

Final report

Team Kroket

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1. Introduction

Over the last years the computer game industry has gotten very large. Take for example the video game industry of the United States; this is one of the fastest growing sectors (TheESA, 2014). As can be imagined, the task of creating an appealing game is at the crossroads of creativity and technology, which is why game design and development is such a complex and challenging endeavor.

Team Kroket, a group of five Computer Science students at Delft University of Technology, was ready to take on this challenge. During a ten week period Team Kroket has been designing and building a fully functional game prototype, which uses modern technology in order to effectively provide unique gameplay.

It is a very interesting and attractive challenge to devise ways of collectively entertaining a group of colocated people. Team Kroket overcame this challenge by developing a Virtual Reality based game for the Oculus Rift and Android Smartphones, called Escapade. A more detailed overview of the game can be found in chapter 2.

During the development of Escapade, Team Kroket was focussed on meeting the end-user's requirements. These requirements were defined by doing research on computer games in general and research on what the target audience needs from computer games in order for them to be enjoyable.

First of all, in order to meet these requirements, the game should have an intuitive interface. Games without this are often seen as less enjoyable (Amory, Naicker, Vincent, & Adams, 1999), so it should be clear how to interact with the game.

Secondly, the game needs an appealing storyline. This will create a rich space for the players to explore (Information Resources Management Association, 2011).

In addition it is important that the game is challenging. It has been shown that challenging games allow players to be more engaged and immersed in the game (Hamari et al., 2016).

The last end-user's requirement has to do with the realism of the game. The realism is important for the controller naturalness of the player (McGloin & Krcmar, 2011). It also increases the immersion and thereby the enjoyment of the players (McGloin, Farrar, Krcmar, Park & Fishlock, 2016).

The coming sections of this report will show how the developed product meets these end-user's needs, by describing and reflecting on the software product and process.

2. Overview software product

In this chapter an overview of the developed and implemented software product will be given. First the storyline will be discussed, after which it is discussed how the storyline is realized with the hardware devices. Lastly, a very high-level overview of the software will be given.

2.1 Storyline

Escapade is played by three players, who are a group of CIA agents. Their current case is the investigation of the disappearance of their fellow agent and colleague. Two of the agents are currently in the CIA headquarters, the other agent is following a lead in the woods... but suddenly he gets knocked unconscious. When he wakes up, he is locked in a dark, scary room. Deadly gas is slowly filling up the room. The gas will completely fill the room in fifteen minutes; a timer starts. Luckily, the locked up agent still has his earpiece, and is able to communicate with the two other players at the CIA headquarters. The agents will have to work together in order to make sure the locked up agent is able to escape.

2.2 Hardware devices

The agent who is locked up is the player wearing the Oculus Rift. Through the Oculus Rift he sees the room in which he is locked up. This player also has an Xbox controller, with which he can move through the room and interact with the objects present in the room by pressing the A button. The two agents at the headquarters have a mobile phone with an app on which they can play the game. The main idea is that the Oculus Rift player looks for clues by interacting with objects in the room. Specific objects will trigger a minigame for the Oculus Rift player, as well as on the mobile applications. The players have to solve the minigame together, and when it is completed, the game progresses, for example a safe with new clues opens or new objects can be interacted with. When all minigames have been completed successfully, the Oculus Rift player will be able to open the door and escape the room.

2.3 Software

In order to implement the game described above, three separate software systems were used. First of all we have the mobile application, which was developed in Android Studio. This software mainly consists of minigames which the mobile players can play (when triggered). Second of all, we have the software on which the Oculus Rift player runs the game. This software is mainly responsible for showing the scenes in the Oculus Rift as well as the minigames for the Oculus Rift player. The jMonkey Engine framework was used for developing this. Lastly, the systems mentioned above must be able to communicate with each other. For this purpose, a server is used. All players, mobile and Rift, can connect to the server and send and receive messages from the server.

3. Reflection on product and process

Within Team Krocket, every member had some software development experience. Unfortunately, not every area in the game development field was sufficiently covered by the team's past experiences. This section reflects on the major problems encountered during development and what the team has learned overcoming each of these problems.

3.1 Product

Network communication

Network communication between the gamehost and all of the clients is required for the game to function properly. The team was somewhat unfamiliar with how applications communicate over networks. The team learned how to use TCP sockets and then decided to keep things simple and implement a human-readable, plaintext protocol and exchange necessary data only.

Android development

Even though Android Applications are powered by Java, development for Android is somewhat different than what the team was used to due to its specific framework. The team was able to familiarize itself quickly by following guides and examples available on the internet.

Game development

The team had limited experience creating videogames and using the jMonkeyEngine. Unfortunately, documentation was not available during development. The team created its own mirrors for documentation.

3.2 Process

Every team is different and no team member is the same. The members of the team had different amounts of experience, different views and attitudes. This caused some difficulties for everyone getting used to each other's views and opinions. It took a few weeks for the team to adapt and for everyone to get up to speed.

Giving everyone the opportunity to express their views and trying to resolve problems actively by discussing them quickly as a group was how the team tried to maintain a positive atmosphere.

4. Functionalities

In this chapter all major functionalities that are part of Escapade will be described.

4.1 Oculus Rift support

The Oculus Rift is a virtual reality system giving the user an immersive experience in virtual worlds. Escapade was designed and built for the Oculus Rift. The Oculus Rift headset should be operated from a Windows powered computer. The Oculus Rift registers the movements of its user, allowing them to control their character in the virtual world. Using the Rift to look around and a gamepad to move, the player has full control over the vision and movement of the character.

4.2 Mobile Application

Escapade has support for mobile devices running the Android operating system. Currently any Android device running Android 4.0 or later is supported. The Mobile App starts one of the minigames when it is instructed to by the gamehost. The application features six distinct minigames, two of which can be played at all time to obtain bonus time for the player in the room, and four of which apply to the main storyline of the game. As the game progresses, all these four games will be automatically started.

4.3 Cooperative multiplayer

Escapade is a local cooperative multiplayer game, supporting three players. One player should be wearing an Oculus Rift while the other players are using the Mobile App. All players have to communicate and cooperate in order to achieve the final goal of the game: help the player wearing the Oculus Rift headset escape from the room. Communication is done in two ways: through verbal communication, and through receiving commands in the game. Initially interacting with objects in the virtual world will start minigames on the Mobile App. Then, to solve these minigames, players need to converse to obtain a solution to the minigame.

4.4 Networking protocol

The networking protocol of Escapade is human-readable. This makes it very easy to understand, troubleshoot and expand. As only events are exchanged between the components, the network overhead is limited. TCP is used to send these messages between the server and the clients.

4.5 Gamehost

All clients (the VR client and the Mobile apps) connect to a host. All network traffic flows through the gamehost. This host is responsible for the entire course of a game session.

5. Interaction design

This chapter will discuss the human-computer interaction of the developed software product. First the used method is discussed, followed by the obtained results. Finally a conclusion will be drawn and a discussion about the product will be given.

5.1 Method

This section will explain what information Team Krocket wanted to obtain from the research, and which procedure and techniques they used to obtain this information. A description of the people who tested the product will also be given.

5.1.1 Research goal

In order to make a successful software product, it is very important to know and understand how users experience the product. As a developer you are often not aware of the difficulties users will encounter when using the software product, and therefore it is very important to collect data on this. In the case of the software developed by Team Krocket, a game for the Oculus Rift and two Android device players, Team Krocket is very interested in how users rate the usability of the game and if the game meets the user's needs on this area. This includes finding out whether users find the interface intuitive, whether they find the storyline appealing and immersive, whether they find the game challenging enough or too hard, and whether they are content with the game's realism. A more detailed explanation of why these aspects are chosen to do research on can be found in appendix A.

5.1.2 Player test procedure

In order to find out how users experience the game, player tests have been done. One player test consists of three players (since the game is played with three players). First of all the roles (Oculus Rift player or Android Phone player) will be divided amongst the three testers. Now the game can just be started and the testers will play the game.

5.1.3 Data collection method

Two methods were used for the collection of data on the player tests. During the player tests all developers in the team were present and actively observing how the test players tackled the game. This was a very appropriate method, because of the multiplayer nature of the game. All players are in the same room and can therefore easily communicate. When players have remarks or do not understand something they just ask their fellow playtesters about this. This resembles the think aloud method, and proved to be very useful in finding out where players had difficulties with the game. The second method we used was an interview after the players tested the game. This method was chosen because the number of testers is relatively low, and this allowed the questioning to really go in depth.

5.1.4 Description testers

For the player tests, we wanted the testers to fall into the target audience of the game. The target audience of Escapade consists of people from the age of 16 up to 50 years old, who like cooperative games where puzzles have to be solved. A more detailed description of the target audience can be found in appendix B. Most of the test players were friends or siblings of Team Krokot. The average person in this group was aged 25, liked cooperative games and had no specific interest in puzzles (but also no negative attitude towards puzzles).

5.2 Results

The overall attitude towards the game was positive, and all test players said they had fun during the testing of the game. While observing the test players, however, it became visible that at some points the game was not as intuitive as was originally thought. This became most apparent by a minigame for the mobile players where the players were supposed to tilt their phones in order to move a ball in the corresponding direction. Many players had their phone laying on a table, and therefore did not notice the ball moving when the phone moved. Apart from this, the interface and actions that the players had to execute were quite intuitive, and the players were able to play the game from beginning to end. The storyline, which is explained to the players in a small video at the beginning of the game, was clear to all the players. However, during the interviews, we did get a lot of remarks that the mobile players are less in the loop about the progress of the storyline and also that the mobile players are less immersed in the game. The realism for the Oculus Rift player was perceived as very high, the realism for the mobile players was perceived as quite low. Almost all test players were in agreement that the game was challenging; not too hard and not too easy. There were, however, remarks about two minigames which were mentioned by a lot of testers. In the first minigame, the players have to crack a code by matching numbers to the alphabet. Many players said that they would have liked to have paper and pen for this minigame. In the third minigame, the mobile players get shown a color sequence, by colors appearing on their screen after each other (players can restart the sequence as often as they want). One remark that was given many times was that the sequence was shown too fast, and that it was too hard to make out all colors in the sequence.

5.3 Conclusion and discussion

It is concluded that the usability of the software product is adequate, but can still be improved. The interface is already quite intuitive, and players know what to do in order to win the game. The intuitivity could be improved by adding more information about how to tackle the game in some places. For example, the minigame described above where players have to tilt their phone should first give information to the player about how to play the game before they can start. The storyline and realism for the Oculus Rift player were already very good according to the test players. These aspects do, however, need improvement for the mobile app players. This can be done by displaying more feedback in the app about the progression of the game. Lastly, we can conclude from the player tests that the game is challenging enough. This aspect could be improved even further by taking into account the

feedback from the testers. This would mean that for the first minigame, which is described in the previous section, a view could be created in the app where players can draw and write. This can then be used as a notepad, which eliminates the need for pen and paper. The third minigame, where the color sequence was shown too fast, can be improved in the following manner. When the sequence is first shown it goes very fast. However, as time passes, the sequence is shown slower and slower, so that in the end everyone can make out all the different colors (but against the cost of using more of your time).

The player tests have shown that the game is fully playable from beginning to end. In addition, the players thought the interface was intuitive and the game was challenging and fun to play. Taking into account all the information given above, the final conclusion is that the software product's usability is adequate, but can be improved by incorporating the feedback of the test players into the game.

6. Product evaluation

This chapter will give an evaluation of the product as a whole. The main goal of this evaluation is to test if the game satisfies the customer needs. This chapter also contains a failure analysis which describes where the product does not perform as intended.

6.1 Method of Evaluation

The method used to evaluate the product will be a checklist based on the customer needs described in appendix A. For each point an evaluation will be made about whether the product satisfies the checklist. If it doesn't, a reason will be given for why this wasn't achievable or necessary. The checklist is as follows.

1. Is it clear how the player interacts with the functionality and Is the interface clear?
2. When starting the game, does a menu show up with clearly indicated options?
3. Is the hardware used in a for the player intuitive way?
4. Is the story told in such a way that the players are motivated to complete the game?
5. Are the puzzles challenging enough for the players?
6. Does the game achieve the needed immersion?

6.1.2 Evaluation

1. At the start of the game all players will receive an intro explaining their role in the game and the different interfaces they need to interact with. When a new interface is added to the game a message will be shown to the players explaining how to interact with the interface. This ensures any player can play the game without external help.
2. All players get a simple menu where they have to fill in their name and ip address they want to connect to. This is all that is needed to connect with the host and start the game. The options are clearly indicated.
3. All hardware is designed in a way that is logical and easy to understand for players from all levels of experience. The only possible exception to this is that the left stick for the VR client is used to strafe and not rotate. However, during play testing users preferred the strafe ability because they already used the Oculus Rift to rotate.
4. As mentioned in point one all players receive an intro. This intro does not only explain the interfaces but also the story of the game and their role in the story. This gives the players enough motivation to try to complete the game.
5. To ensure that the puzzles are challenging for all players a wide variety of puzzles are used that each test a different skillset. The skills being tested are hand eye coordination, problem solving, memory, dexterity, communication and exploration. This assures that no matter who is playing the game they will encounter a puzzle that will challenge them.
6. The VR client uses the Oculus Rift combined with audio and visual effects and the mobile clients use a visual representation of a CIA headquarter computer. This assures that all players will be fully immersed in the game.

6.2 Failure analysis

While the final product was rigorously tested for potential failures, our playtesters were not able to find ways to glitch or break the game. This however does not mean the final product is free of failures. The main failure which can occur is when a module loses its connection to the host for example by an internet outage (or in case of the host lose connection with its clients). This is a severe issue that will cause the Game to fail completely. Because none of the modules will be able to receive or send messages making game logic verification impossible. The only solution to solve this failure would be to restart the game from scratch. The likeliness of this error depends entirely on the stability of the user's internet connection. This failure however is an inherent problem for every game that uses a form of online multiplayer and therefore is hard to prevent.

7. Outlook

This section contains the outlook for the product. There are elements of Escapade that can be improved; these possible improvements will be considered in this chapter. How these improvements can be achieved will also be elaborated.

7.1 Improvements

At the very beginning of the project, when the idea for the virtual escape room was pitched, someone posed the question “why choose this over a real escape room?”. This question was to be answered by inserting unrealistic elements in the escape room. Currently, the only unrealistic element is toxic gas entering the room. In the future it would be nice to expand this. Some examples of ideas that came up were letting the Oculus Rift player hallucinate, loss of gravity in the room and tilting the room or have the room turn upside down all together.

As described in chapter 2.2, the players play minigames to escape the room. In the current product, three minigames are present. It would make for a more exciting and longer experience if there were more different type of minigames that can be played. To continue on the topic of having essentially more game, it would be desirable to have multiple escape rooms. Although the puzzles can be randomised to a certain extend, the story will always be the same. The games relies in part on mystery, and this will be taken away when one escape room is played multiple times by the same person. Also, players will probably not want to play the same escape room, with the same story and puzzles over and over again.

Escapade is currently only available for Android phones and a computer that runs Windows. Since many people have iPhones, Windows phones and computers that run on Linux or iOS, it would be customer friendly to support these platforms as well.

Lastly, there is some improvement possible in the graphics department. The room could have a more scary feel by adding certain lighting, or other mysterious objects. Objects and textures could be made custom for this game, to ensure they would be a perfect fit. Currently there are no animations, for example if a door is opened. The aforementioned graphic elements would make the experience much more immersive for the Oculus player.

7.2 Improvement strategy

Adding more minigames and unrealistic elements are two things that tie together. The strategy for improving these two elements would be to first write an extended storyline that incorporates more minigames and unrealistic elements. After this a team of developers will need to implement these elements in game for the Oculus Rift, the accompanying app and the server. This team would also be able to implement everything for multiple platforms.

Making more escape rooms could be done in the same way many game makers nowadays release DLC. DLC stands for downloadable content, this is additional content created for a certain game. For this game, it would be possible to add a new escape room once a year, and release it as an extension to the game.

For the improvements for the graphics, it would be beneficial if there was a separate team, whose only job is to make and decorate the room properly.

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Appendix A Analysis of customer needs

This appendix elaborates in more detail on what the customers want from a game, and in specific what they want from the game developed by Team Kroket.

Escapade, the game developed by Team Kroket, is meant for entertainment, which means that the customer should have an enjoyable and immersive experience. In order to achieve this, the game should meet as many of the customers' needs as possible. This section will discuss some of the most important needs of customers to enjoy a game, and how these aspects will be incorporated in the game.

Earlier studies have shown that games which have an interface that is not intuitive or even hard to use are often seen as less enjoyable (Amory, Naicker, Vincent, & Adams, 1999). Therefore, to meet the customer's' needs, it should be clear how to interact with the game and the interface has to be intuitive. When starting the game, a menu will appear which shows the available options in a clear manner. The description of the options will also be clear, so that confusion can be avoided. The game will be made further intuitive by using the hardware in the way the players are used to. For example, the thumbstick on the gamepad, that will be used by the Oculus Rift player, will be used to walk around in the environment, as in most games.

The storyline of the game is also an important aspect. One of the genres of the game is adventure, and "in adventure games, narrative is important in order to create a rich space for the player to explore. Often these games rely on intriguing story to propel the player to explore the world" (Information Resources Management Association, 2011). In this game this is also the case and is done by telling the players the story about the murder investigation and the locked up player. This will motivate the locked up player to explore the room and motivate the mobile device players to solve the puzzles as quickly as possible.

Another aspect that customers desire of a game is that the game is challenging. It has been shown that challenging games allow players to be more engaged and immersed in the game (Hamari et al., 2016). In order to incorporate this into the game, the puzzles will have to be of appropriate level with respect to the target audience; the puzzles are not too simple and not too hard, instead they will be challenging to solve. The same goes for the Oculus Rift player, who has to look for hidden objects and clues in the room. The objects and clues will be hidden in such a way that they are not apparent right away. Some intellectual effort is needed to proceed in the game.

A last factor that players also find important is the realism. It has been shown that the higher the game's realism, the higher the controller naturalness of the player (McGloin & Krcmar, 2011). Also, "increased immersion facilitates enjoyment" (McGloin, Farrar, Krcmar, Park, & Fishlock, 2016). Realism is achieved in the game by creating a storyline that could happen in real life or could be seen on a television show. The Oculus Rift also contributes a lot to this aspect. The purpose of this device is to make the experience as realistic and immersive as possible. Therefore a game with the Oculus Rift will also be perceived as realistic.

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Appendix B Analysis of the target audience

This appendix elaborates in more detail who the target audience is of the game developed by Team Kroket and why this is chosen as the target audience.

It would be ideal to produce a game that targets everyone, and that everyone finds fun to play, but this is probably impossible. "There are some games that fall within more than one genre, however they warn that special care needs to be taken since such games might not be appealing for any of the genre audiences" (Manero, Torrente, Freire, & Fernández-Manjón, 2016). Therefore Escapade targets a specific group of people, which will now be discussed.

First of all, the target audience ranges from the age of 16 up to 50 years old. This is due to the fact that most people within this range are familiar with modern technology and own a smartphone. Especially older people often lack knowledge about modern technologies (Ellis, Nurden, & Moye, 2010). In addition, the Oculus Rift can cause levels of discomfort in the form of VR-related motion sickness (Allen, Hanley, Rokers, & Green, 2016), which can be of higher severity for people falling outside of this age range. The game is not suitable for most children, since it needs a gentle and careful user. This is due to the fact that many modern technologies, such as the Oculus Rift and smartphones, are still sensitive to incautious actions such as falling on the ground. Children still have to learn that objects and instruments must be used with due care (Worzbyl, 2004), and therefore children are not in the target audience. In addition to this, the puzzles that are to be solved in the game might be too difficult for very young children. This will be because of the nature of the game. The puzzles are designed to be challenging for (young) adults, and thus young children will have a hard time solving these puzzles within the set time limit.

Apart from age, it is also important that the players like the game concept, so that they want to play the game. The Oculus Rift user is mostly busy searching the environment and communicating his findings to the other players. The other players will be busy with playing minigames, to obtain information and clues for the Oculus Rift player to escape, and communicating with the Oculus Rift player. The target audience will therefore include people that are interested in cooperative games, like to solve problems and play minigames.

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