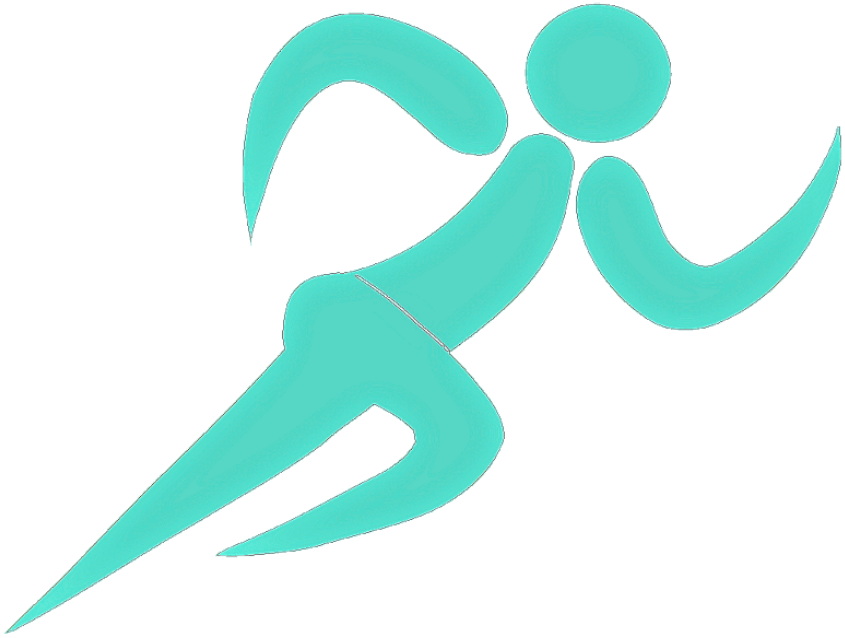

The Pursuit

Next Generation of Hide and Seek with Augmented Reality

Bachelor's thesis in Computer Science and Engineering

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Abstract

As technology has rapidly been integrated in the lives of most people, especially young people, there is a great need to break the pattern of a sedentary lifestyle among this group. While the older generations spent their free time during their youth playing outside, the youth today instead spend their time in front of screens. With this project, our hope is to get people more active by creating a mobile application that integrates a hide and seek type of game with movement in real life. The goal is to find out whether this type of application is a fun way to be active. The application is available for smartphones with either Android or iOS as operating system. The mobile application complements actions of the players during the game, such as navigation on a map as well as setting specific rules for the game, such as the duration of the game. When testing the application, all test subjects found the game to be interesting although the specific game concept needs some further work. All test subjects did however want more games with the same type of interaction on the current market.

Sammanfattning

Med teknikens snabba integration in i vardagen för de flesta människor, särskilt ungdomar, finns det ett stort behov av att bryta mönstret av stillasittande bland denna grupp. Medan de äldre generationerna tillbringade sin lediga tid under sin ungdom med att leka utomhus, så tillbringar dagens ungdom istället sin tid framför skärmar. Med detta projektet hoppas vi få människor att bli mer aktiva genom att skapa en mobilapplikation som integrerar ett kurragömma-likt spel med rörelse i verkliga livet. Målet var att ta reda på om denna typ av applikation bidrar med ett roligt sätt att vara aktiv. Applikationen är tillgänglig för smarttelefoner med antingen Android eller iOS som operativsystem. Mobilapplikationen underlättar för spelarna under spelet genom att bidra med navigering på en karta, samtidigt som den inför särskilda regler, bland annat en speltid för spelet. Efter testningen av applikationen tyckte samtliga testpersoner att spelet var intressant, även om det specifika spelkonceptet kan behöva ytterligare arbete. Samtliga testpersoner ville dock ha fler spel som innefattar samma sorts integration på dagens marknad.

Acknowledgements

We would like to thank our supervisor Krasimir Angelov for giving us support throughout this project and for being open minded about the idea. We would also like to thank Arne Linde, fackspråk and the rest of the people involved with the project in being a great support unit for this bachelor thesis. Finally we would really like to thank all of the people who helped us test out our application in trying to prove the application of our concept, you are awesome!

Glossary

API - Application programming interface, a specification on how a specific software should be used.

APK - Android application package, a file format to distribute Android applications.

Apple Inc. - A company based in California that develops software and hardware.

App store - Apple's way to distribute applications to the users of the iOS system.

Back-end - Often referred to as code that is run on a server that is not accessible by the user.

Cocoapods - An application level dependency manager for the Swift programming language.

Cocoa Touch - A user interface framework for the iOS systems.

CPU - Central processing unit, the unit that executes the software with basic arithmetic calculations.

Database - A way of storing and accessing data in a computer system.

Dynamic programming language - A programming language that typechecks code at runtime instead of compile time.

Entity - A representation of data in a database.

Framework - A collection of libraries for software development.

Front-end - The part of an application that the user interfaces with.

Git - A version control system developed by Linus Torvalds.

Github - A hosting service for git repositories.

Google - A company based in California that develops software and hardware.

Higher order function - A function that either takes another function as an argument or returns a function in a programming language.

IDE - Integrated development environment, an application for software development that incorporates many commonly used tools to help development.

Java - A strictly typed object oriented programming language maintained by the company Oracle.

Javascript - A multi-paradigm dynamic programming language maintained by Mozilla,

Netscape and Ecma International.

Mapview - An optional way of displaying content in a map application that shows a map of the location.

OS X - A computer operating system developed by Apple Inc.

Parse - A cloud platform developed by Facebook Inc.

Pattern matching - A feature to check for likeness in values.

Satellite view - An optional way of displaying content in a map application that shows satellite imagery of the location.

SDK - Software development kit, a set of tools to help development for a specific platform.

Shell - The command-line interpreter for most Unix based operating systems.

Swift - A multi-paradigm strictly typed programming language maintained by Apple inc.

Unix - An operating system developed by Bell Labs.

VCS - Version control systems, a tool to mange changes in files.

Windows phone - A phone with a mobile operating system developed by Microsoft.

Xcode - An IDE for developing applications for the iOS or OS X operating systems.

XML - Extensible Markup Language, a way to encode data.

Contents

1

Introduction

Technology in all forms is becoming more integrated in people's life than ever before, with the use of smartphones becoming a central hub for our social interaction through communication via text, video and voice[1]. One area that seems not yet fully explored is the integration of games with this type of interaction. Can games utilize the technology in peoples smartphones to create new types of games that were not possible before?

1.1 Background

The technology of today is often used to help people in their daily life, but in some ways it limits the need for movement. Therefore, it becomes essential to integrate exercise to our lives in other forms[2]. Since exercise is an important aspect in staying healthy, games might be a good way to get exercise and interact socially without making the act of exercising feel like a chore.

The most limiting part of regular play without technology could be argued to be communication between the players. With the use of smartphones it should be possible to break these limitations as they provide excellent tools for this. With a mobile application that dictates the rules and the communication between players, regular play can be made more complex and user friendly.

The game that this project focuses on recreating is a reversed type of hide and seek, with one person hiding and the rest of the players searching. The data that different players get from their devices depend on their role in the game, and the application dictates when and where this data is shared. A game like this might not be possible without the communication advantages of modern smartphones.

1.2 Purpose

The main goal of this project is to find out whether the application developed in this project entails a fun way to play. By adding logic of a game that is similar to hide and seek and using smartphones to illustrate all needed information, the project aims toward getting people activated physically using the application.

Initially the main focus of this project is to achieve a fully developed application with well-functioning basic game logic, and a well-developed server that administrates communication between users of the application. There needs to be a good structure in the implementation for the application to be fully extendable with new features as well as for improving current features. There also needs to be a constant focus on the user experience when designing the user interface. This will lead to a stage where the application can be tested on users as to evaluate whether or not it is a fun way to play.

1.3 Restrictions

Due to time restrictions of the project, this application was only developed on the two currently leading mobile operating systems. By choosing Android and iOS as the platforms to develop on, the majority of the market will be covered[3]. This will broaden the possibility for more users to be able to test the application. Restricting the development to two platforms is not enough as each platform regularly change their feature set and API. For the application to be available as broadly as possible, the systems supported is version 4.3 and beyond for Android as well as version 8.0 and beyond for iOS.

For the application to work correctly, the device running the application will need to have a network connection during the whole game, and precise location data. The application will utilize the GPS chip to gather precise location data, and therefore the device needs to have a GPS chip to play the game.

When moving over a big area during a typical game, it will not suffice to only have a Wifi connection as the connection might be greatly impacted by the movement of the users. Instead it is crucial for the device to have a 3G/4G chip with an active data plan to ensure an intact communication with the server.

There will be no consideration taken to users with no connection to the Internet or to those that do not send their coordinates for any other reason. Although this might greatly impact the game, it is not something that can be regulated by the application created in this project.

The user will also always have the possibility to turn of their data traffic or their GPS which similarly could disturb the game immensely. Since the game developed

in this project is an augmented reality game, there will always be possibilities for users to try to cheat. This will be taken into consideration when developing, but as far as GPS and data traffic goes this will not be taken into consideration.

2

Game prerequisites

The idea of the game is to have two different teams that compete against each other. One of the teams is a one-man-team and will be referred to as the prey, and the other team consists of all the other players and will be referred to as the hunters.

The hunters are supposed to try to catch the prey within a given area and duration of time. Failing to do this results in a win for the prey. All players are using their mobile devices and each team is shown different information. The prey can see all of the players on his screen whilst the hunters only can see the persons in their team, i.e. everyone but the prey. Every hunter can also see their own distance to the prey, and by checking their map and communicating with each other they will try to triangulate and surround the prey. Their objective is to out-maneuver and catch the prey.

In order to make this application, different platforms have been used, which this chapter will briefly cover. It will also touch upon how smartphones could affect a person's exercise routine.

2.1 Android

Android is a mobile operating system developed by Google[4] and is used by the majority of mobile devices on earth[3]. The Android operating system is the only focus for the "Android Open Source Project" or "AOSP" which is a project overseen by Google that anyone can contribute to[4]. This is what makes Android such a powerful operating system and why it is so widely spread. The operating system is considered open for developers because it is free to install and run applications on devices using Android, by generating APK files that can be installed directly on the device. This makes it easy for developers to test applications on multiple devices.

The Android system is built with a user interface that is based on direct manipulation, i.e. by using a touchscreen you can swipe, tap and pinch the screen etc. to manipulate virtual objects on the device[5].

2.2 iOS

iOS is a mobile operating system developed by Apple Inc. iOS is built on the same Darwin operating system as Apple's desktop operating system OS X. Both operating systems are UNIX systems, but the iOS operating systems do not give the user or the applications shell access, as the OS X does. This limits what users and developers can do with the operating system. The operating system compensates this restriction by having a fully sand-boxed environment, which does not allow applications to be installed if Apple has not approved the applications through their own App Store. This makes the platform very secure from malicious software and scam applications.

2.3 Server

As this project entails creating an application for two different mobile operating systems, there is a need for a server to hold all relevant game logic as to not duplicate the logic for both mobile applications. A server is a computer installed with software designed for specific use, such as for example handling and evaluating client requests.

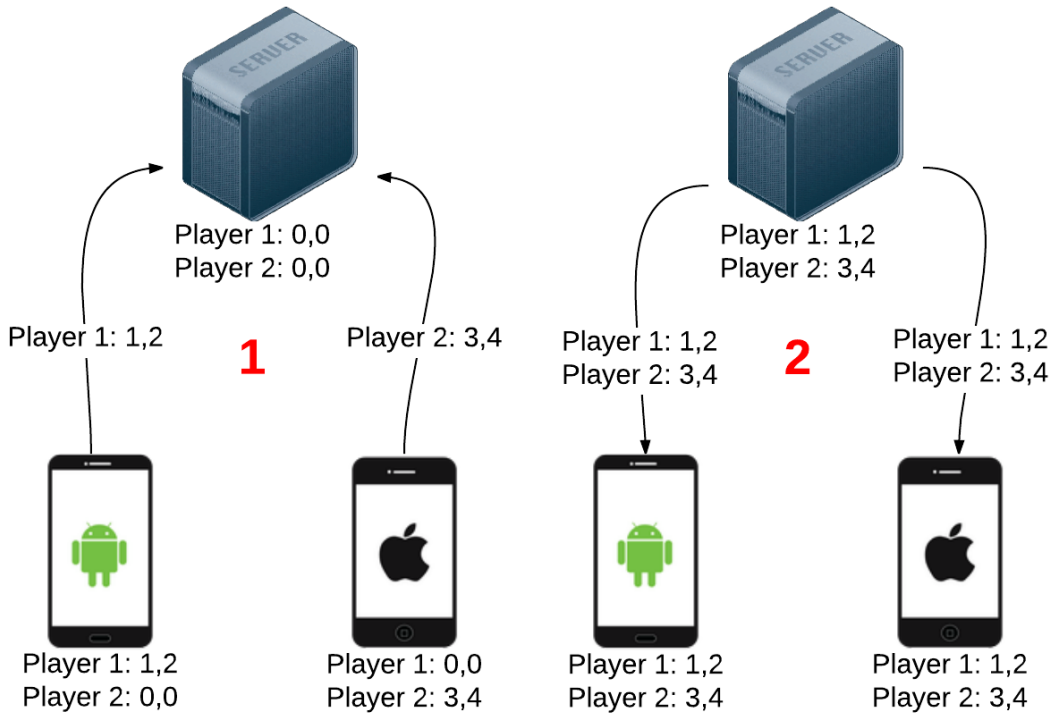

Figure 2.1: Communication between two different devices and the server

As Figure2.1 shows, the exchange of for example coordinates between two smart-

phones goes through the server. The Android device is "Player 1" with coordinates 1,2 and the iOS device is "Player 2" with coordinates 3,4. The server should use a database to store the different coordinates for each player. At first the server has no information about the devices coordinates, but as shown on Figure 2.1 the devices should send their own coordinates to the server which then saves them in a database. In the next step of the communication the server should respond to the two devices with the updated coordinates for everyone.

2.4 Health aspects

A survey shows that about 50% of smartphone owners in the U.S use their smartphones for health-related questions and track their exercise and calories[6]. This means people are getting more and more aware about their health and level of exercise. A mobile application is often easy to use and you can access it whenever you want. It could keep track of your results as well as motivate you to keep exercising by sending reminders when you have not exercised for a couple of days.

Smartphones can however, according to some studies, also have a negative impact on your health. An example of this is when a child gets a smartphone at a young age and instead of going out and playing with friends, the child stays inside playing games on a device[7]. A survey conducted by Playday in the U.K. showed that over 50% of the adults questioned, played outside for seven days per week when growing up. When children today were asked the same question only 23% answered that they play outside as much as the adults had done[8]. One of the reasons stated as a response to the survey was that parents might have become more protective, but as stated earlier children nowadays seem to prefer playing computer games or other indoor activities. By developing an application with augmented reality one could enhance the gaming experience by actually having to the users move their own bodies. A user, no matter the age, will be able to play a favorite game and exercise at the same time, hopefully having a great time.

3

Method and tools

To be able to determine whether the application would fulfill its purpose, a number of user tests were constructed. The user tests were made to evaluate both the flow of the application, and in the end the playability of the game as well as the actual interest for this type of game. Before this could happen, however, there needed to be an application for our testers to use. The application consist of a server and two mobile applications and the method for developing these will be further covered in this chapter.

3.1 Creating the mobile applications

As previously mentioned a decision was made to only implement for phones with either Android or iOS as the main operating system. Besides this being based on the market it was also based on a couple of different aspects such as experience, a great accessible knowledge online and personal access to devices. Because of this there were two different methods used for developing the two mobile applications. There was also a third method for the development of the server and finally a version control system to handle conflicts within the project.

3.1.1 Development for Android

The development of the application on Android was done using Android Studio. It is the official and recommended Android IDE to use, released by Google[9] and has built-in tools to help design and create new user interfaces.

Android applications are preferably written in Java as the SDK provided by Google is written in Java, which is also the programming language used in Android Studio. The user interface is constructed using the markup language XML.

3.1.2 Development for iOS

When developing for iOS the IDE Xcode was used for developing the application. Cocoapods was used for dependency management of the third party libraries. Cocoa Touch is the user interface framework provided by Apple to develop the graphics for the application.

The programming language used to program the iOS application was Apple's own language Swift. The design pattern Model-View-Controller-Store was used to structure the application code which is very similar to the regular Model-View-Controller pattern that is recommended when using the Cocoa Touch framework. The difference is that the network code is done in a separate store class to make the model and controller objects more maintainable.

3.2 Development on the server

The cloud based service of Parse was used for the server implementation[10]. The server code is written in JavaScript, a dynamic programming language, and uses the Parse API Libraries and the Parse command tool to push the code to the server.

Parse is compatible with a wide variety of different platforms such as Android, iOS, Windows Phone, JavaScript and so on[11]. Parse offers both a free option for small applications and paid alternatives for bigger applications that require more data traffic[12]. The largest benefit of using Parse is that a developer do not have to implement all the infrastructure of the server but can start developing the application right away, thus saving a lot of time.

3.3 Version control system

When working on such a large project as this, it is essential to back-up previous work. When using a Version Control System (VCS) this issue is simplified to a great deal. By using git, and with the service GitHub, there is an automatic saving of all previous versions of the project and it is therefore easy to trace back to a version that works if anything goes wrong. This is used for all different aspect of the project, i.e. the server code, the iOS code, the Android code and for all the different presentations.

3.4 User testing

To be fully able to establish whether the game fulfills the purpose of being a fun way to play, there needs to be user testing taking place throughout the project. Firstly to eliminate all the uncertainties a new player could face with the flow of the application, and secondly to research whether the application works as it should and whether it would be widely appreciated or not.

The initial test with testing the information shared and flow of the application was a minor test to get general feedback from others, while the design was in its final stages. This will be covered further in 4.2.1.

As for the testing to see if this is a good way to play, an event was created on social media to invite people to take place in a user test in Slottskogen. Preparations were made with making the application APK as well as constructing a questionnaire. How this test turned out will be covered in 5.2

3.5 Designing the user interface

To be able to design a user interface for the application before it had even taken form, a tool was used to create the layout and test the coloring of the application. This tool was Fluid UI that is a web-based tool where one can drag, drop and adjust the entire layout to get a feel for the final design. The tool has a great number of different layouts for different smartphones and tablets and was therefore a good help in designing for multiple platforms[13].

Designing for Android versus designing for iOS contributes with a different set of rules for how to show content. When designing an application for Android, there are a great amount of guidelines as for how to structure the application for the benefit of the user. Some examples of this is that the start screen should reflect all the information relevant for both a first time user and a returning user[14], as well as designing the buttons on the phone to work differently depending on the aim of the content[15].

When designing for iOS there is a set of rules similar to the Android rules, but with a different formulation. For instance how to use direct manipulation of the touch from the user as well as creating a design that lets the user be in charge of the application i.e. designing for a feel of user control[16].

4

Design and implementation

As the main goal of this project is to establish whether or not it is enjoyable to integrate common play with the use of smartphones, there needs to be development set to produce a product by which this could be tested. Because of this the project has touched on many different subjects. A broad set of skills has been necessary to acquire for all members of the group. There was also a need for different parts of the project to interact with each other which in itself demanded a lot from the structure of the project. These different parts will be explained further in this chapter.

4.1 The design of the game

The project was at its early stage already set to focus on the idea of recreating the game Mario chase, which is part of the Wii U game Nintendo Land[17].

The game can be described as following:

The game has two types of players that are divided into separate teams; the hunters and the prey. The hunters know of each others positions and their own distance to the prey, shown on the screen. They can talk freely to each other and strategically figure out the position of the prey. The prey sees everyone on the map and the goal for the prey is to not get caught, so moving to confuse the hunters is of great importance.

While the game of Mario chase is played in front of a screen with the user steering their player with controllers, this project is making a similar game for the outdoors which in itself changes a lot of the basic rules of the game. As the project entailed creating a mobile application that acts as a tool to this type of game, it was important to evaluate what content to show. This will be covered further in section 4.2.

Mario chase has a couple of set landscapes with a certain size and with players having the same speed in chasing each other[17]. When integrating Mario chase to a new type of integration there was a lot of discussion on what rules will be in place for the new game. Firstly the main theme was kept in place, which is that multiple

players try to track down the one single player who is the prey. With continuing to decide on rules to implement, there was a multitude of rules found in Mario chase that at first seemed almost too complex to solve within the scope of this project.

In Mario chase the prey gets a lead by having some amount of seconds to run away from the other players. In real life however this seemed to be much more complex as the other players will see which direction the prey is heading off into. Instead, the rule of the game created in this project is that everyone at first runs away, and after a set amount of seconds the players get to know what role they play in the game.

With the users having a landscape that is not set as in Mario chase there also needs to be restrictions on for example the area of the game and the longest distance away from the prey the hunters need to be to catch her. These variables could make a huge impact when playing in real life.

The other major aspect that we had to figure out was how to display the game in such a manner that it follows the same flow as the original game. With having to move while playing, the issue with accidentally pressing buttons might arise. This was something that was greatly considered during the design of the applications user interface.

4.2 The design of the user interface

As the game is played through mobile devices, the user interface had to be designed with a sparse canvas to layout the necessary components on. There needs to be a lot of information when setting up a game and when playing the game, but at the same time the user could easily be confused or get distracted by other things if the application is too hard to understand and focus on[18]. A main issue was showing the content and giving the user enough options, while not cluttering the screen and confusing the user completely. Another issue is that the application is available for two different mobile operating systems with two different guidelines for interface design. In wanting the two applications to be similar, as to allow the user to easily switch between smartphones with the different operating systems, there needs to be the same look of the application regardless of operating system. With this in mind, the design followed the main components of these design guidelines as well as non-mobile operating specific ideas of designing an interface, this will be further explained in this chapter[19][20].

When designing the user interface the main importance was in the actual play-time of the game. When the game is played the user is under a time constraint and needs to keep moving or hiding depending of their role. If the player is in a role that demands lots of movement the user interface needs to be designed in a way that prevents the player from easily making wrong actions by mistake.

Besides hindering the user from making mistakes the application also needs to

present relevant data in an easy and understandable way. The user must never need to second-guess what the data in the application is trying to represent. In the beginning of the application this involve having the option of creating or joining a game, having relevant alternatives of rules when creating a game as well as showing a lobby with all the players that are in the game. As for the play-time of the game this entail showing a map of the landscape, some illustration of the other players as well as buttons to illustrate the main functionality such as catching the person hiding.

With all this in mind, the design of the user interface of the application started out in the beginning of the project with the look of Figure 4.1.

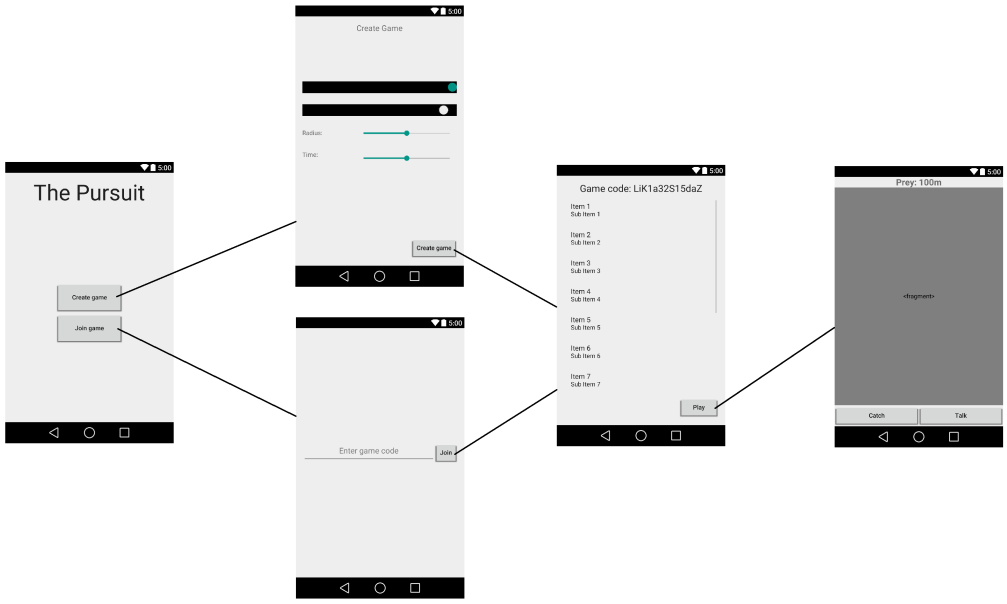

Figure 4.1: An early design of the User interface of the application

The early design was evaluated with a minor user test to see if the the flow of the application was pleasant for the user, as well as to see if the application contained information that the user will convey in the right way.

4.2.1 User test of the user interface

In designing the first user test the main focus was upon establishing a good flow of the application, as well as making sure the information that was displayed to the user was sufficient while not overwhelming.

At this stage the prototype was merely finished and the application still had the look of Figure 4.1. Firstly it was important to evaluate the path of the general user. For instance a user is more likely to join a game than to create one, since a game needs a minimum of two players and could probably in most cases involve many

more, and still only need one creator. The result can be seen in a summarized form in Appendix C.

As the result shows there was a discussion regarding the coloring of the application, the name on the buttons, how to navigate during the map part of the game, as well as evaluating the general flow of the application and for adding screens in between current views.

For instance, the addition of a countdown view seemed very logical immediately and the same went for deciding on locking the screen to one position throughout the application, which for this application seemed most fitting to be the portrait view. At the same time the discussion also led to some confusion in how to show information such as the rules and also the user needing more information about what rules the creator specified. All the different subjects covered played in to the final design, with some elements still left for future development.

4.2.2 Final design of the user interface

After a lot of research and with the help of the user testing the final design of the user interface ended up with the look of Figure 4.2 with the help of the tool Fluid UI [13].

Figure 4.2: The final design of the User interface of the application before being implemented

Some aspects of the application remained the same in the final design seen in Figure 4.2 as in the initial design seen in Figure 4.1. The general layout stayed the same although some minor changes were integrated, such as changing places on the join-button and the create-button and adding a rules-button. As for understanding the main flow and where to continue was clear to all users during the user test of the interface, this concept remained the same throughout the design process.

The first real decision that was made about the basic look of the application was the choice of color for the application. Since the application is a game that has the purpose of getting more people active, a color scheme of variant colors from the nature seemed fitting. This initially meant combining the colors of blue and green. When researching further on the impact of color on people[21], this thought was only confirmed further with support by the color of green being the color associated with nature and health and the color of blue being a very likable color.

With wanting the application to be more dynamic, the background was created as a gradient between two different colors. This meant creating a palette with the gradient consisting of two colors of similar nature, but with different lightness, as well as having an accent color, in this case white, as the primary color of all text to be displayed directly on the background. This choice of color for all text was made by further researching accent colors for the combined color of green and blue, with the result being really light colors and with the final decision being white[22].

As for the size and style of different texts throughout the application, the main focus was on the text always being easy to read and a consistent font throughout the application. Choosing these different aspects served mostly on trying out different fonts and testing the readability, but also using certain guidelines[23]. This also went for having differentiating sizes for different texts that served as an indicator on what importance certain parts of the text have.

The only difference in the color of the text comes with the buttons of the application, where the buttons are designed to illustrate regular use and special use with the contrasting color of black as text color. The join button which is the most commonly pressed button is green to signalize that the user should go ahead, much like the green in a traffic light[21]. Without wanting too much of a color scheme mess in the application design, the create button was decided to be yellow. This was also based on the fact that J. Lim[21] states that yellow is a creative and fun color, which is the main purpose of the application. By possibly pressing the yellow button and creating a game the user could be inspired by the want to have fun.

With only one button left to design on the start view, the button to access the rules of the game, it was decided to be a color somewhere in between the two other buttons to illustrate the cohesiveness of the page. The button is also thinner than the rest of the buttons to illustrate that it is not as important. The general user will have an idea of what type of a game the application is and the button is primarily for new users.

Turning to the rest of the application the same color scheme was used for all buttons throughout the application, with the primarily used button being green and the secondary used button being yellow (except for the rules button). The same goes for the progress bar of the duration of time in the game view of the application. Another occasion when shying away from the general outlook of the application is in the players lobby where the list of players is defined in a square with a lighter color than the general background. This was to illustrate it being different from the

rest of the view, since it is updated every time a user joins the game[22].

Lastly there was some discussion regarding the color-scheme on the countdown-screen of the application. As this is a screen that is not generally meant to be looked at for more than a few seconds at a time because of the player at this time is running away from the rest of the players, it was not of great importance for it to state any information other than the seconds left. Instead, the focus in designing the background for this view was to have some sort of illustration to catch the attention of the player. Because the player during this stage of the game is dependent on knowing how much time is left of the countdown this needs to be easily accessible. Having a large text showing the time left as well as having changing colors throughout the countdown could help with catching the attention of the player as well as keeping the information to a minimum.

4.2.3 Final content of the user interface

With maintaining a similar flow as in Figure 4.1 the largest difference that can be seen in comparison to Figure 4.2 is the added view of a countdown. This countdown that all users will see was added as the users need to be able to move away from each other in the beginning of the game. The view contributes with an equal setting for this to take place.

Another aspect that is different in Figure 4.2 from the initial design of Figure 4.1 is that the options in creating a game are better defined. In the final design there is a couple of options available for the user to decide on, with all the options having a default value.

The first option is whether or not to have a fixed game area. A fixed area in this instance means that the area of the game is defined as a radius from the starting position instead of being constantly updated depending on the position of the prey. For this alternative the default value is to have a fixed game area. As for the next alternative there is a slider to define what the area radius of the game should be. This option is only available when having chosen a fixed game area and the slider goes from the minimum value of 100 meter to the maximum of 1000 meter. The default value for this slider is 500 meter. This decision was based upon the idea among the group members of an average game taking place within a diameter of 1000 meter. The third alternative of choosing catch radius defines at what distance or below from the prey the hunter has to be in order to catch the prey. The alternative is again shown on a slider, with the minimum value of 5 meters and the maximum value of 15 meters with the default being 5 meters. Depending on what landscape the users are in this seemed like an option that could be relevant. As for showing the distance to the prey in the game view, the change from distance to "you are very close" always takes place when the hunter is closer than 20 meters from the prey.

Since the game can be played in various different landscapes with different areas this

also demands the option of changing the duration of the game. This is yet again chosen on a slider with the minimum value being 2 minutes and the maximum value being 30 minutes. In this instance the default value is 10 minutes as the default radius of 500 meter corresponds to an appropriate level of difficulty for the prey according to tests done by the members of the project. Lastly the option of deciding on nickname was added for the users to be able to identify each other in the lobby and on the map. The field will automatically fill with the latest name that has been used in the application. As the user may however have different nicknames in different groups of people this option is always displayed when creating or joining a game.

For the other views there were similar options in Figure 4.1 as in Figure 4.2 with some exceptions. For instance having a rules button available in both the start view and the lobby view. This button was added to give the users all the information they need about the game in order to play. Another aspect that is also changed is the illustration of the time in the game view as this in Figure 4.2 is illustrated through a progress bar that shows the duration ratio of the game that has passed. Finally there is also additions in the lobby view. Firstly, in accordance with the result of the user test, displaying the rules decided by the creator of the game for all the users to see and secondly in having a check mark next to all players that have pushed the ready button and therefore are ready to play.

4.3 Designing the server

The main component of the application is the server back-end. This is where the logic and the state of the active games are stored (see Figure4.3 for a state diagram representation of how the functions should be used, and see Figure4.4 for the list of functions). That means that the server has to be flexible because of the back-end being responsible for the logic and the state of the game. This has made the server a key component and the smartphone applications the front-end that transfers data to the server so that it can update its state and then send back the current state of the game to the devices.

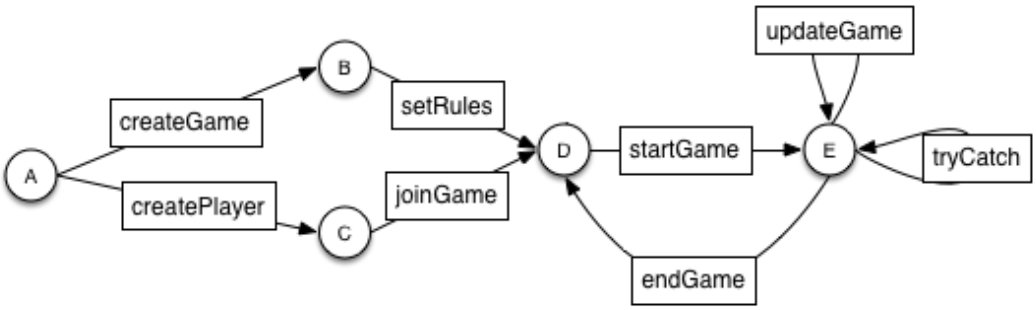

Figure 4.3: State diagram on how the functions on the server are used.

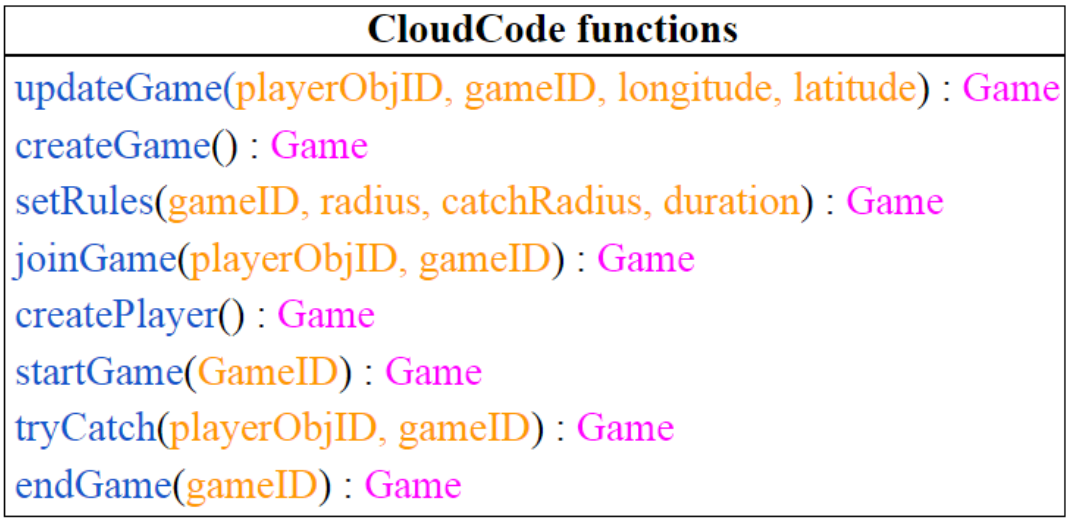

Figure 4.4: All the functions implemented on the server through Parse's CloudCode.

As seen in Figure 4.3 and Figure 4.4 there is number of methods on the server which is called upon at different stages of the application. In stage A and B there is a creation of a game with specified rules and an addition of a player and in stage C another player is added to the game. In stage D the application is checking if all players are ready to start the game and in stage E the game is played and the state of the game is frequently updated. Finally the game reaches its end which leads back to stage D.

As the server is a hub that connects all different devices, there is a lot of traffic going in and out of the server during a game. If this data is more than the server can handle, there can be complications delaying the data that is processed and sent to the mobile devices. This problem can occur if there are too many games or players active at the same time, as the free version of Parse that we use has a restriction on the maximum number of requests sent to the server per second.

4.3.1 Implementation

The state of the game is stored in a object oriented database (see Figure4.5 for entity relation diagram of the database) on a server hosted by Parse, where every entity has a specific and isolated responsibility. By decomposing the data to smaller pieces, redundancy is minimized as data does not need to be duplicated as part of a different entity, but instead they just have relations to each other.

Most of the logic is implemented on the server and the interface is clear and easy to use from the application. Instead of working with the database directly through the application, they instead are invoking functions that take specific arguments and return the updated state of the game (see Figure4.4 for definitions of these

functions). By doing this, the error handling on the devices can be minimized and centralized as there is no need for specific implementation for each system. As the devices invoke these functions through Parse's SDK, the communication to the server and concurrency on the applications will be handled automatically by the Parse SDK.

By designing the server in this way, the manipulation of the database is possible only through the code on the server while the application code is not allowed to alter the state of the game directly. This guarantees that the data manipulation is centralized and consistency is easier to maintain.

The server logic is a collection of functions (see Figure4.4) written in Javascript using Parse's Javascript library and pushed to Parse's CloudCode, which stores the server code. Most of the functions are designed to take the ID of a game, and the parameters that should be updated on that game that the ID references to in the database. So every function is basically a small script to manipulate the database on a higher abstraction level.

4.3.2 Design of the database

The database is constructed by six different entities that have a clear separation in responsibility that can be understood by the name of the entity and its attributes as seen in Figure 4.5.

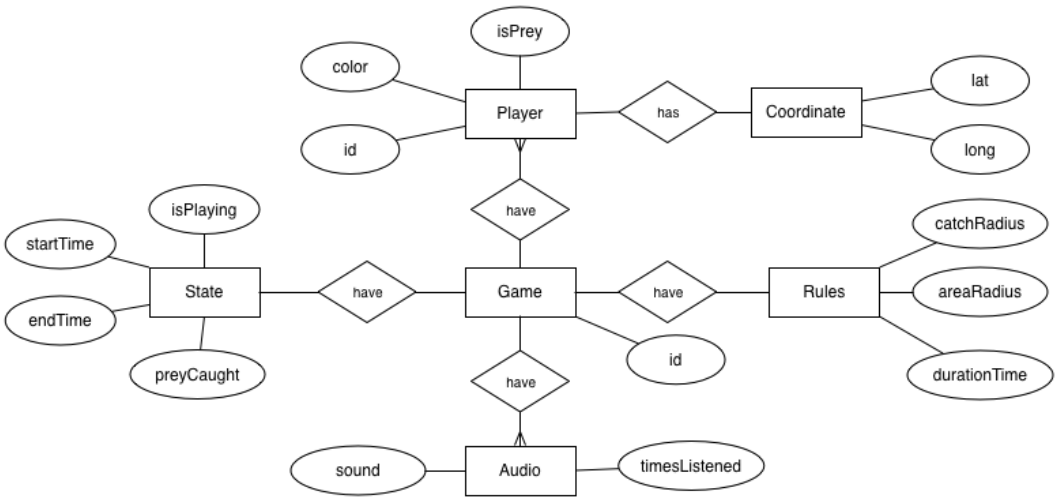

Figure 4.5: The ER-Diagram of the database

The game entity has an ID to identify the game and relations to all the other entities. The game entity's main purpose is to connect the other entities to create a representation of a game. The rules entity describes how the game should be played and what the game allows the player to do. Player and state entities together create

the current state of the game which includes the coordinates of all players as well as if the prey is caught, the start and end time of the game, the audio files that has been uploaded and if the game is currently playing.

4.4 Designing the mobile applications

The mobile application is the way a user communicates with the game and other players. As the application is a multi-platform application, there are some differences between platforms in the recommendations for design, limitations of what is possible, and in how some features function.

When developing for mobile devices regardless of system, it is important to consider how to minimize the battery impact and data traffic on the mobile network. It is also important not to differentiate how the application works on the different platforms as the user should not need to relearn how to use the application when using another platform. The application should also follow the recommended guidelines for each platform so users of a specific platform can be familiar with how the application works, based on other applications on the same platform. This was accomplished by following the interface guidelines provided by the platform owner which is further described in chapter 4.2.

All views were designed using a built-in design editor, and minor adjustments that were not possible in the editor were done directly in code. A relative layout was used for each of the views to position and form view-elements. The position of each element can be specified as relative to other elements within the layout. This minimizes the code that needs to be written to handle special scenarios on devices with different screen sizes[24].

4.4.1 Architecture of the application

Both mobile applications have been designed so that every view in the application has a clear purpose. This view is a reference to the view that can be seen on the screen, not a view object containing code. This means that the code for every view in the applications are independent from every other view, except when passing data from one view to another. Every view will handle the actions that can be done on that specific view and call the correct functions so the right logic or network request is performed. Most of the game logic is handled on the Parse server, and all the network requests goes through the Parse SDK, which hides all the communication details, such as JSON conversion and HTTP requests to the server and takes care of all details regarding network traffic (see Figure4.6 for more details on how the application works with the Parse SDK). After the action is handled it is also the view's responsibility to make sure that the correct state of the data is represented on the view.

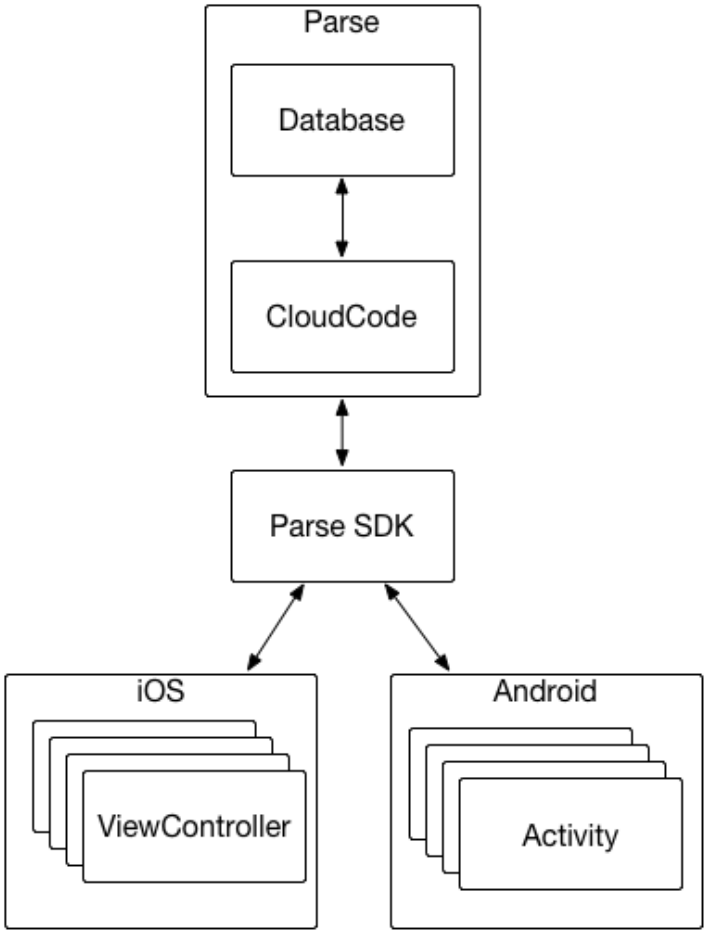

Figure 4.6: Structure on how the mobile applications use Parse SDK to communicate with the server.

4.4.2 Implementation

The start view of the mobile application contains the options to either create a game or join an existing game. When the mobile application has received the input to join a game it invokes a method on the server via a network request. By doing so the server creates a player object and returns it to the mobile application so that it has all the prerequisites to join a game. When the method to create a game is invoked, a new view is created that contains input for what parameters within a certain limit should be used to set up a game. These parameters are then used when sending a request to the server. When the server has created a game it returns a game object that contains a player object. The mobile application needs to keep a reference to the player object so that it can differentiate the current player from other players. When either of these actions is successfully performed the end result is that the mobile application move to the lobby view with the current data.

The lobby contains a list view that show a representation of all players current ready

status from the existing game object. This game object is updated through a request that the mobile application sends to the server every second. The game ID is also represented in text on this view as well as the buttons for leaving the game and setting the player status to ready. By performing the leave game action the player object is removed from the game object and the application leaves the view. If the ready action is performed then the object's ready attribute is set to ready and the same attribute is updated on the server so that all other users can have their data updated with this change. When all players are ready it is possible for the creator of the game object to start the game. When the game creator has requested to start the game, all other players see this change through the same request that updates the game object, and takes the application to a new view that shows a count down timer until the game starts. When the timer is finished, the mobile applications for all users are taken to the game view.

The game view is the most vital part of the mobile application, and is where it communicates with the server more frequently than in any other view. The mobile application sends the player's location with a different frequency depending on whether the player is a hunter or prey, to make sure that the latest location is uploaded on the server. It also sends the player's location with a constant frequency if it happens to be the prey, since it is more crucial for the game outcome. The update frequency for the hunters decreases with distance, since it is not as decisive for the game outcome if they are too far away from the prey and this saves data traffic and battery usage.

A map covers most of the game view and displays the data it gets from the function that retrieves all player names, location and color from the game object on the server. It does so every second and displays the data by rendering markers on the map. A text label is shown on top of the view and displays different information depending on whether the player is a hunter or a prey. A timer is started as soon as the user gets to the view and is displayed as a progress bar below the text label. The mobile application will notify the server that the game state has changed, either when the timer runs out or when a hunter has caught the prey. All players will be notified by a dialog window on the game view, showing different information for hunters and prey, depending on the game state. The players receives this information by checking the game state through a function that the mobile application requests on the server every second.

The catch method can only be invoked by players that are hunters, and the mobile application sends information about the player's location to the server once this method is invoked. The server calculates the distance from the player and the prey and successfully responds if the hunter is within an acceptable distance to the prey, changing the game state.

The voice functionality is another restriction only available for hunters, where the mobile application only retrieves the latest audio data that the device has not yet played, from the server. The uploaded audio file on the server contains raw data, and needs to be converted to a playable audio format before the device can play the

sound using a media player. Sound will be recorded once the user holds the talk button, and will be converted to raw data and sent to the server as an object, once the talk button is released. This object is placed in a queue until all messages are received from all users, and later destroyed.

5

Result

While the main priority of the project was to complete the application, the main purpose was to find out whether or not this sort of game is fun to play. This in itself also steered the direction in which to implement the application and focus on usability. The end result of the application from a user's standpoint as well as the user testing will be further introduced in this chapter.

5.1 Application

The project resulted in two mobile applications, one for Android and one for iOS. As previously mentioned this decision was made by looking at what knowledge there was in the group as well as also having a grand idea of it being available for a broader set of users. Only one of the mobile applications did however reach the final stage of implementation.

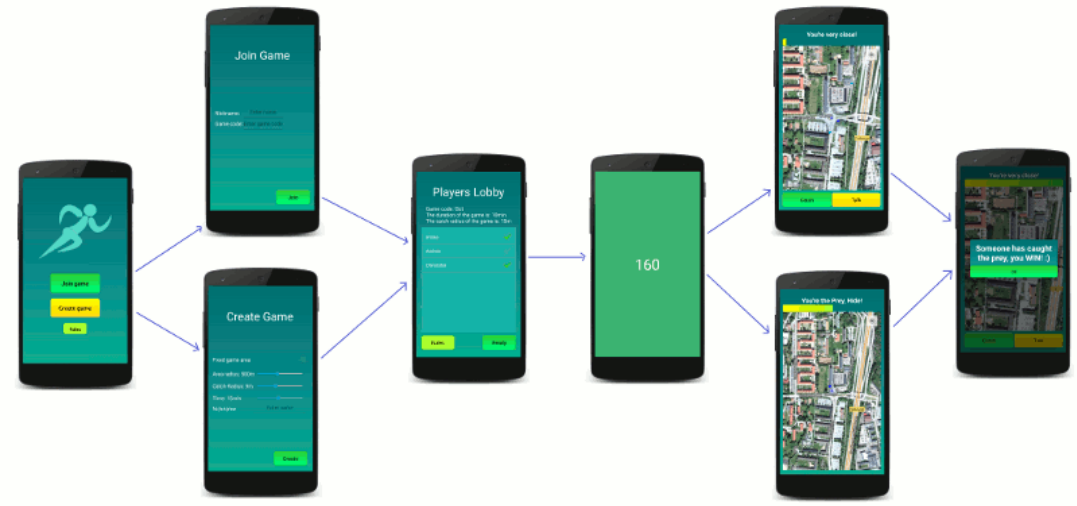

Figure 5.1: The flow of the mobile application on an Android phone

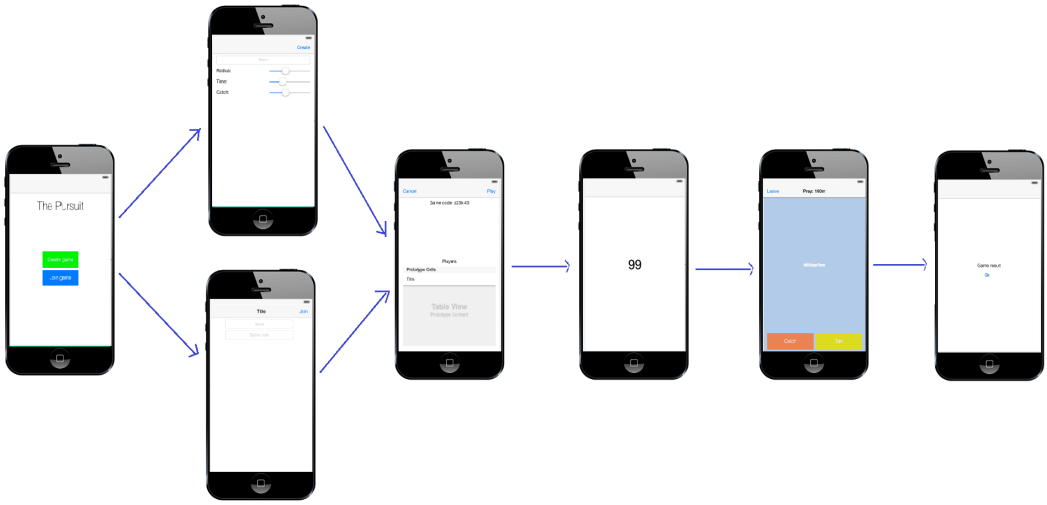

Figure 5.2: The flow of the mobile application on an iOS phone

The iOS application (seen in Figure 5.2) did unlike the Android application (seen in Figure 5.1) not have all components in place. The difference being that the iOS lacked the talk-functionality that the Android application has as well as the iOS application not having the final user interface integrated.

Looking at the Android application, which reached the end-stage of its evolution by having the user interface fully attached, there is the flow chart seen in Figure 5.1 which illustrates what a user is faced with at different stages of the application. These different stages will now be further explained individually from a users perspective.

5.1.1 The icon and name of the application

After downloading the application the user is faced with an icon on their smartphone that illustrates a person running and the name "The Pursuit".

Figure 5.3: The icon of the mobile application as displayed on Android phone as well as in itself

When choosing an appropriate name for the application there were many suggestions on the table such as ChaseIt and Getaway. In the end The Pursuit seemed like the most suitable name for the type of game that the application entailed. When deciding on what type of icon to design there was an instantaneous thought on it being a person running. With this in mind there was an image available for free use which acted template in designing the final icon[25].

5.1.2 Starting the application

When starting the application the first time the user is confronted with a screen where there are three options; either creating a game, joining a game or reading the rules. The user is again faced with the icon of the application, which illustrates to a certain extent the type of application as can be seen in Figure 5.4.

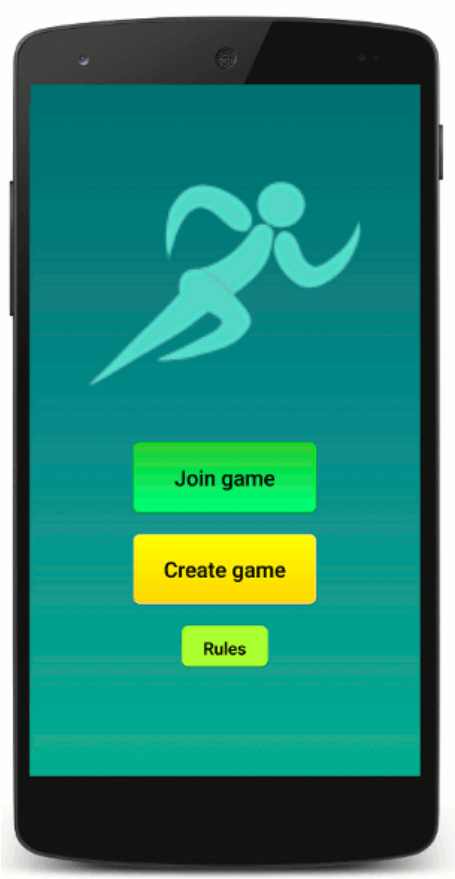

Figure 5.4: The start view of the mobile application

When choosing which way to navigate in the application the user should already have knowledge of whether or not a game has been created by friends. If a game has already been created they will have access to a game code from the friend. As the application does not communicate the game code in any way, the communication of

the game code is something that is left for the creator of the game to take care of. If a game has been created by friends the user has the option of joining that game and if no game has been created the user has the option of creating a game. If the user has any further questions regarding the rules there is also the option of reading the rules of the game.

5.1.3 Creating a game

When having pressed the create game button in the start view the user is presented with a multitude of options for the game as seen in Figure 5.5. The user gets to decide what area the game is to be played in by choosing a radius, the duration of the game, at what radius the prey is caught within as well as if the game area is fixed or updated due to the position of the prey. The user also is asked to enter a nickname, one that at later use of the application will be remembered and auto-filled to the same value unless changed. Finally there is a create button at the bottom corner of the application for moving forward in the process of creating a game.

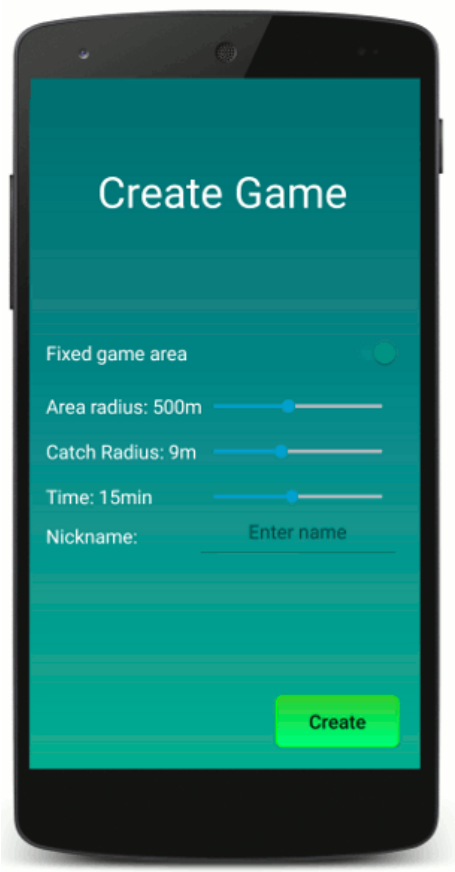

Figure 5.5: The alternative to create a game on the mobile application

When choosing among all these settings there are always default values displayed

when entering the view. For a first time user this is something that will bring great help but as the user is more at home with the application there is still the possibility to change the settings according to individual preferences. This goes for entering a nickname as well, it might not always be appropriate to play under the same nickname with two different groups of friends. When having decided on all the different settings there is an understanding to press the create button to continue on and create the game and move to a newly created lobby.

Some of the options available have however not been fully implemented. The options of fixed area and the radius of the game area is at this point values that can be set but has no effect on the game. Nothing will happen if a user is outside of this area during a game but the options were still left as for the users to choose a mutual agreed upon game area to play on.

5.1.4 Joining a game

When having pressed the join button in the start view the user is faced with two different fields to fill in, a game code and a nickname as seen in Figure 5.6. The game code is a code the user will be presented with by the creator of the game, and again the nickname is any name the user wants to use and will be auto-filled to the latest entered nickname. There is also a button on the bottom which the user must press after all the fields have been filled in.

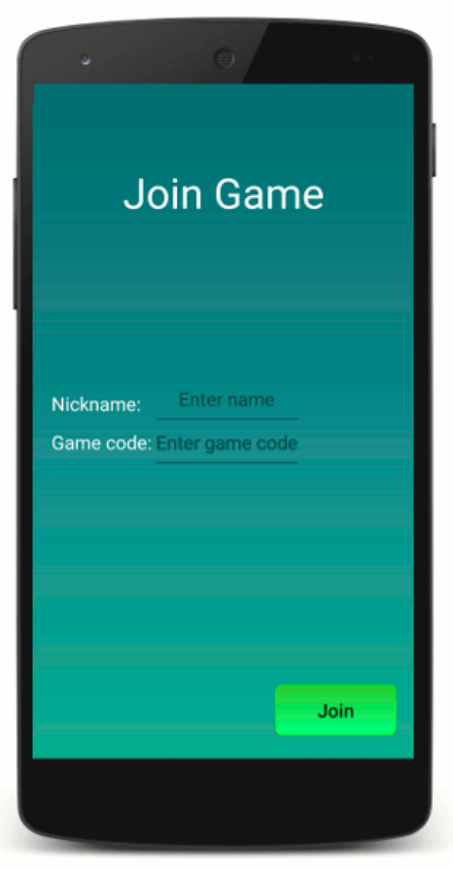

Figure 5.6: The alternative to join a game on the mobile application

For this view the user only has a limited amount of possible actions. There needs to be knowledge of what game code to enter and this communication will as previously mentioned take place outside the application. As with create game this view also gives the user the option for a nickname. When having entered the fields and pressed the button the user is moved to the lobby of the given game.

5.1.5 Players lobby

When either having created or joined a game, the user reaches a view where all the players whom have actively created or joined the game are visible in a list as seen in Figure 5.7. Furthermore the user is also presented with the conditions given by the creator and yet again faced with the button "Rules" which contains the same material as in the view at the start. Finally there is also a button that reads "Ready" which is supposed to be pressed to signalize that a user is ready to start the game.

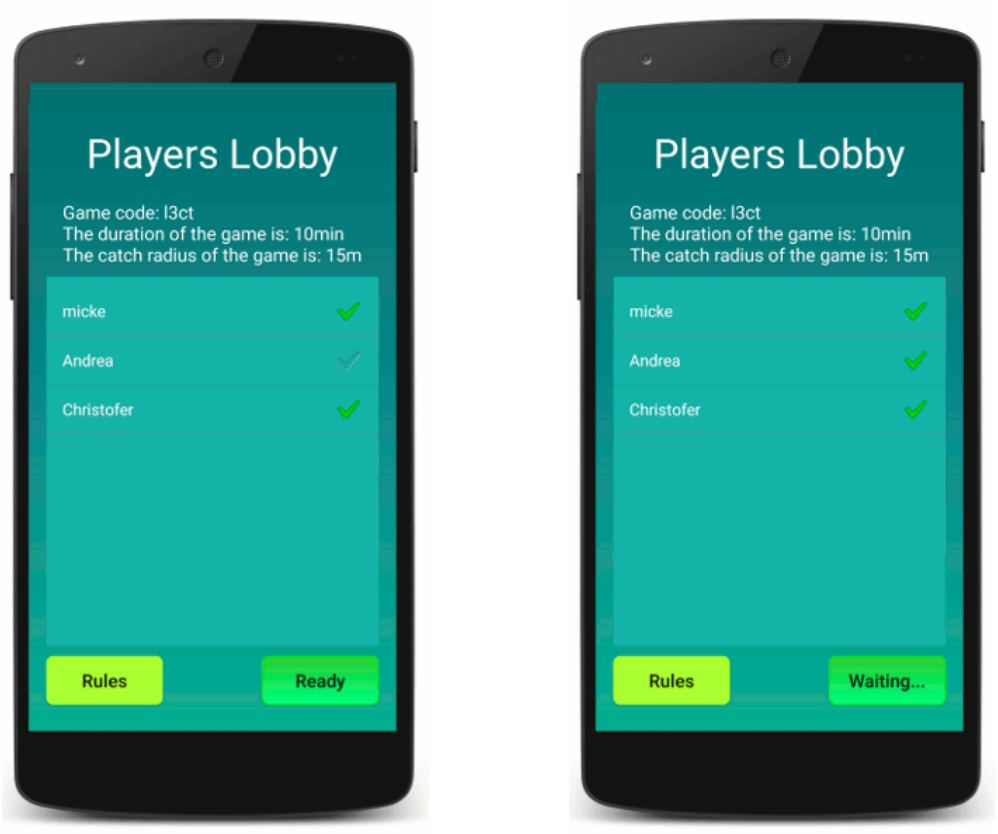

Figure 5.7: The players lobby on the mobile application with markings of the players who are ready as well as when the user is ready

At this point all the users are informed of the decision of the creator. The duration of the game, the catch radius and the game code are fully visible to the users as well as information on which players have joined. When a user is ready and fully read up on all the rules it is time to press the ready button. At this point a green check-mark will appear next to the users name. In this view there is also a safety feature for not being able to exit the game without extra confirmation. This gives the user an extra chance to remain in the game if accidentally having touched the back button on the smartphone.

The game starts when all players have pressed the ready button. At this point in the application there is a lot of information for the user to gather but the application should at this point be more or less self explanatory for the user.

5.1.6 The rules of the game

In both the start view of the game as well as in the players lobby, the user has the option of pressing the rules button. This results in a dialog window being displayed above the current view in the application and the user is faced with a great deal of text which describes the general rules of the game. This can be seen in Figure 5.8.

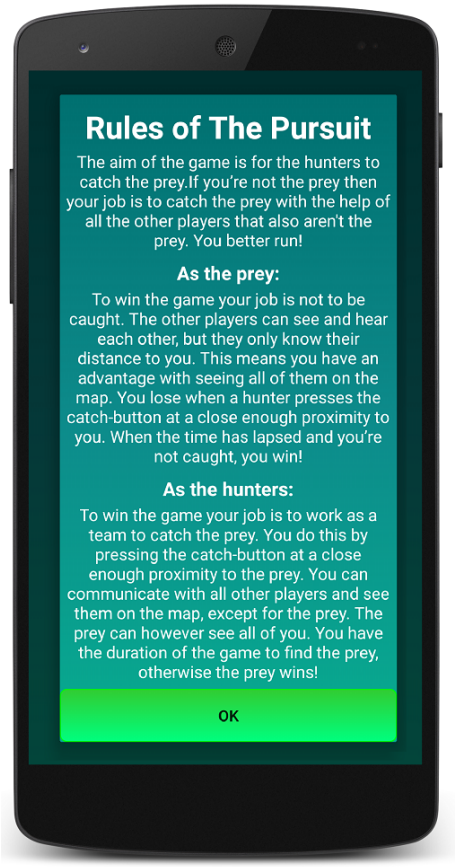

Figure 5.8: The rules appearing when pressing the rules button.

At the points of which this button is available the user is either just starting the application and having no knowledge of the game or the user is in the players lobby and has time to spend reading the rules more thoroughly while waiting for the rest of the players. Either way this option is primarily for the first time user and therefore contains the most basic set of rules.

The rules are formulated to contain basic information of the game, specific rules and information for players who are the hunters and specific rules and information for the player who is the prey. The information is mainly the same but is also constructed from the viewpoint of either type of player in regards to what the specific players sees and hears as well as the main goal for the type of player. The rules was designed to be presented in this way to make it easier to get a general idea of the game from a different perspective.

5.1.7 Countdown to the game

When everyone in the game has pushed the ready button all of the player's screens turn into a three minute countdown with the colors of the screen changing as the

countdown goes as seen in Figure 5.9. At this state of the application the user has no options but are instead informed of the remaining time until the game starts.

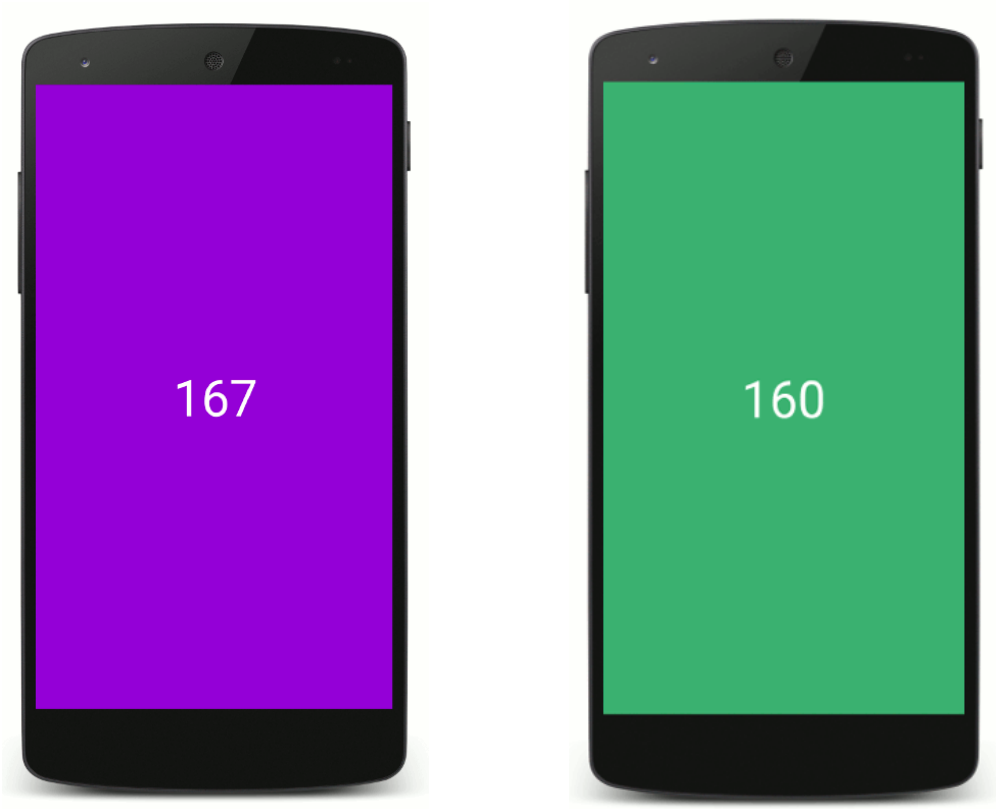

Figure 5.9: The countdown view in the mobile application with the color changing as the countdown continues

The user has the only information that is necessary at this point, which is how much time there is left until the game starts. As the number is counting down with the frequency of a second, this information should be easy for the user to connect with a final time. This view has sparse information to be appropriate for this stage of the game which entails running away from the other players.

With trying to integrate the playful side of the game with the mindset of every user, the countdown is also illustrated by the change of color with the rate of the countdown, with the color changing twice every second. The main focus of the user at this stage of the application will not lie on the mobile application screen in itself but instead of running away from the pack of players. The color scheme of the view should contribute in attracting attention to the time left.

5.1.8 Playing the game

When the countdown is finished all the players are faced with the game view where the most important information is displayed on the top of the application, with either the distance to the prey or the information that the player is the prey. Depending on the role of the player the view also varies which can be seen in Figure 5.10. If the player is the prey there are no buttons to press and if the user is a hunter there are two buttons displayed. These buttons are catch, which will try to catch the prey, and talk, which will send an audio-file to the rest of the player's team members.

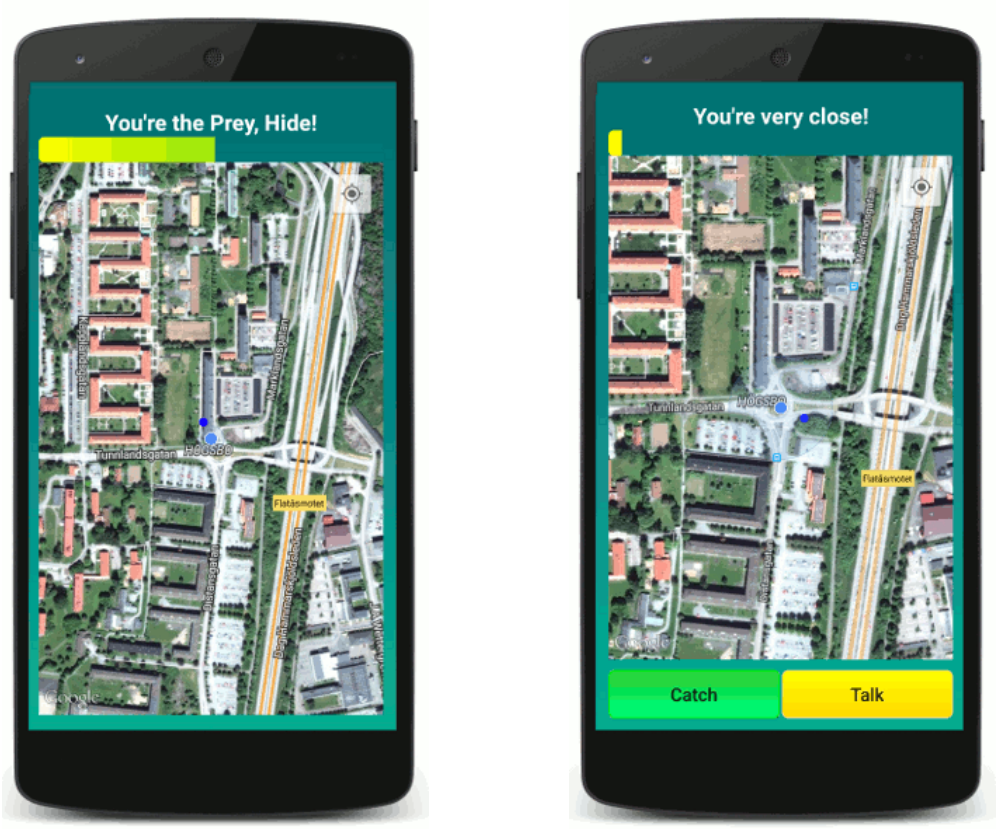

Figure 5.10: The game view on the mobile application, with the left being for the prey and the right for the hunters.

Both of the views show other players on the map but the difference is that the prey sees everyone and the hunters only see everyone except the prey. Both type of players see the same progress bar which is counting how much time has passed since the start of the game. When the progress bar reaches the end the game is over.

When playing as a hunter there are more options than for the prey with two added buttons. They are in their name somewhat explanatory but they also have animations as to what happens when they are active.

Figure 5.11: The game view on the mobile application, with the left being when having just pushed the catch button and the right being when holding the talk button.

When having pressed the catch-button there is two actions possible. Either the hunter is close enough to the prey and the game is over or the hunter is not close enough to the prey and the game continues. In this last instance the catch-button is locked and there is a countdown from 5 displayed on the button as to illustrate the time left of it being locked which can be seen in Figure 5.11. This to keep the hunter from constantly pressing the button and hoping for the best when at a close proximity to the prey.

The talk-button is implemented to record a message and then play it to all other players on the hunters team. While recording the button changes appearance as can be seen in Figure 5.11. There is no limit as to how long a message can be or a check if the button is accidentally pressed. This functionality is only implemented on the Android application so far.

For the prey, the only thing that you have control over in the game map is zooming in and out of the map shown which can be seen in Figure 5.12. This is also available to the hunter. The current player is always showed in the middle of the map, but have the possibility of zooming out as much as wanted.

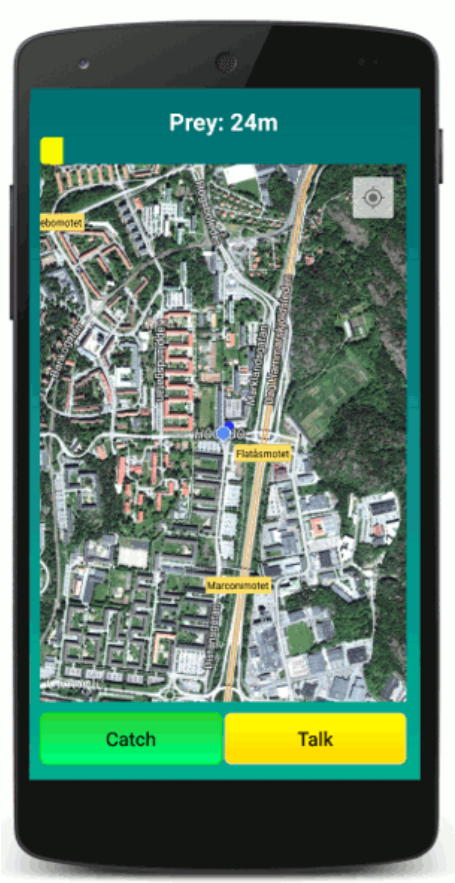

Figure 5.12: The game view on the mobile application when somewhat zoomed out.

As this is a pattern that could be found in any given map view, the user should be able to quickly pick up on the way to navigate the map. At the same time the user never strays from her own location, but is always directed to herself in the middle of the screen.

The game ends when either the time has run out, which happens when the progress bar reaches its end, or when the prey is caught by a hunter, which happens when the hunter is close enough to the hunter and presses the catch button. Either way, when the game ends there is a dialog shown to all players that shows either if they win or if they lose. When pressing the ok-button the player is transported back to the players lobby. The winning dialog can for example look like Figure 5.13.

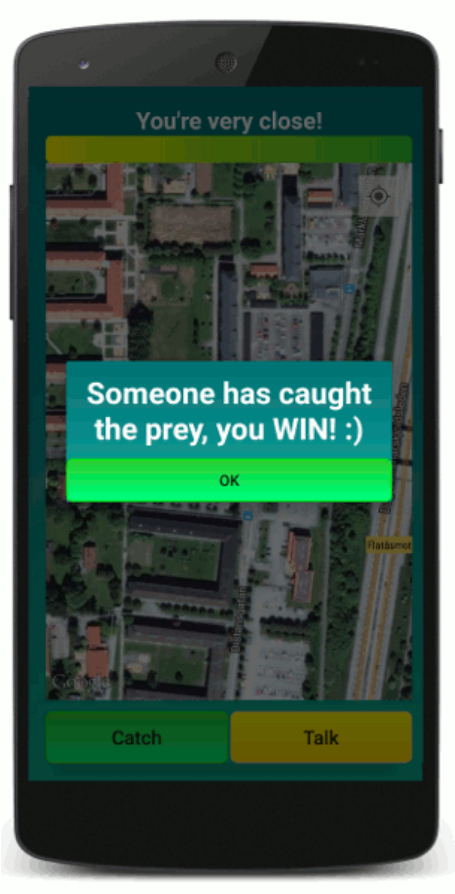

Figure 5.13: The window shown when the hunters have won the game.

Finally there is also a safety feature in this view as for what power the user has, with the back button on Android phones being disabled. This is because we assume that the user do not want to be able to accidentally exit the game. For the user to actually exit the game the process needs to be killed on the smartphone.

5.2 User study

When reaching a satisfactory point of the implementation for the game it was time to do a final user testing. This user testing was set to take place at Slottskogen, which is a large park in the central parts of Gothenburg[26]. The testing was planned to take place during the last week before the project came to an end and many friends and family-members where invited to take part in the trial of the final application. As some of our family-members and partners could not make it to this event there were also some additional minor user studies done in the same fashion, separately from this larger user study.

In designing the second test the main focus was to establish if the game was fun to play, and if not, was this a fault in the execution or in the concept of interacting in

this way.

The evaluation form sent out to all participants of the test can be seen in Appendix A. It contains questions such as: "Was the game fun to play?", "Was the rules and the concept of the game easy to pick up?", "Did the game work fault free and if not, what happened?", "What role did you play in the game?" and lastly "Would you like to see more of this kind of game in the current market?".

With 10 people trying the application and submitting their views on their experience, there were many comments on what was problematic during the game as well as conveying their thoughts on future development of the application. The answers to the survey can be found in Appendix B. All participants voiced their opinions in this survey and for the the initial question of "Was the game fun to play?" there was an average of 4.2 on a scale from 1-5, where 1 was not so fun and 5 being really fun.

When reading the answers on the question "Was the rules and the concept of the game clear from the icon and the start page?" most people responded to it being somewhat clear by the man running indicating if being some sort of application involving movement. Some answers signalized it not being entirely clear that it was a game rather than perhaps a running application, but at the same time another answer stated that it seemed like a game and did not understand it involved movement. On the question "Did you immediately understand what to do?" this result seemed to be represented with 8/10 users saying that it was clear and the only comments where that it was not obvious that is was a realtime multiplayer game, which is the same comments as in previous question. One comment did however say that the rules helped, but they might need some revision.

As for the questions of "Did the game proceed without issues" and "If not, why?" 6/10 had issues while playing, although most of them involved an update for players that the maximum amount of request towards the server had been reached. As the free version of Parse only allows a certain amount of requests per second, this was something that could have been avoided with having a payment plan for Parse. This did however not impact the game according to one answer. At this point the answers also reflected the difference in what mobile operating system the phone had, with some Android users expressing a problem with GPS updates and the iOS users expressing a problem with the talk button not working. Also there was confusion in the countdown as to what the user was supposed to do. There was also a suggestion as to the creator being able to determine the length of the countdown before the game starts. Finally there was one user that had a problem with the application crashing at the stage of the game being over.

The question of "Would you prefer another type of mapview, and if so which?" got a pretty unanimous result with all players saying that it was appropriate for the application. One user did even point out that it was a great choice for the type of game, as the player for example can see a larger area of grass and avoid it. Another user did however suggest having the option of regular map view at times when the game is played in a city environment instead of in a park. The only other

suggestions was that one user had difficulty understanding how the zoom worked and would prefer having specific zoom buttons.

As for what roles the users played in the game, it did not seem to matter to the general feel of the application. The players had similar average in the first question of how fun it was as well as the same issues with all other things such as GPS updates etc. Another question that was completely unanimous no matter what type of player or operating system was the answer to the question of "Would you like to see more of this kind of game in the current market?". Every single one of our users answered yes, as in wanting more of these sort of applications.

Lastly the question of "Any other comments that could help us?" resulted in a large number of suggestions. Varying from simple changes such as the user wanting to set their own countdown time and having a better GPS proximity, to larger additions such as having a text-to-speech functionality and having the possibility of setting a start time different from now, as to say that the game starts in five hours. Also there were suggestions that with minor editions could give extra functionality such as being able to leave the game while playing if needed, being able to pick who plays the hunter and the prey and being able to play the game over a larger duration of time. One suggestion that many users had in common was the want for more information, with displaying information such as "turn the media sound on", "activate your gps" and "Run away/Hide" perhaps during the countdown.

Finally there were some last wishes on the application such as to minimize the battery consumption, adapt the design of the application to bright sunlight, changing the placement of a button and lastly something that was taken into consideration throughout the project, constricting what type of movement is allowed i.e not allow to travel by other means than decided upon.

6

Discussion

The applications built during this project had some shortcomings due to time constraints, which made it impossible to test out different variations of the rules and features of the game. This discussion is therefore firstly based on the limited testing that was done with the application and with this, analyzing what changes would be appropriate and maybe even necessary. Secondly it will also cover a brief reflection on the way in which the application was developed and user tested such as to shed light on the difficulties in reaching a final conclusion.

6.1 Developing the application

The initial idea of the project was to create the application for two different mobile operating systems, Android and iOS. While this decision was based upon a number of different reasons covered in this report, the end result did lack in consistency between the two applications. With the limited time of this project there should have been a focus to reach one fully functioning application and then moving on to the other one. Instead there is some functionality which is not entirely complete for either application. This unfortunately led to the final user testing suffering from different user having different functionality. This was most obvious when some phones with Android were having difficulties with sending correct GPS-positions as well as the iOS version not having the talk-functionality properly in place.

With having fewer members than the regular project group the talk functionality as well as many other that was discussed at an early stage had to be eliminated from the final product. These ideas were reflected by the users in the final user study as they thought of many of the same suggestions in their reflection over future development. This entailed having a countdown screen that illustrates important information, having a properly functioning talk feature, being able to leave the game while it is in play etc. All of these ideas unfortunately were not in the final product.

6.2 Network and communication issues

One of the major difficulties in developing for applications that are in constant connection to a server is that they have a lot of demand on the device the user is using. When developing the application most of these were thought of, such as updating at different frequencies depending on how close the hunter is to the prey and choosing to update from all connections in a certain order, i.e. GPS, Wifi, 4G etc. But as the application reached its end and the user study took place there were still some issues, with some people having the wrong GPS-coordinates or having them updated at a weird frequency and/or proximity.

All of these issues are variables out of the applications control and the application have to assume that the device will have a somewhat reliable connection. These are some scenarios that need to be handled and taken into consideration as no network connection can be trusted to work at all times without complications. One of these scenarios might be to handle short bursts of no connection between the device and server, which should keep game working as intended but with less frequent updates for the user until there is a stable connection. Another might be to even kick the player out of the game for not having regular updates to the server as to not hinder that player from making the game harder for the other players. The most crucial complications a slow connection can bring to the game is that other players may rely on the fact that real world should be in sync with the state of the game. As expressed in the user study there were problems where the hunter tries to catch the prey and the hunter's or the prey's position is not updated fast enough. The hunter can be close to the prey in real world but not in the state of the game and as a consequence would not let the hunter catch the prey even if she is close enough.

Choosing to use Parse as the server provider for the game logic for the applications came with a lot of benefits. At the same time, however, it restricted the usage of the application as shown in the answers of multiple users in the user study. With the free version of Parse only offering a certain amount of requests per minute, this limit was passed from time to time by the users in the test. As for extending the game towards a larger audience this would definitely be an issue, but as for proving if the concept of the game works it did not play essential part in the decision.

6.3 Content and design of the user interface

When having completed the user study there were some apparent questions from the users regarding initial impression of the application. The icon and the name and the general outlook of the start page did give most users the impression of it being an application involving movement, but at the same time some users felt that it did not give enough information of what sort of movement and what the rules were for the game. There is a point to be made for changing some of the text in rules to make

it clearer to the user. At the same time there was one user who interpreted it the opposite way by realizing it was a game but not about how it involved movement on their own and this still begs the question on how to reformulate the rules. This result sheds an unsure light on how to further develop the current design. The reason behind this confusion might instead be because of the users not having chosen to download the applications themselves and by this reading up on it in advance. As this will be an action of the general user the questions raised by the user might not be a necessary change of the application.

One idea that the users raised in the user study which might be of interest is the fact that the hybrid-map that is currently displayed as the map might not always be appropriate. When playing in a park the users expressed it to be of great advantage as for knowing the terrain of the map. One user did however state that if the game is taking place in a central location with a lot of buildings this surrounding might be confusing in such a view and the map view might be preferable in this case. With trying to minimize the affect that a user accidentally can have on a game while playing this seems not to be appropriate as an option in the game view, but might be worth including in an extra setting when creating a game.

The same goes for the functionality of zooming in and out which one user expressed as being confusing and instead wanted a button for zooming in and out. While this could be clearer for the users it still adds an extra possibility of accidentally pressing a button without intending to while running, and when looking at the map a second time realize they see the entire continent of Europe.

This was also heavily taken into consideration when it comes to the one of the more crucial interactions a hunter can make in the game, which is sending audio files to the other hunters. If the button is used improperly, either by mistake or by the user not having knowledge, it will affect the data load on the network and the CPU load for all other hunters as they will automatically download and play this audio. In some cases this audio may also confuse the other hunters if the audio sent was not meant to be heard by other hunters. With this in mind the user interface was designed for the button for the user to hopefully have minimum unintended action with it. At the same time there was not enough time to implement boundaries such as time limit on the audio etc. which would limit such accidental usage.

Another thing that was mentioned from a user in the user study was that in some scenarios it was hard to see the map on the screen as for the bright sunlight reflecting on the screen. With the game being meant to be played outside where strong sunlight may occur and shine directly on the screen this might be an issue when the phone does not have automatic light settings. It might also be an issue for some phones as the material used for the phones might not be as good at not reflecting light. With the application having a color-scheme that is not light there might be an issue with this in the creation of the game, but at the same time this activity is taking place when the users are all stationary. The problem might arise when actively playing the game and not having a great amount of time to look at the screen. In these instances of bright sunlight it might again be a good idea to have the possibility in

the creation of the game to choose the map view instead of hybrid view.

6.4 User study

Due to the limited amount of users during the test the results of the feedback are not comprehensive enough to make a definite conclusion of which features worked and which that did not work. The test was mainly done in one location during a limited time. The time and place of the test could affect how the player perceive the game as the game may be played differently under other circumstances which were not tested. As some features for both applications were not complete during test the result may have been different if this was not the case. An example is that the voice communication did not work on the iOS version and the location data had some troubles on the Android version for a few of the users in the test.

6.5 Health aspects

As the game requires the user to move in order to play an interesting game and preferably communicate with other players, there is a health benefit of playing this game compared to games that do not require the user to move. How much and fast the user moves is dictated by the player and their interest in performing in the game. If the user does not move fast enough it gives the other team an advantage. Also by utilizing the communication possibilities and working as a team it may increase the social bounds between the players of the same team. For many people going out doing some kind of exercise feels like a chore but seeing as the user study showed such high results of the game being fun this game can be seen as a great alternative. With playing the Pursuit the focus lies more on the actual game than the physical aspect of the game, with the end result of the user getting exercise.

6.6 Future development

During the development of the application many possible features were discussed but could not be implemented due to time constraints. One thing mentioned in the user study was the idea to regulate what speed the user can travel at. As there are no rules on how the player may travel during the game, a player could get an advantage by using a vehicle to travel faster than possible by foot. This unfair advantage is something the application should regulate by perhaps warning the user and as a last resort disqualifying the user. One way of doing this is to calculate the traveling speed of the user and if the speed is above the allowed limit for a longer period of time the warning should appear. There can be some complications of this feature

as the location of the user may not be very precise during some situations and then get a better location data after some time have passed and this better location data may differ in such a big way that it may seem that the user have traveled above the allowed limit.

Another detail the users brought up in the survey was that it was not clear what the user was supposed to do after pressing the ready button and moving into the countdown. This was something that was planned to be integrated into the activity by displaying texts such as "Run away, you might be the prey" as well as "Do not forget to turn your GPS on" and "You might want to raise the media volume to hear the other players". Although some of the insecurity in the users might depend on them not fully understanding the application before entering the countdown screen. It does still seem like a good idea to have such an illustration towards the users.

Finally there was an overwhelming desire for more adjustable settings as well as a broader range of possibilities than currently available in the game. The users formulated ideas such as being able to set their own countdown time, being able to set a longer duration time for the game, being able to create a game with a set start time, choosing what roles to play as well as having text-to-speech of the application. All of these ideas seemed like great additions to the game but were not in the scope for us to have time to implement. Some are easier to change such as letting the user dictate the countdown time and having the possibility to have a longer duration time of the game. Some ideas would take longer to implement such as being able to set a start time as well as having text-to-speech of the application. In the end all these suggestions by the users with them showing such enthusiasm, along with the turnout of the user study, point towards the fact that this type of game is sought-after in the current market.

6.7 Proving the concept of the game

With the ten people in the user study trying out the application and all being asked the question "Was the game fun to play?" there was a great response in the average of 4.2 on a scale from 1-5, where 1 was not so fun and 5 being really fun. This was something that showed real potential for the issue of proving the concept of the game that was produced. Even more interesting was the result from another question in the survey, "Would you like to see more of this kind of game in the current market?" with every single on them answering yes. This is the feedback that was hoped for when coming up with the concept of the game. With the game in itself being a recreation of another game, the main purpose was to find out if this sort of play is fun.

With only having a limited amount of participants in the test and it therefore not being entirely conclusive, there can still be a case made for the unanimity of all the users who did try the application. With such a unanimity we can only hope for the case to be the same throughout the world and that this type of play makes a huge

entrance into the market.

7

Conclusions

The goal of this study was to find out if playing games with the help of mobile devices could enrich the experience. The user study that was done shows that the majority of testers agree that it is fun to play this type of game. Many of the testers did have input on how games like this could be better and with more resources these ideas could be explored further. Due to some limitations in today's technology, with for example precision and speed of location data, the experience of games like these can only be assumed to be better as technology advances.

As all testers supported the idea a broader availability of this type of games and different games with the same concept, this is something we believe should be explored further to see where the boundaries of this type of games are. Many already classic games like catch the flag or king of the hill could probably be more interesting with augmented reality enchantments. We believe this will contribute to a greater world of play as well as perhaps contribute to an increase in the amount of young people who play outside.

For this we believe to be the most important aspect of exploring this type of integration of games with technology, the possibility to change an unhealthy behaviour in the youth to a healthier while still playing by the rules dictated by today's technology.

References

[1] M. Pantzar, "Domestication of everyday life technology: Dynamic views on the social histories of artifacts, " Design Issues, vol. 13, nr. 3, Aut 1997

[2] S. Consolvo et al. "Design Requirements for Technologies that Encourage Physical Activity, " Designing for Tangible Interactions, Apr 2006

[3] IDC "Smartphone OS Market Share, Q4 2014" *www.idc.com*. 2014; http://www.idc.com/prodserv/smartphone-os-market-share.jsp [Collected: 2015-05-06]

[4] Android Open Source Project "Frequently Asked Questions", *source.android.com*, 2015; http://source.android.com/source/faqs.html [Collected: 2015-05-06]

[5] Android Developers "Android User Interface", *developer.android.com*. 2015; https://developer.android.com/guide/topics/ui/index.html [Collected: 2015-05-06]

[6] M. Deutschman "4 Ways Consumers Use Smartphones for Health Information" *www.kantarmedia-healthcare.com*. 2013; http://www.kantarmedia-healthcare.com/4-ways-consumers-use-smartphones-for-health-information [Collected: 2015-05-15]

[7] S. Muhammad, S. Tariq "Impact of Smartphone's on Society" *www.researchgate.net*. 2013; http://www.researchgate.net/profile/Tariq_Soomro/publication/236669025_Impact_of_Smartphone's_on_Society/links/00b7d518ce4de2509d000000.pdf [Collected: 2015-05-14]

[8] Playday Organisation "Unwelcoming communities stop children playing out" *www.playday.org*. 2013; http://www.playday.org.uk/media/media-releases/7-august-2013.aspx [Collected: 2015-05-17]

[9] Android Developers "Android Studio" *developer.android.com*. 2015; https://developer.android.com/sdk/index.html [Collected: 2015-05-10]

[10] Parse "Parse About" *www.parse.com*. 2015; https://parse.com/about [Collected: 2015-05-14]

[11] Parse "Parse Documentation" *www.parse.com*. 2015; https://parse.com/docs [Collected: 2015-05-04]

[12] Parse "Parse Pricing" *www.parse.com*. 2015; https://parse.com/plans [Collected: 2015-05-04]

[13] Fluid UI "Fluid User Interface" *www.fluidui.com*. 2015; https://www.fluidui.com/ [Collected: 2015-05-04]

[14] Android Developers "Android Navigation" *developer.android.com*. 2015; https://developer.android.com/design/patterns/navigation.html [Collected: 2015-05-10]

[15] Android Developers "Android App Structure" *developer.android.com*. 2015; https://developer.android.com/design/patterns/app-structure.html [Collected: 2015-05-10]

[16] iOS Developer "iOS Design Principles" *developer.apple.com*. 2014; https://developer.apple.com/library/ios/documentation/UserExperience/Conceptual/MobileHIG/Principles.html#//apple_ref/doc/uid/TP40006556-CH4-SW1 [Collected: 2015-05-15]

[17] Nintendo "Mario Chase" *www.nintendo.se*. 2014; http://www.nintendo.se/wiiu/spel/nintendo-land_mario-chase [Collected: 2015-05-06]

[18] J.Tidwell, Designing Interfaces, 2nd ed. Sepastopol:O'Rielly Media Inc. , 2011

[19] - "Designing from iOS to Android (and Back Again)" *google.com*. 2015; http://www.google.com/design/articles/design-from-ios-to-android/ [Collected: 2015-05-30]

[20] iOS Developers "Designing for iOS" *developer.apple.com*. 2014; https://developer.apple.com/library/ios/documentation/UserExperience/Conceptual/MobileHIG/ [Collected: 2015-05-29]

[21] J. Lim "The Meaning of Color in Marketing" *blog.tailwindapp.com*. 2014; http://blog.tailwindapp.com/the-meaning-of-color-in-marketing/ [Collected: 2015-05-06]

[22] Google "UI color application" *www.google.com* 2015; http://www.google.com/design/spec/style/color.html#color-ui-color-application [Collected: 2015-05-06]

[23] iOS Developers "iOS Color and Typography" *developer.apple.com* 2014; https://developer.apple.com/library/ios/documentation/UserExperience/Conceptual/MobileHIG/ColorImagesText.html [Collected: 2015-05-15]

[24] Android Developers "Android Relative Layout" *developer.android.com*. 2015; http://developer.android.com/guide/topics/ui/layout/relative.html [Collected: 2015-05-06]

[25] Pixaby "Svart Löpare" *pixaby.com*. 2012; http://pixabay.com/sv/mannen-k%C3%B6r-siluett-svart-l%C3%B6pare-40739/ [Collected: 2015-04-15]

[26] Göteborgs Stad "Slottsskogen" *www5.goteborg.se*. 2013; http://www5.goteborg.se/prod/parkochnatur/dalis2.nsf/vyPublicerade/8602D7D46CAE30F0C1257A2F003D64CB?OpenDocument [Collected: 2015-05-15]

A

User study of The Pursuit

Redigera detta formulär

Utvärdering av The Pursuit

*Obligatorisk

Var det kul att spela? *

1 2 3 4 5

Nej, spelet var värdelöst ○ ○ ○ ○ ○ Ja, det var grymt kul

Var det tydligt från ikonen samt startfönstret vad det var för applikation, varför/varför inte?

Om inte, vad var det som var oklart?

Förstod du direkt vad du skulle göra? *
Var reglerna klara från vad du kunde finna i appen

- ○ Ja
- ○ Nej

Fungerade ert spel felfritt? *
Var det några problem med uppdateringar, kracher osv.

- ○ Ja
- ○ Nej

Om inte, vad var det som krånglade?

Skulle du föredra en annan typ av kartvy? I så fall vilken?
Satellit, Maps osv.

Vad spelade du för roll i spelet?

- Prey
- Hunter

Vilket operativsystem var det på telefonen du körde applikationen?

- Android
- iOS

Skulle du vilja se mer av sådana här sorters spel på marknaden? *
(Spel som aktiverar dig medan du spelar)

- Ja
- Nej

Några ytterligare kommentarer som kan hjälpa oss?

Skicka

Skicka aldrig lösenord med Google Formulär

Tillhandahålls av

Det här innehållet har varken skapats eller godkänts av Google.

B

Result of the user study of The Pursuit

10 personer svarade på utvärderingen

Fråga 1

	Var det kul att spela?		
	Betyg	**Antal svar**	**Andel i %**
Ja, det var grymt kul	5	4	40%
|	4	4	40%
|	3	2	20%
|	2	0	0%
Nej, spelet var värdelöst	1	0	0%

Fråga 2

Var det tydligt från ikonen samt startfönstret vad det var för applikation, varför/varför inte?	
1	Ikonen visar tydligt att det handlar om att röra sig, vilket är bra :)
2	Ikonen får mig att tänka på en idrott- eller motionsapp.
3	Ganska, det verkade vara någon typ av jage med tanke på namnet och ikonen.
4	Ikonen var tydlig och visar att applikationen går ut på att röra sig
5	Det var tydligt att det var ett spel, men typ av spel kunde inte avgöras genom bara start fönstret.
6	Ganska, det är ju uppenbarligen en person som springer så det var ganska lätt att inse att man skulle få röra på sig.
7	Det var inte jättetydligt att det var kurragömma, men kanske för att jag inte är van vid den engelska termen för kurragömma. Att det är en springande gubbe som ikon hjälper med att det hamnar om någon form av aktivitetet men inte att det är ett spel. Kunde lika gärna vara en app som håller koll på min löpning.
8	Kanske skulle ta och lägga till en till gubbe antingen framför eller bakom som visar att man jagar eller blir jagad, just nu ser det ut som en spring/löpnings applikation :)
9	Den var ganska tydlig. Ser ut som en sportapp.
10	Nej, det var inte tydligt att själva spelandet skedde i verkliga livet. När jag läste reglerna trodde jag att man spelade i mobilen och inte att man skulle springa runt. När man fattade vad spelet gick ut på förstod man bättre varför startfönstret och ikonen såg ut som de gjorde.

Fråga 3a

	Förstod du direkt vad du skulle göra?	
	Antal svar	**Andel i %**
Ja	8	80%
Nej	2	20%

Fråga 3b

Var det tydligt från ikonen samt startfönstret vad det var för applikation, varför/varför inte?	
1	-
2	-
3	-
4	-
5	-
6	-
7	När man kommer in i appen så står det bara join game, create game och rules. När man läser reglerna så förstår man att det handlar om en lek, men det syns inte på något sätt att det är ett multiplyer realtime spel om man bara kollar på appens startfönster.
8	Det blev dock klart när man läst reglerna.
9	-
10	Det borde stått i reglerna vad spelet gick ut på och hur länge man spelade istället för bara regler för de olika rollerna.

Fråga 4a

	Fungerade ert spel felfritt?	
	Antal svar	**Andel i %**
Ja	4	40%
Nej	6	60%

Fråga 4b

Om inte, vad var det som krånglade?	
1	Den varnade för för många request. Gps-positionen var lite hackig ibland men i det stora hela fungerade det bra.
2	Min koordinatposition hoppade runt en del på kartan så det var svårt för mig att hamna inom en 15 meters radie från 'prey'-spelaren, men detta misstänker jag snarare bero på att min hårdvara (Galaxy S4) kan vara trasig då de andra spelarna inte verkade ha samma problem.
3	Det kom en pop-up under spelet med att för många request hade gjorts. Men det var inget som störde spelet i övrigt.
4	Kom upp några felmeddelanden ibland (max request reached)
5	Det fanns en talk knapp på iOS som inte fungerande under testande vilket hade varit önskvärt.
6	-
7	Det tickade ner från 178 med olika färger som bakgrund när alla i spelet hade tryckt på ready. Fattade inte vad som hände eller vad jag skulle göra. Om detta är en timer där man kan springa från varandra så borde det stå någon form av instruktion. Sen hade det varit bra att kunna ställa in hur lång timer man vi ha när man startar spelet. Ifall man råkar vara på olika platser redan så kanske man inte vill vänta mer än 3min på att starta.
8	När tiden gick ut så kom det upp "The Pursuit har stoppats" -> tryckte ok -> kom till main menyn. Han inte se vad det va skrivet på pop-upen då "The Pursuit har stoppats" la sig perfekt ovanpå.
9	Blev lite förvirrad vid nedräkningen. Var inte så tydlig vad man skulle göra direkt.
10	-

Fråga 5

Skulle du föredra en annan typ av kartvy? I så fall vilken?	
1	Gillar hybridläget så det var perfekt!
2	Då testet gjordes i en park föredrar jag nog satellitvyn då det vanliga kartläget saknar många detaljer där, men i vanlig stadsmiljö misstänker jag att kartan kan vara bra, då slipper man höga hus eller träd som skymmer.
3	Det passade väldigt bra i den miljö vi var i, dvs slottskogen.
4	Hybrid-vyn funkade fint
5	-
6	Jag gillar hybrid-map
7	Spontant tyckte jag det var ett bra val av kartvy. Jag gillar att man kunde se vad för slags omgivning som fanns omkring en. Större gräsplättar syntes på kartan så man visste att man inte skulle springa dit. Kartan var som sagt bra men jag saknade zoom knappar på sidan av kartan. Det var inte intuitivt att man kunde zooma eller flytta på kartan.
8	-
9	Tycker kartvyn var bra
10	nej, det var bra som det var

Fråga 6

	Vad spelade du för roll i spelet?	
	Antal svar	**Andel i %**
Prey	4	40%
Hunter	6	60%

Fråga 7

	Vilket operativsystem var det på telefonen du körde applikationen?	
	Antal svar	**Andel i %**
Android	4	40%
iOS	6	60%

Fråga 8

	Skulle du vilja se mer av sådana här sorters spel på marknaden?	
	Antal svar	**Andel i %**
Ja	10	100%
Nej	0	0%

Fråga 9

Var det tydligt från ikonen samt startfönstret vad det var för applikation, varför/varför inte?	
1	Skulle vara bra att kunna ställa in tiden från lobbyn till att spelet startar. Kanske skulle catch radius kunna ökas lite också för att kompensera för gps:en. Skulle också vara lite kul om man kunde välja att köra ett långtidsläge som kanske skulle kunna vara någon/några dagar, skulle nog bara kul i en storstad.
2	Under testets gång diskuterade gruppen lite olika varianter på spelet som skulle vi skulle vara intresserade av. • En text-to-speech-funktion där man kontinuerligt får höra avståndet till "prey"-spelaren och röstmeddelandena utan att man måste ha mobilen i näven hela tiden. • Lite större valfrihet i inställningarna när man startar ett spel. Just nu varar det längsta spelet man kan skapa i 30 minuter, men om man spelar över t.ex. hela Göteborg kan den tiden vara lite kort. Det skulle också vara intressant om man kunde välja att en specifik spelare skulle vara prey innan spelets början, som ett alternativ till att servern väljer. • Spelet börjar på ett specifikt klockslag, som alternativ till nedräkningen. Dessa på grund av att jag är intresserad av att kunna starta ett spel när jag och mina vänner är hemma för att sedan kunna jaga varandra över hela Göteborg för att sedan mötas för någon annan aktivitet.
3	Det skulle nog vara väldigt roligt att spela på en större skala.
4	Minska batterikonsumtionen, lägga in mer features som t.ex. ställa in egen nedräkningstid
5	Bättre och snabbare uppdatering av allas position hade gjort spelet enklare.
6	Uppdatera GPS-positionen oftare. Soljus kunde göra det lite såvrt att se ibland när den var som starkast.
7	• Kanske ha titeln på spelet på startsidan under ikonen? • Under rules så kanske man man ska börja med att förklara vad appen är för något, något i stil med "The persuit is a multiplayer game where you play a realtime version of the old game hide-and-seek." • Som tidigare sagt, ha zoom knappar på kartan • När man ska skriva in nickname och game code så hade det varit nice med en markör som visar att man har markerat fältet. Dessutom borde nog join knappen ligga högre upp för just nu hindrar tangentbordet användaren att klicka på knappen utan att ta bort tangentbordet först. I vilket fall på min telefon. (Samsung Galaxy S5) • Som tidigare nämnt, nedräkningen innan spelet började ger inga direkta instruktioner. För min del startade nedräkningen på 178 och visar massa olika färger när den tickar ner. • Jag får ingen uppmaning om att starta min gps, så det kanske borde komma som en instruktion på t.ex. players lobby samt stå någonstans under rules? • Det finns ingen direkt knapp för att ge upp eller avsluta spelet innan tiden gått ut. Kanske hade varit gött att ha om någon av spelarna måste dra? I vilket fall, grymt välgjord app!
8	• Lägg till att man kan välja vilken roll man skulle vilja spela, skulle båda dock välja t.ex. hunter så blir det random vad man blir. • Kanske skulle kunna lägga in så man ser hur fort man och bytet rör sig, samt göra så appen inte fungerar över en viss hastighet så man inte spelar när man kör bil så man inte utför en fara för omgivningen ;).
9	Göra så att man kan ställa in egen nedräkning, var aningen för långt. Förbättra GPS eftersom den inte var så exakt.
10	• Borde stå något mer när spelet räknar ner, när man har startat ett spel, än bara en siffra. Typ "Runaway/Hide, press skip when you are ready." • Skulle föredra en bakåtknapp på skärmen för att gå ur ett spel. Utöver att använda backåtknappen på telefonen.

C

User testing of interface

Användartestning 1 (Från 23/3-15 - 29/3-15)

Att starta applikationen:

- Förstår man direkt vad man skall göra?
  - Join game viktigare än create game, då den används oftare
  - Vad finns det för alternativa namn?
- Finns all information som behövs?
  - Vad är ett spel? - Någon infoknapp tillgänglig med förklaring av spel
  - Join game, vilket spel? Finns det random spel utan inbjudan?
- *Vilket utseende skulle passa?*
  - Mörk/grå/svart vs. ljus/vit/gul vs. blå/grön
  - Knappfärg: Ljus med mörk/mörk med ljus

Att skapa ett spel:

- Förstår man direkt vad man skall göra?
  - Bra med defaultinställningar, men skala?
  - Vad innebär vissa av rubrikerna?
  - Vad är det för namn som skall anges
- Finns all information som behövs?
  - Rubrikerna borde ha någon sorts förklaring, alt borde döpas om.
  - Namn? (Kanske borde vara en egen pop-up)?
- *Vilket utseende skulle passa?*
  - Typisk operativsystem stil vs. helt i line med applikationen.
  - Vilka defaultvärden skall visas, och hur?

Att gå med i ett spel:

- Förstår man direkt vad man skall göra?
  - Vad är en gamecode?
  - Ingen information tillgänglig
- Finns all information som behövs?
  - Tydligare vad en spelkod är, färdigifylld med xx osv.
  - Namn återigen, se skapa spel.
- *Vilket utseende skulle passa?*
  - Se starta spel, likvärdig fråga?

Lobby:

- Förstår man direkt vad man skall göra?
  - Övergången mellan gå med/skapa till lobby tydligare
  - Vad finns på sidan, massa namn?
- Finns all information som behövs?
  - Jag är redo, Namn och färger osv. kommer förklara fint.
  - Placering för enkel navigering? (top vänster osv.)
- *Vilket utseende skulle passa?*

- ➢ Färgkodning som ovan frågor.
- ➢ Tanke kring placering och översikt. Lobby i annat tema?

Spelkarta:

- ❖ Förstår man direkt vad man skall göra?
  - ➢ Tydligt med användande av google maps. Låsa viss funktionalitet?
  - ➢ Kunna röra sig fritt blir klumpigt
  - ➢ Horisontellt eller vertikalt?
  - ➢ Knapparna catch och talk?
- ❖ Finns all information som behövs?
  - ➢ Kunna trycka på en spelare, ja. Men avstånd måste visas bättre.
  - ➢ Knapparna tydligare vad de gör osv.
- ❖ *Vilket utseende skulle passa?*
  - ➢ Tydlig skillnad på knapparna talk/catch, självtalande?
  - ➢ Ram i standardtema.

Övergångar:
Meny → Starta Spel
Meny → Gå med i Spel
Gå med i Spel → Lobby
Starta Spel → Lobby
Lobby → Spelplan
Spelplan → Vinst/Förlust
Vinst/Förlust → Lobby