role, because then the hackers will pick the detective the next round. One of the detectives will always have the workplace at the police station on the game map, while the other one is undercover. The one working at the police station is more exposed to being questionable to the hackers.

The role distribution will be the following. There will be at least two hackers, one for every three innocents. A minimum requirement for a game round is, therefore, eight players. Two hackers, two detectives, and four innocents.

Role	**Ability**	**Team**
Hacker	Co-operate with the other hacker(s) to attack one person every night. That person is now out of the game	Hackers
Detective	Co-operate with the other detective to find the hackers. The ability to reveal one role every night.	Innocents
Innocent	None	Innocents

Table 5.1: Basic description of the roles

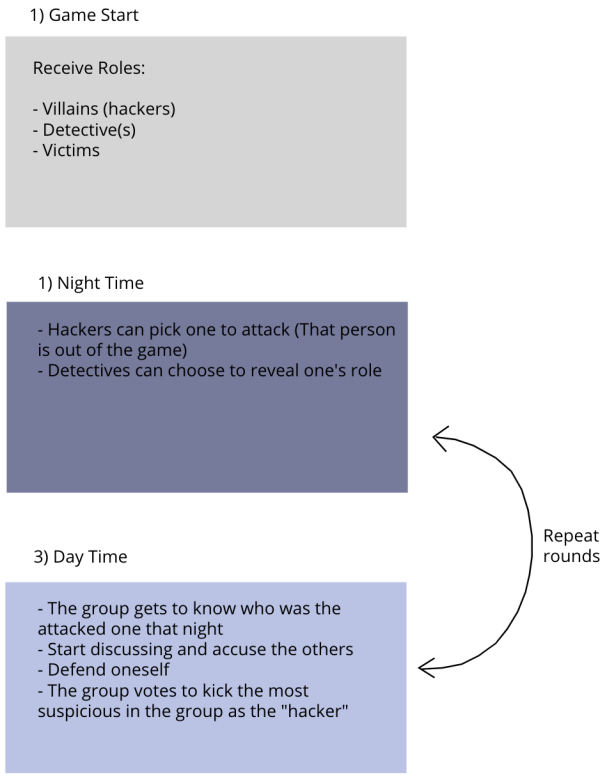

Figure 5.1: Quick explanation of the rules

5.2.2 Night

The night phase represents a time of day where all citizens are asleep and only the bad guys are up. This is the stage where the hackers have powers to attack another player and remove them from the game. The game lets the hackers discuss who to choose. Usually, they pick the one who they think are the most suspicious of being a detective, which would be the biggest loss for the innocents. The rest of the players won't know which player is out before the day.

In the other end, the night time is also the time where the detectives can talk to each other and pick one role to reveal. They will use this knowledge to their advantage. Their best-case scenario is to reveal one of the hackers, because now they can know who to specifically accuse. If reveal an innocent's role, they now know that person's role anyway and can trust them.

The following interface graphics shown in this subsection are just a rough first draft prototype to only get the conceptual stage right for the idea evaluation (The updated game interface is shown in the last section of this chapter).

Figure 5.2: Game map at night time

5.2.3 Day

This is where the main part of the game happens. At the very start of the day time, the player who has gotten attacked the night before is announced. That player is now out of the game. The animation starts and every character moves from their home to their workplace. There will always be at least two players who are working at the police station. This is for balancing reasons to not let it be more challenging for the hackers to identify a detective.

The players now will start to discuss the events happening the night before. The events described here is the storyline the game provides as a background for the hacker attacks. The hackers' mission is to persuade the others to fall for the trick that they are on the same side. Their goal for the day time is to not be suspicious and accuse someone else for the attack. The discussion will go on with the flow. The story is there for the players to play along. When the story is about location privacy breaches, the players will need to play along to the threats and have an active part in the learning process of raising their own awareness. The discussion here is on the basis of the players own imagination and improvisation to the story and not real events.

After the discussion ends. Generally, there are a few players who are accused the most. Following a suspicion, players tend to pick sides blindly and the accusations come in. These need to be seconded by someone else. All the accused ones have the right to defend themselves. Other players can also defend them. The round ends with a voting round. The

players can pick who to vote as guilty from the accused ones, and the one with the most votes is out of the game. The player declared guilty will show its role, and is out.

The night round begins again... This will cycle until either all the hackers are gone, which would make the innocents the winners, or when there are as many hackers as innocents, which would make the hackers the winners.

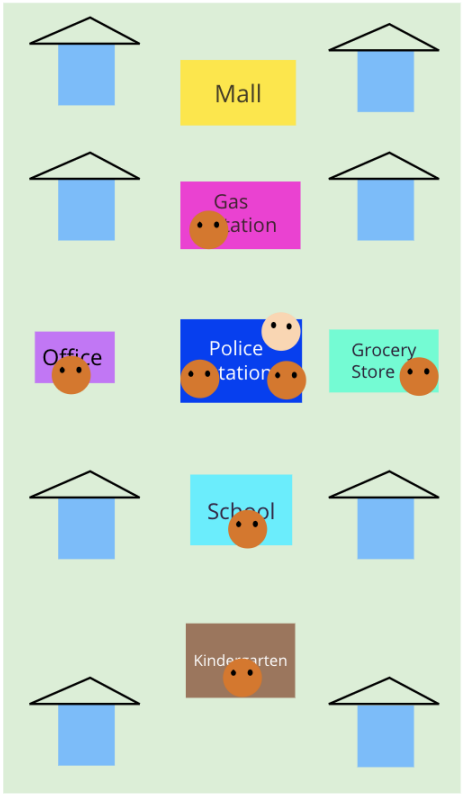

Figure 5.3: Game map at day time

5.2.4 Reflection Session

After the game, the players are provided with a reflection session, which consists of information about location privacy and various examples from the game. In addition to basic information, the players will also be educated on how to prevent having their personal information in the hands of the unwanted. There will be information especially tied to mobile devices, since privacy leaks in this area are very dangerous when the real-time geo-location-information is shared. This will let the players easier relate to the situation from the game, while contextualizing the mobile device at the same time. The choice

however, will always be theirs, because there is no right or wrong choice on whether to share the geo-location or not. That choice has to be promoted because there are many advantages to gain by sharing your location-information as well, but do it responsibly.

The ultimate goal of this after-game phase is to connect everything and tie all the thoughts and information through the gameplay together into a simple and educational piece of graphic that will turn the awareness raised by this game to a basic level knowledge of location privacy threats.

This last reflection session aims to display the moral of the game more clearly to the players. It hopes to show that anyone, even in your own circle could be a bad person that could want harm to you by using your personal location-information maliciously. In the process of displaying this, it hopes to teach the users about the privacy trade-offs, and to weigh risks and benefits of enabling location-information. It is not an intent to scare the players away from using the advantages, but rather educate them about what the threats are, and that they should use it responsibly.

An illustration of the reflection session presented in the last section of this chapter, **Game Design 2.0**.

5.3 Story

The story this game presents to the players is a really exaggerated version of real scenarios. The intent with this type of fantasy mixed with reality creates a relatable, but still overwhelming storyline that can trigger feelings in the users in hopes to raise awareness towards location privacy threats in them.

The story of this game is most influential during the start of every day phase. This is when the players know who has been attacked, and *how*. How these players are ”dead”, will present a threat, or a breach of location privacy. The goal is for the users playing this game, to think about various ways location privacy could be threatening. The idea goes back to chapter 2, the problem elaboration. The concerns and threats presented there will be taken and re-presented as an exaggerated story in this game.

The story is about a town of regular, working citizens. Every day, they wake up and go to work. Each player’s character then moves to their assigned workplace. Little did they know. At night, while they were sleeping. One of them has been attacked, or maybe killed. Some of the working citizens were not regular. These were hackers within the same community, who have access to everyone’s personal geographical information with malicious intent.

Every day that passes by without detecting all the hackers, one regular innocent will be attacked every night.

An example of an attacking story:

While the town was in deep sleep. A vicious group is still awake. These people have all the personal information they could want, about everyone in the town in the palm of their

hands. They know who you are, what you do, and where you are at all times. Without even you knowing. One day, naive the teenager Peter (Username) was reported missing by his parents. He was working late at the gas station the night before, but when his parents woke up, they noticed that he never came home. An investigation was done, and witnesses explained he had shared the geo-location-data from his phone on a social media app to his friends. One of his best friends said he was last seen on the map, at a midway point on the way to his home from the gas station, then he suddenly stopped sharing. The detectives believe that somebody has been misusing his personal location-information to kidnap poor Peter. They are now on the mission to capture these villains.

This is an example of a story that the players read after a night where a player has been attacked. These stories have a goal to teach the players ways that location privacy can be threatened and hopes to engage them by keeping the stories true to life.

5.4 Additional Thoughts

This section is mainly about thoughts for future consideration regarding testing and iterations, things to keep in mind, and changing alternatives in the game dynamics.

An aspect that will need to be tested, is the timing of the rounds. The discussion rounds are anticipated to go on for a really long time if it is not constrained.

Another thing to take into consideration are the game mechanics. There are changes in the game dynamics that could be made that either balance the gameplay, increase the fun, the engagement levels or make the game simpler and easier to understand.

One weakness of the game right now is that the minimum requirement of the number of players is 8. It could be more difficult to test, and the threshold to play could be higher because of the number of players required. One solution to consider is to decrease the minimum amount of players. It could work by minimizing the amount of hackers and detectives to one, and having the rest be innocents. The game would then be really hard for the hacker. To balance that, there could also be two hackers, one detective and the rest as innocents. This can pull the minimum requirement down to four players. The trade-offs would be that the game loses some of the fun by having a large group to discuss and argue with. The number of players will also be tested in the pilot test.

If the pilot tests show that the hackers are too overpowered and will gain too much advantage from the board, there is a way to balance it out. When the detectives reveal roles at night, if the detective picks a hacker, the hacker would instantly be captured. Instead of sitting on the knowledge and wait for the hacker to be accused, the detective can capture the hacker right away.

Changes that could benefit the fun and engagement are adding additional roles and achievements. By adding roles, one can increase the engagement by giving the players new and interesting roles to try out. The roles are randomized, and this would minimize the chance of growing tired of being an innocent every game without any abilities.

One fun game mechanic that could let the players utilize the game map more, in addition to the basic animations that are planned right now. To give the players a feeling of achievement, there could be a money system introduced. This now adds a reason to go to work, other than it is being a simulation of a scenario. Players will receive an amount of salary by going to the right workplace, after each day phase. This money could, for example be used to buy another private detective, in addition to the already existing players who are playing the roles. It can also add another aspect of mind games, innocents can trick the hackers into believing they are a detective, by not going to their own workplace, but to the police station instead. This is a game mechanic worth exploring in one of the testing rounds.

5.5 Summary

While the concept is about location privacy, the game itself is not a location-based game. It is a game which simulates a location-based situation in order to increase the awareness the players have towards location privacy. The game intends to create scenarios to let the players play freely within the flow, but at the same time, have location privacy in the back of their minds during the game. Furthermore, after the game ends, the players will also receive more information which regards how to secure themselves and tips on being more aware of the information their own phone could be displayed to the world. One major difference in creating the game this way, in contrast to a location-based game, is the limitations of the game world itself.

5.6 Game Design 2.0

Disclaimer: This section was written after chapter 6

After conducting the pilot test in chapter 6, the game design became fully updated after feedback from users and a game expert. The images shown in this section is the updated version of the prototype that is being tested in the next chapter, chapter 6, **Pilot Test**. These interface designs are being tested in chapter 7, **First Iteration**.

Firstly, the game map was redesigned. The interface now has a clear separation between the night and day phases. At night, the background has a blurry style design with dark shades which resembles a dark, night time. In opposite, the day time possesses a really light theme, in the same blurry background style, which resembles bright daytime.

The other thing that got a design was the reflection session described in section **Reflection Session** above. This has become an info-graphic that shows one of the threat scenarios in a more in-depth form than the game story. Like a continuation of the story. The reflection session constitutes most of the learning elements in this game, and it does so by tying together the story and an elaboration.

These designs can be found in the Appendix for a larger view.

Figure 5.4: Night phase design 2.0

Figure 5.5: Day phase design 2.0

Figure 5.6: Interface of the Reflection Session pt.1

Figure 5.7: Interface of the Reflection Session pt.2

Chapter 6

Pilot Test

In this chapter, the status of the game is described and tested. The pilot test will be used to evaluate the concept idea in a low fidelity form. The feedback will be considered in a results conclusion and the game design evaluation will be explored and analyzed.

6.1 Status

In this pilot test iteration of the game, the game is in a low fidelity stage. The game is designed in a lightweight paper board version of the game. This is done in order to easily test out the game concept, as well as engaging a group of people in a really early stage of the game.

The game consisted of all the main features that are designed to be in the digital version, but in a physical form. The character animations are intended to be moved physically by the players as figures on a board.

6.2 Purpose

The main purpose of the pilot test is to evaluate the concept and the idea. As well as the flow of the game and how engaging it is. An important goal of this test is to see how useful the concept is as a method to bring awareness to location privacy. Running the pilot test with potential users from the target group can help decide how interesting and useful the idea is. It would also result in helpful feedback regarding the usability of the game, what they think about the concept, and most importantly, if it helped to raise awareness after playing the game.

This iteration of the game was as mentioned, a low fidelity prototype version of the game. Therefore, the purpose is less about the usability of the game, but rather about the idea and the concept. With that being said, the prototype's design is laid out as how the game is planned to be designed, so there would be a similarity in the gameplay.

6.3 Prototype Evaluation

The evaluation was performed with participants well within the target user group. There were eight students from 16 to 25 years old. With students all the way from the Norwegian High School grade (Videregående), to university students, and young adults who are working. The evaluation done in this test were not being targeted individually, the reason is being that the test was being conducted before applying to NSD (Norwegian Centre for Research Data) to collect information through a questionnaire. Important information was collected nonetheless, just not as individual answered surveys, but as non-personal qualitative data collection as a whole test group themselves, where none of the answers would directly be linked to an individual, but as a discussion summary from the group itself.

The game took place around a table, which consisted of the game map itself, and various game pieces to symbolize and animate the character and their movements around the map. The evaluation was done in four different parts:

1. A discussion part about the participants' attitude towards location privacy and their experience with it (A summary of these thoughts will be written about in the results section).
2. An explanation phase where the players get an explanation of the game rules and purposes.
3. Playing the game.
4. Feedback about the game and a post-game discussion about location privacy.

In this section, a description of the whole process will be given. The preparation of the prototype, the conduction of the test itself, and a discussion of the feedback collected from the participants.

6.3.1 Preparations for the Pilot Test

In the process of preparing the prototype, the game design was made in order to cater to the actual mobile game, while the paper prototype would be essentially the same, just played in real life as a board-game. While the concept is about location privacy, the game itself is not a location-based game as mentioned in the Game Design chapter. The game simulates a location-based scenario, where the intentions are to increase the players' awareness towards location privacy. Where in a location-based game, the limitations to a game map could be as big as you want, whereas in a constrained, simulated game map, it would be

less challenging to control the outcome, in addition to being able to play wherever one would like. For example in this prototype, as a board-game.

To prepare for the pilot test, the game design was printed out and made as a board-game. Sheets of roles were written down to give the players, and the game rules prepared. During the test, the plan was to play at least five times. The reason was to fully test out different variations of the different roles and give the most of the participants a chance to play as a threat in order to give feedback for the roles.

Another thing that has to be taken into consideration was the number of players. There were eight participants, which means there would have to be two players each round for the hacker role. Eight people were the minimum requirement of players in order to have a balanced distribution of hackers and innocents, where the detective(s) are a part of the innocents' team. It is planned to play the game several times, first to let them get a feel for the game, and then afterward, randomize the roles and introduce variations of different roles to test out the gameplay mechanics. It was prepared to test two different types of detective roles in some of the game rounds. One of the detectives was a regular one, who had a workplace at the police station. Whereas the other one, was an undercover detective, who would get a random workplace, not at the police station.

6.3.2 Discussions Before Playing

Before conducting the pilot test of this early iteration, a discussion regarding the participants' experiences and knowledge of location privacy and privacy, in general, were taken. The user group goes from a teenager age and up all the way to young adults, the participants were all in this category. In general, users within this age group have a basic understanding of what privacy means, and that is also correct with this group of participants. That was just overall privacy in general. When talking about location privacy, there was more uncertainty throughout the group. Some had an understanding of location privacy, others with just plain surface knowledge. When discussed, there were answers like: ”It is something about sharing of geographical information” to ”Someone could use that information to stalk you”. These are great examples of a reason for threat, and one consequence of it.

The talk went on and someone eventually mentioned Snapchat with the Snap Map feature as a relevant issue of threat, when I brought up the topic of relevant location privacy threats that could happen to ”you”. This specific issue has been addressed before previous in this thesis under the Problem Definition chapter.

After discussing, the group agreed that this was an important topic to have some sort of knowledge of, and everyone who has a device that can share geo-data should be aware of the threats and how to prevent them. After receiving a small amount of information about location privacy, they were all excited to start playing the game.

6.3.3 Testing of the Game

The game started with an explanation round of the rules. Most of the players have played one or another variant of the party game ”Mafia” previously, which is a rule set Location Stalker is based upon. The board map was placed on a table in the middle of the players, and each of the participants chose an item as their ”player” and placed it on their home spot.

Night Time:

The game starts at night, and everybody has to close their eyes and place their hands out. This process in a digital game would be more instant, and each player would receive their roles secretly on screen. Roles and workplaces were written on pieces of paper and given to the players. With eight players, means that there were two hackers involved in the game. The distribution would be two hackers, two detectives, and four innocents. The game moves on, and the game master, or storyteller, tells the hackers to open their eyes to look at each other. They now know who the other hacker is, and will discuss seemingly later on in the game. At the same time, they agree on who to hack the first night. The hackers close their eyes again, and the detectives open their eyes. They now get to choose one person to check, referring back to the game rules in section 5.2 in the Game Design chapter: To check means that the detectives would get to know if the chosen person is a hacker or not. After these processes are done, the game moves on to daytime.

Day Time:

Everybody Opens their eyes, and the town wakes up. A story is being told about how the person who was hacked at night was being abused. This story was told with a theme relevant to the location privacy topic each time. This is an important aspect to set the mood and wire the players' brain to think about the topic. The victim sadly has to leave the game to become an inspector. The players continue the day, starting with moving their character on the board to their associated workplace. This movement on the board will simulate the animation of moving the characters in the game. One essential thing for observation was how the players interacted with the board, and or if they used it to plan their future moves. During this day time, the players have a discussion amongst each other on who to lynch from the game, or in other words kick out. After someone has been kicked, the player reveals their role, and night time begins again with the same procedure as last night.

During the discussion part, the first round of playing was messy and very time consuming. Lessons were learned and applied for the next rounds, the game master used a timer for each day in order to keep the discussion in check. After trying multiple rounds, the time that was used was five minutes each day period, that were found to be the most efficient time, where everybody could defend themselves and accuse others without talking in circles and discuss nonsense. This time will be estimated to be longer in a digital game, the reason being that the discussions are being typed, instead of face to face.

End Game

The game has ended when either both hackers has been lynched, which means the innocents win, or when there are as many hackers as innocents, that would be a win for the

hackers. After the game, each player receives a graphic of basic information about location privacy, how the game story is relevant, and how to defend themselves by checking their phone settings.

The games went on for an estimation of 90 minutes. The participants were captivated enough to keep going, and wanted to continue the game. With the interest still at the top, the decision was easy to keep going. The chance was used to test out different variations of the roles to see which one balanced the game the most.

6.3.4 Discussions After Playing

The discussion that took place after playing the game, was done in a similar fashion as the one prior. The whole testing lasted around one and a half hours. It was only planned to play three or four rounds, but the participants finished with seven game rounds played. With this much experience during one test, the feedback given from the players will be useful for future considerations. I started the conversation by asking what they felt after playing the game for quite a while. The majority felt they enjoyed playing the game, and it was fun to play for an extended amount of time. They mentioned that the known rule set from the party game Mafia made it easier to learn for those who had played it from before. Nonetheless, a comment to consider regarding this is that the rules should be explained as a ”new rule set” in the actual game, instead of a game that is built upon Mafia. It would help give the gave a sense of individuality, therefore help push the topic of location privacy with hackers and exploited victims, rather than mafias and dead victims.

Another issue that was discussed, was the board. Because they were sitting in front of each other, and played in real life, the players used physical aspects of the game rather than the game map to their advantage. There were fewer advantages in focusing on map movements, rather than eye contact and body movements. In a mobile version of the game, the players would have to look at a game map, considering there are none to look at for physical movements.

The participants felt that the gameplay itself taught them some information that lingered in the back of the mind while playing. Although they did not think of location privacy all the time in the game, it was always a part of the game story. The scenario story was set up like a simulation of real life with threatening hackers stalking your location-information. It all tied together in the end, with the summary and a reflection session with the players on how to secure themselves against threats. The participants felt that this was rather useful, and after the first game, it is a great piece of information to receive. It definitely raised the level of awareness. Despite this, after feedback from the players, the majority felt that after the first time the information comes up, it was not interesting anymore. After that, they were already aware of the issue and just wanted to end and restart a new game.

6.4 Results

This section will present the results obtained after observing, discussing and receiving user feedback. The pilot test ran smoothly without any unexpected events or failures. The participants felt that the general game rules were confusing to understand at first, but after one test run, they completely understood the rules and got the hang of it. The players were also in the right target group of teenagers to young adults. There was general knowledge of location privacy, but it was still uncertainties and learning potentials, as expected.

The paper prototype of the game presented most of the key features as a digital one would have had, and feedback regarding certain game mechanics will be highly relevant. The part where it was not the same, was the physical game board itself. The feedback from the players resulted in that the game board would be more important to the gameplay a digital version, than the real life board-game version. By having the movements on the game map as a main, important factor in the game, the resemblance of a location privacy breach simulation will be clearer. The players will get a sense that one of the other players are watching their moves, and will always know where they are at all times.

The players collaborated with and competed against each other to find out who the hackers are. Collaboration is an important part of this game, both in the game mechanic itself, and as a factor for engagement. This makes communication a key aspect of the game. In this test, the players had face-to-face communication and interacted directly with each other. The change from this to a mobile game would be an implementation of a messaging system. Either an integrated one, or use an already built messaging system for the players to communicate. As shown in the chapter of related works, collaboration and competition has the ability to make a game much more fun and holds an important reason for raised engagement.

The results of the feedback were in some way expected, but also useful. After testing the concept idea, the outcome was that the game idea and gameplay was interesting and fun to play. The information about location privacy was not too much, but just enough to make people aware of the situation. The session for reflection after the game was a useful touch to have. In a mobile setting, this would be closer to reality for the players, as the scenarios presented were based on mobile location sharing, and the information would be a little bit more relatable to the individual playing. I also found that there should be a choice, whether the player wants to receive this information after every game played or not because it would be redundant, and once they become aware, the game has done its job and reached its job. To raise the player's awareness, and to educate them slightly on how to secure themselves.

6.5 Next-Step Evaluation

The next step is to implement the design into a digital version of the game. The design work is based on the same principals as the paper prototype. The first takeaway from the pilot test results was that the game map itself has to become an integral part of the game.

Without the players being able to look at each other's movements and facial expressions right after waking up, the map movements is the only thing to look at.

The information screen after the game for the reflection session was crucial for location privacy awareness. That was an important aspect in order to justify it being relevant to a mobile game. The information has to be able to contextualize the phone in order to let the players connect instantly to the device they are playing on.

One aspect of the game that was important to focus on, was the story. The main part of why the game relates to location privacy is the story scenarios behind the game. The theme has to be scary enough to raise awareness, but still realistic enough so the players can relate to their everyday life. If this story is done right, the players would be able to play the game and realize that location privacy is a serious issue, and the threats could possibly be dangerous.

Chapter 7

First Iteration

In this chapter, the user test of the first iteration of the game is described. After receiving feedback from the last pilot test, improvements were made. Problems and negative feedback were discovered when testing the first pilot version of the game. These have been evaluated and corrected.

After conducting the pilot test, the game idea and game design has been shown to and discussed with a game design expert for evaluation. The results after this conversation were that the interface design of the game needed some work. The prototype looked rough and boring. The expert recommended using more playful characters and icons to raise the engagement of the players.

7.1 Status of the Game

In this iteration, the game design got a full overhaul. The interface was updated to a more playful and more established design. The looks alone are supposed to be more inviting for the players and hope to raise engagement and fun. The game map itself has gotten a gradual, blurry and colorful background. The workplace icons have been moved to a cluster in the center after feedback from the game expert. The workplace has also become icons that look nicer and actually shows what the workplace looks like, rather than a box with a name from the pilot test. The reflection session graphics have been made to an infographic, compared to the pilot test's, which was just information given to the players to test how they would react to such a summary session.

Illustrations from the game interface can be found in section 5.6 at the end of the Game Design chapter.

The game is still in a preliminary stage, where the testing is with hi-fidelity prototypes. The actual game has not been developed. After discussions with the game expert, the

conclusion was, at this point in the project, to create a higher quality hi-fidelity prototype rather than a badly, developed game. By doing it this way, the game concept with most of the mechanics, are still being tested, the high-level requirement can still be achieved and learning goals reached, all by using preliminary prototypes. This test will be a combination of a board-game-like-prototype and a digital one. There will be combinations where the communication will be done with a digital solution, while the game map and movements are still physical on a paper prototype of higher quality than the pilot test.

7.2 Test Results

In this test iteration. There were in total of eight participants. Some of these are the same players that tested the game last time, some were new. The advantages of testing the same players are that the basic game rules don't have to be explained thoroughly again, only updates and changes. Another positive aspect is that they now have insight into the problem and know what the goal of the project is. The results of the first pilot test have been evaluated and changed ahead of this first iteration test.

One thing the players mentioned after the pilot test was that the functions of the game map were insignificant. The reason was that the game was being played like a party game in real life, where the players took the discussion face-to-face. One thing to be changed in this user test was to remove the face-to-face talking possibility. The goal was to simulate an in-game chat, therefore the method used was to create group chats on Facebook Messenger. There was an all-chat with everybody, a hacker only chat, and a detective only chat. This is the communication channel used in this version of the test. The test also restricted looking at each other. In order to simulate a mobile game, the players had to play along to the best of their abilities, to not look and judge each other's body languages. The test was conducted with two rounds with the same rules as the pilot test, to let the new players get a sense of how it was before, and then five rounds with the new communication system.

The overall game design has been updated as stated. In this test, the players played with the updated game map. The infographic in the reflection session is in the updated version.

7.2.1 Night Time

For night times, all the players had to turn around facing away from the others. This is implemented to not being able to peek at who is the one's typing when they shouldn't. The hackers choose who to attack in their chat, and the detective chooses who to reveal in theirs. This went by really naturally, just like the face-to-face version from the pilot test.

By using chat as a communication channel, the hackers now were more willing to use the map to find who the detective is. This is in addition to the discussion.

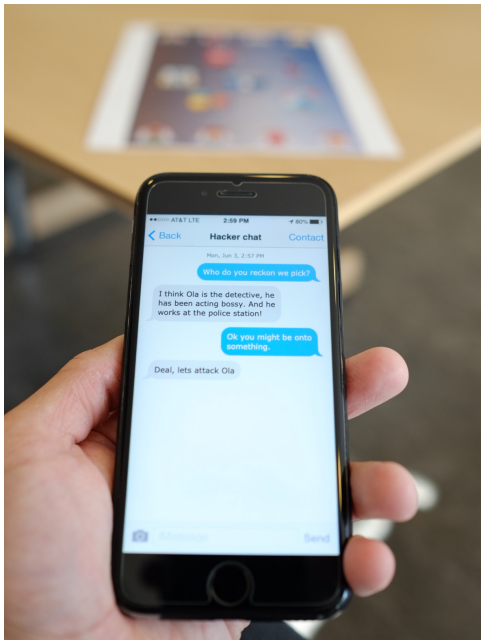

Figure 7.1: A player playing as a hacker

7.2.2 Day Time

This is anticipated to be the most challenging part of this test. All the discussions that were done by talking, yelling and pointing, now is in a chat. For the first two rounds, an observation was that people tried to race to write. The chat became fluttered and spammed down. All the players wanted to say their opinion as quickly as possible. This was mentioned to the players, therefore the chat became more controlled in the next rounds. This was fixed in this test, but you cannot expect players from random online servers to be that polite, considering this being a mobile game.

The players felt that the updated interface was more playful, and was nicer to look at. The fact that the game map was more enjoyable, made the engagement go up.

Four of the players meant that the game is more fun to play when the discussions are happening face-to-face. One participant commented that the chatting gets tiring and annoying after a while. They meant that as a party game, it would be more fun to play around a table with friends.

Interestingly enough, out of eight players, seven answered that the game brings more attention to location privacy now, compared to the last pilot test. The game is built more centered around location privacy in this version, the game map has a much bigger role here. The story in this test got updated to a more structured story with better threat examples. That also played a big part in raising awareness in this test.

7.2.3 Reflection Session

The updated reflection session infographic was received well. Seven out of eight players said it was useful. They felt that they have gotten a summary of the story. Some mentioned that, during the game, they just wanted to win, so the story flew by without them actually thinking about it. The reflection session lets them resonate, and think about the moral of the story. In the pilot test's reflection session, it was only the game master telling the players a story with information. The players meant that making the graphic was the right move. It was easier to understand reading it by yourself, and the fun graphics helped. Seven out of eight players said they learned at least one thing new about location privacy by going through the reflection infographic.

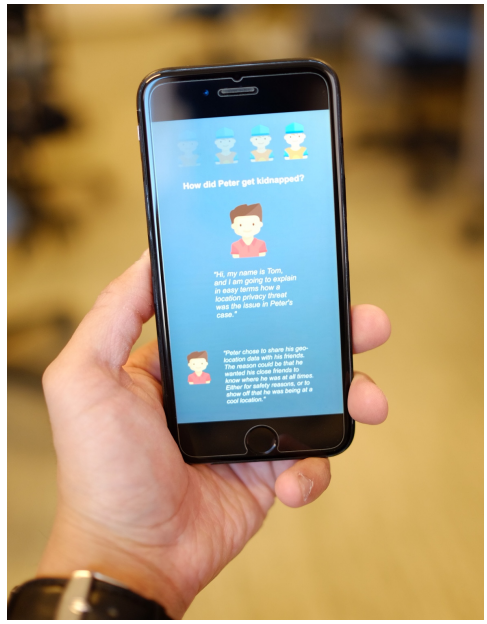

Figure 7.2: A player testing the reflection session infographic

7.3 Discussion

In this section, there will be a discussion about how this first iteration test answers to the learning goals of the requirements.

Engagement and Learning:

The test shows that by adding the chat element to the game, the game declines in the fun and engagement aspect, but at the same time, excels in the learning. It is unfortunate that these specific results show that in order to raise the learning potential with the chat, the real life discussion aspect has to be constrained.

Awareness:

The players felt that this version of the game raises awareness better than the last. The magnified functionality of the board and the better story plays the main part in this. One player said that the story was much better laid out in this test, with location privacy specific reasons for the attacks at night made it easier for the player to connect real life to the game.

Collaboration / Competition:

This is a game where collaboration and competition are necessary to play the game. Three of the four players that felt the game was more engaging face-to-face, also meant that the game is more collaborative when it is being played face-to-face. The last player of the four chose to vote that the game is more collaborative in the new update with the chats. The player commented that with these chats as a communication channel, the hackers and detectives can now talk and collaborate in a much better way than the old point and nod.

Chapter 8

Discussion

This chapter will present a discussion of the evaluation of the game. The next sections will be a discussion of the state of the game, the process of designing it, and the game in relation to the research questions. A summary of the evaluations of the results for each research question will be discussed throughout this chapter.

8.1 Game Evaluation

Through the project, the game faced more and more towards a preliminary concept design, rather than developing the actual game. The reason behind it was, for the game concept of Location Stalker, the game mechanics allowed it to be user tested by combining a paper prototype with board-game elements combined with digital solutions for other game aspects. By completing a mix between these, the game would still work as the intended game concept for a mobile game.

In this section, I will elaborate on the different stages of the conceptualization of the game has been through, and why the path was chosen or not.

8.1.1 Rejected Location-Based Game Ideas

The game started as ideas for a location-based game. The idea was to teach location-based privacy, by letting the user experience the threat situations themselves without being at risks. This was supported by the theory learned from the literature review of serious games.

Originally, the goal was to explore the opportunity to develop an idea for a location-based game that was inspired by ”Hide and Seek”. A game kids usually play where one is

counting to an X amount of seconds and the others were supposed to go hide. The concept design was attempted. The idea was inspired by location sharing social media and how they manage it. In short, you share your location-information to your friends, and then the data becomes unavailable once you have been inactive in that app for an X amount of time. The idea was to let the geo-position be available to the group once you go in and check their locations, and unavailable if you have not checked the game for some time. Through the process of evaluating the literature review, weaknesses were shown, and the learning outcome was not of any significance, and the game was tipping too much over to the fun-side without being very fun.

Another location-based idea was a single-player, augmented-reality, exploring-game. The player would create a ”fake” social media character, and input interests, favorite brands, and more. The game would then display advertisements in augmented reality everywhere so the user would see how much information companies sit on top of. If they know your location-data, they could spam you with advertisements from everything, everywhere. This was meant to be shown in an exaggerated way. This game idea died out quickly, because the engagement and fun aspect, were not up to par to answer the research questions. And technically, it was not a serious game at all.

The last game idea is the closest to the Location Stalker. This was supposed to be Location Stalker before moving the game towards a non-location-based mobile game. The story and learning goals were supposed to be the same, but the game mechanics very different. The players were supposed to move around, back and forth to and from the workplace, which would feel very useless and boring, only for the hackers to see their locations. In the end, the fun-aspect of the game was among the reasons the game slowly moved away from the idea. One of the other weaknesses was the game pace, it was too slow. With the game idea being so communication heavy as well, and having intergroup collaboration through texts. It would take ages to finish the discussion **and** move to a location. After evaluating the learning outcomes of this idea, the game idea was still relevant. Therefore, the concept of creating a multiplayer, mobile, game with the same story, was still applicable, just not as a location-based game, but as a game that simulates a location-based situation in order to let the players feel closer to the scenario.

8.1.2 Mobile Game vs BoardGame

After the game was designed. A pilot test was conducted in order to confirm the concept to be viable before developing it. The test was done using a paper prototype which worked as a board-game. At that point in time, the plan was to just test the idea and then create the mobile game afterward. Fast forward to after the process, the results from evaluating the feedback and observations from the pilot test showed that changes could be done to the game design while keeping the game map as a paper prototype. The game was then updated to become the board-game and mobile game combination that was tested in chapter 9, First Iteration. By having these early prototypes as board-games, lets the idea be tested out cheaply, with most of the functionality available. To answer the research questions for this thesis, a good prototype is enough.

One of the takeaways from the end results was that the in-real-life communication was one of the key parts that took away the game board, which means the location-based system of the story is diminished. That was also the reason the next prototype used Facebook Messenger as a communication tool to prototype an in-game chat function. From the first iteration test, the players were positive to the fact that the in-game chat function brings the attention more to the game, and therefore also the game board, which promotes location privacy awareness. A trade-off, and an argument against it is that the players felt average to the fact that it was less fun. Half the players felt more engaged when playing with face-to-face collaboration.

8.2 Research Questions

In this section, the four research questions are being discussed and answered with elaboration to the research done in this Master thesis.

8.2.1 Main Research Question

How can a serious mobile game be designed in order to raise awareness towards location privacy issues?

The results of the discussion evaluations indicate that the game is useful for raising awareness towards location privacy. The game has collaborative and competitive, engaging gameplay with heavy communications with the other players. Exaggerated, but still realistic enough stories, so the players can still feel a life-like scenario that promotes awareness. The four following research questions will together answer the main research question more in-depth.

8.2.2 RQ 1

How can a mobile game teach the players about location privacy?

In the game Location Stalker, the main thing that stands out as the most educational aspect is the reflection session in the end. It comes in the form of a info-graphic that ties the whole game story together. It is made with a goal to let the players reflect over what they just played, and while playing, they might have just tried to win, but when reading and looking at this summary, they will have more time to resonate when the threat and solution is being elaborated.

The reflection session is a really direct method of teaching location privacy. The storyline of the whole game is not as direct, but it is persistent and follows the game all the way. It being about concerning cases of location privacy threats and breaches help a lot. This sets the tone, so the reflection session has the ability to summarize all the information in a neat way that the players can relate to.

8.2.3 RQ 2

What type of game mechanics can be used to raise engagement?

In the **Related Works** chapter, multiple types of serious games were assessed. From these, the engagement levels were evaluated and considered. The most important element chosen to drive engagement was to create a multiplayer game. The game is much more enjoyable to play with friends, and when playing together, the motivation to play goes up, therefore the engagement rises. The levels of discussions in the game create an environment where the players always have to stay active in the communication, which also drives engagement.

One drawback in engagement from the last iteration was that the communication went from face to face to an in-game chat. This is where the game has to prioritize the trade-off between having a higher engagement level, versus having a higher level of awareness raised towards location privacy.

It is not only being a collaboration, multiplayer game, it also has intergroup collaboration, which means both co-operation with some, but also competition with others. This creates a competitive nature to the game, which makes it more engaging to play.

8.2.4 RQ 3

How can the game keep the balance of having fun while reaching the learning goals?

The answer to this research question is something that ties together the last two. How can a mobile game teach the players about location privacy, but at the same time use game mechanics to raise the engagement? The storyline has a strong presence in this game. The game is all about setting the players in situations that are relatable but still exaggerated. That is an ability a serious game can have. A game can be used to teach players about threatening situations that otherwise would be risky to experience. The players would rather discover the threats by playing Location Stalker than to be stalked and kidnapped themselves.

8.2.5 RQ 4

How can the game help users protect themselves against location privacy threats?

The reflection session also helps in this area. After learning about the different threats and risks, the players also receive information to what settings they have to look into in order to take control of their personal information. The thesis also presented four different ways privacy could be seen. In short, the players will learn that they have the rights to who they want to share their personal information with. They also learn about the trade-offs between benefits and disadvantages to sharing location-data. There are no black and white answers to location privacy, there are advantages in enabling it, as there are applications that use

location privacy that benefits you, but there are also threats and concerns in others. The player is going to learn how to think critically about location privacy.

Chapter 9

Conclusion

In this chapter, a summary of the main results and contributions to the field of serious games for awareness towards location privacy this thesis presents is reviewed. Considerations for future work is also presented in the end.

9.1 Summary

This thesis has explored the many ways of designing a serious game. The knowledge evaluated resulted in a preliminary design for a game called Location Stalker. The game was designed on the basis of literature reviews done on related work. In the related work, a number of serious game types and mechanics were analysed. The analysis was done with the higher requirements that were built upon the research questions in mind.

The game concept was evaluated and tested twice with eight persons each evaluation. The first user test was the pilot test. In this test, the concept idea was tested. In the second user test, a more thorough preliminary version of the game prototype was made. This was the final evaluation.

The prototype is a serious game design that simulates a location-based system in order to increase the awareness of the players towards location privacy. The game is a mobile game with some board-game elements in it.

Location Stalker has a learning goal of raising the players' awareness towards location privacy. In the process of achieving that goal, the players will also learn about the threats of location privacy, and how to handle them.

The game managed to balance engagement and fun, and educational learning goals. The results of the observations, user tests, and evaluations show that the game was well received within the user group that was tested. The players playing it had fun and claimed

their awareness towards location privacy rose. When that is achieved, the game has fulfilled its goal. The concept is still in the preliminary phase and has some weaknesses, but the research questions were answered and the results were satisfying.

9.2 Contributions

The work done in this thesis contributes to the field of serious games towards location privacy awareness. Contributions are done:

- in the form of the design of the preliminary game prototype, Location Stalker, that can be used to raise location privacy awareness, educate players on location privacy, or just to have fun.
- in the literature review and analysis of different serious games that promote mobile, educational gaming and collaboration. The work done here was used to lay the groundwork for the game idea of Location Stalker.
- in the evaluation of the two user tests done with the prototypes, both in an early pilot test, and in the form of a board-game combined with a mobile game.

9.3 Future Work

The work done in this thesis has resulted in a preliminary prototype of the game. For future work, implementing the game as a full, native mobile game is an idea. Other than that, after evaluating the game design in chapter 5, there was a section called **5.4 Additional Thoughts** where the identified improvements for future iterations were recognized.

The main bulk of the future work is about expanding the game. Updating the game to make it more engaging, more educational, and having more features for the players. Changes that could benefit the fun and engagement are adding additional roles and achievements. By adding roles, one can increase the engagement by giving the players new and interesting roles to try out. The roles are randomized, and this would minimize the chance of growing tired of being an innocent every game without any abilities.

Another game element worth considering is one that could let the players utilize the map even better. To give the players a feeling of achievement, there could be a money system introduced. This now adds a reason to go to work, other than it is a simulation of a scenario. Players will receive an amount of salary by going to the right workplace, after each day phase. This money could, for example, be used to buy another private detective, in addition to the already existing players who are playing the roles. It can also add another aspect of mind games, innocents can trick the hackers into believing they are a detective, by not going to their own workplace, but to the police station instead. This is a game mechanic worth exploring in one of the testing rounds.

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Appendix A

Game Design 2.0 Extras

Under here there are the interfaces of the design in a larger format for easy readability.

Figure A.1: Night phase BIG

Figure A.2: Day phase BIG

Figure A.3: Night phase BIG with characters

Figure A.4: Day phase BIG with characters

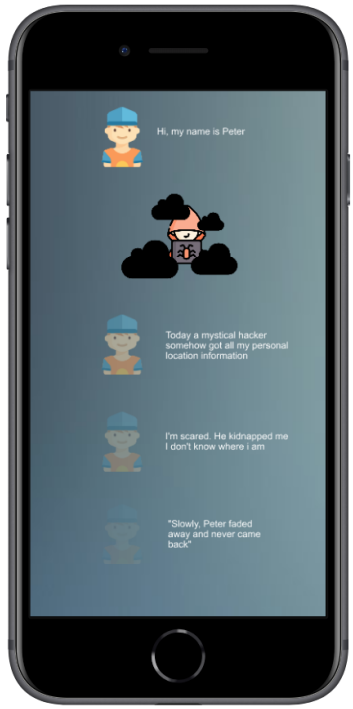

Figure A.5: Reflection Session part 1

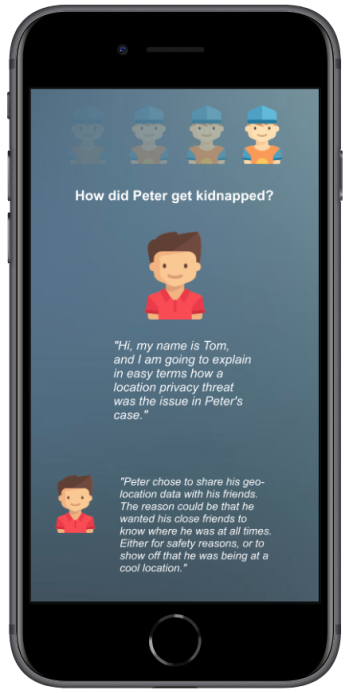

Figure A.6: Reflection Session part 2

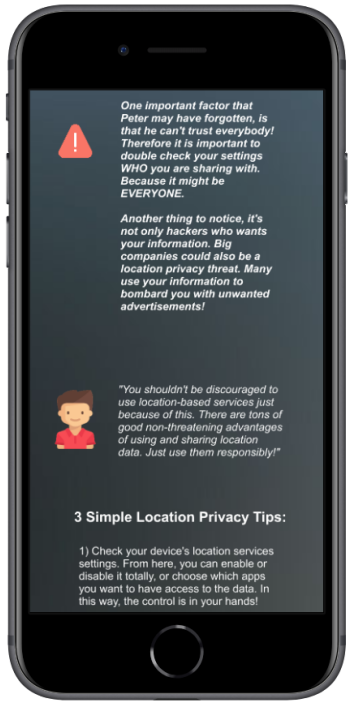

Figure A.7: Reflection Session part 3

Figure A.8: Reflection Session part 4