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CHALLENGES IN GAME DEVELOPMENT

Playtesting and prototyping as important steps in game development

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ABSTRACT

The mobile game market has emerged lately. For many developers it is much easier to enter this market because of the possibility to bypass the game publisher as well as the low costs of development of mobile games compared to PC games or gaming consoles. Though the barriers to enter the market have lowered a lot, the development risks remain at the same high level.

The purpose of this research is to find out how the prototyping and playtesting approaches help to benefit in game development. The theoretical basis for this study has been divided into two parts: the iterative prototyping approach as the game development methodology and the playtesting part. The research case is a 3D mobile game, which has been implemented using the selected methodology approach. After the implementation of the prototype, the playtests have been conducted and analyzed.

Based on the implementation part and the analysis of the observations and interviews made during the playtesting phase, the results of the study have shown that indeed the selected approaches help to benefit in the development of the game. Playtesting has helped to determine weak points of the game as well as bring new thoughts about the improvements. Prototyping has helped to answer the game design questions and determine the flaws of the game in the early design stages.

Keywords: game design, game development, prototyping, playtesting, Unity3D, mobile game

CONTENTS

ABBREVIATIONS

GDD	Game design document
IDE	Integrated development environment
NDA	Non-disclosure agreement
PC	Personal computer

1 INTRODUCTION

With the growing popularity of mobile phones and tablets, the mobile game market has evolved and grown rapidly. iPhone’s AppStore and later Google’s Play Market brought a new way for consumers and developers to establish a connection and bypass publishers, which dramatically increased the market. It has lowered the barrier for developers to enter the market since the cost and time to develop mobile game are less compared to PC or console games. For consumers it means that many games on mobile market being Free-to-Play or with a price starting as low as $0.99 are reasonable to buy and try if they like it. (“The Evolution of Mobile Games”, 2012; “The Growth of Mobile Gaming”, 2014).

Though the entrance factor to the game market has significantly decreased, the importance aspects of game development remain the same. One of these aspects includes the big risks of the game not being successful and therefore not selling well and bringing profit.

There are development techniques, which could lower the risks and the costs of developing a game. One of these techniques is the iterative prototyping development approach. The game is developed by building prototypes on each iteration and this makes it possible to make the changes to the game at early and middle stages without costs or with a low amount of costs. Another important technique in game development is playtesting. Playtesting plays an important role since it helps to identify potential game design flaws and gather feedback from real players at early stages. It helps to understand better whether your game is accessible, usable, and if its mechanics are actually appealing (“Playtest”).

This thesis studies the efficiency of playtesting and prototyping in the game development lifecycle through creating a playable working prototype and conducting the playtesting sessions.

2 RESEARCH DESIGN

This chapter describes used research design and methodologies used in the study, as well as provides motivation for the research study.

2.1 Research question and motivation

The playtetesting phase in conjunction with prototyping iterative approach plays an important role to help build games at lower risks and costs of development. Thus, the defined research question is “What benefits do iterative prototyping and playtesting bring in development of the game?” The type of the research question is explorative.

The aim of this research is to go throughout the whole process of building a working mobile game prototype as well as conducting the playtests. The collected and analyzed data could bring ideas for further improvements of the game. The development process is done from the viewpoint of a game designer, programmer and art designer.

The study is motivated by the importance of understanding the process and challenges of the game development, game design and prototyping due to growing demand for mobile games on the market and due to games-specific development nature.

2.2 Research methodology

The research method is qualitative. This method has been chosen in order to understand what are the underlying reasons, opinions and motivations in the implementation of the prototyping phase and decisions, thoughts and reasons of playtesters in the playtesting phase. The quantitative research method is used to quantify data and generalize results from a sample population of interest. It is used to draw findings, which are conclusive and descriptive in their nature. It does not show the underlying reasons behind the decisions, thoughts and opinions and therefore is not suitable for the needs of the research.

For this research, the mobile game prototype is developed using the iterative prototyping methodology, rather than the traditional waterfall methodology. Due to the specific game design changing nature, the iterative prototyping approach fits the game development much closer. The differences between these methodologies are explained in chapter 3.4.

After the prototype has been developed using the chosen methodology, the playtesting session with further analysis of the observation has been organized. The selection of the players for playtesting is based on the theory for playtesting, which is described in chapter 3.6, and the defined target audience for the prototyped game.

The research approach is based mainly on two theories, which include the game design and development methodologies, and playtesting phases.

The first of these applied theories is the game design process described by Ernest Adams (2009). It includes the understanding of game design stages, game design documents, game design concepts and level design.

The second main theory applied was originally proposed by Jesse Schell (2008). It is an iterative prototyping methodology in game development and the theory related to organization of playtesting. Latter methodology describes what questions should be asked at the interview, how to choose the playtesters, where and how should the playtesting session be organized and finally, what to look for the playtest.

The outcome of the research is the answer to the research question, the informative explanative description of the process of designing, developing and playtesting the game. The conclusions made could help to verify the role, suitability and benefits of playtesting.

3 GAME DEVELOPMENT METHODOLOGY

This chapter starts with the introduction of the game design process and how it is different compared to traditional software design process. It continues with the description of the iterative prototyping approach and comparison to the traditional waterfall model. Then there are technique tips given related to prototyping and level design. The chapter ends with the description of the playtesting methodology.

3.1 Software design

In general, software design is the process of implementing a set of solutions to a set of problems ("Software design"). The design process usually goes from one of its most important parts – gathering and analysis of software requirements. The design process continues with the definition of goals, creation of system specifications, possible screen mock-ups, prototypes and proof-of-concepts ("Software development").

3.2 Game design process

There are three stages in the game design process (Adams, 2009). On the concept stage, the concept is designed in such a way, that it is not changeable later, i.e. it is the foundation for the game design. The elaboration (or development) stage is the stage in which all the details of design are added through playtesting and prototyping. On this stage, some of the new features may be added. The final tuning stage is the so-called polishing stage at which the design is finally locked and no new features can be added. It is rather subtractive process where the imperfections are removed, rather than additive where new improvements are added. (Adams, 2009).

The difference in game design process compared to traditional software design process is that the design process continues during and after the implementation (elaboration) stage. In traditional software development, the software design stage is usually done once and then proceeds with the implementation stage. It is not a common thing for software design to be changed during the whole development process.

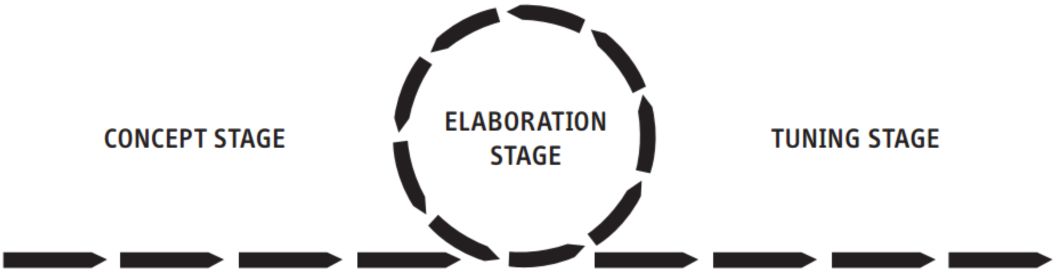

Figure 1. The game design stages.

3.3 Game design documents

Design documents are needed to write the idea down, so it is more explicit, concrete and not just in vague abstract form. Design documents are important for the whole development team, as it can refer to these documents and get the idea what they are intended to do. (Adams, 2009)

There is no single GDD standard, thereby many types of game design documents do exist in the professional game industry, and not all of them will fit each project. Hence, below are overviewed some of possible documents. (“Game Design Document”, 2014; Adams, 2009)

3.3.1 High concept document

This document is usually used as a sales tool. The high concept document is needed to present overview of the game idea, usually for the management, publisher or producer, to be read in a few minutes. Sometimes it is also helpful for the team to see a big picture of the game.

According to Ernest Adams (2009), the high concept document mainly contains descriptions of the following terms:

- high concept statements which briefly describe what the game is about
- the camera model – a system, which controls the behavior of the imaginary camera

- the interaction model – a system, which determines what resulting actions happen by the player input
- the genre of the game
- the target audience and the target platform
- general summary of progression
- a short description of the game world

3.3.2 Other game design document types

The character design document is used to describe in-game character by showing its appearance and moveset. It should include concept art of the characters as well as background information (where applicable): history, strength and weakness, relationship with other characters and so on. This information will help in making future design decisions. (Adams, 2009)

The world design document serves as the base for building the game world and its arts. It usually lists background information about different kinds of things that the game world contains. Level designer and other artists will use it when building the game. (Adams, 2009)

Flowboard is a combination of flowchart and storyboard. It shows different relationships between different game modes and under what circumstances the transition between them happens. This type of GDD is created in an editor such as Microsoft Visio or can be hand-drawn on paper sheets. (Adams, 2009)

A story and level progression document is created if the game has more than one level or there is a kind of progression through the game which the player experiences. This document is the place to outline how player experience the story from beginning to the end. This place is also to indicate how the player experiences the story, e.g. via dialogs, cut scenes or other narrative elements. This document is also suitable for the place to describe story branches and what in-game decision lead to which branch. (Adams, 2009)

The game script describes the rules and the core mechanics of the game. It should be written in such a way, that is would be possible to at least theoretically play the game without the computer, i.e. perhaps as a tabletop game. Paper-based prototypes are inexpensive, but invaluable tool, especially for indie-developers, to test the game and its mechanics without actually playing it. (Adams, 2009)

3.4 Game development prototyping approach

There are many different software development methodologies. One of the traditional approaches is the waterfall model. Though it has some advantages and positives sides, it does not always fit the project needs and the project's specific nature. One of the alternatives is the iterative prototyping approach. This chapter describes the methodologies and compares the differences between them.

3.4.1 Waterfall model

The traditional development approach is a waterfall model where the work moves sequentially in one direction: from design to implementation with polishing at the end and then shipping the final product. The disadvantage of such an approach is that it leaves no space to go back to review what has be done and make appropriate changes at the right time. (Schreiber, 2009)

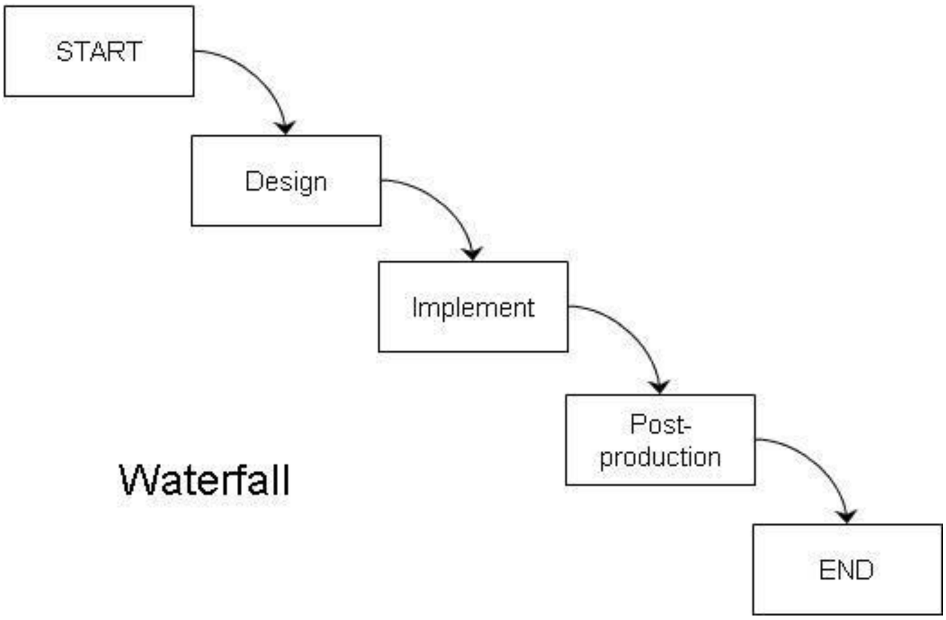

Figure 2. Waterfall model.

3.4.2 The iterative prototyping approach

In iterative approach first comes design stage and then implementation as in the waterfall model, but then there is always a step to review and test what has been done and do the appropriate changes to the previous step(s). This way the whole design, implementation and evaluation process iterates several times. In digital world, game is quite expensive thing to implement to test. That is why game designer often uses rapid prototyping model. In this model, game prototype is created on paper first, which adds confidence that the game will be fun to play. The process afterwards continues with the implementation phase and repeats with playtesting and tuning and occasional modifications to game design. (Schreiber, 2009)

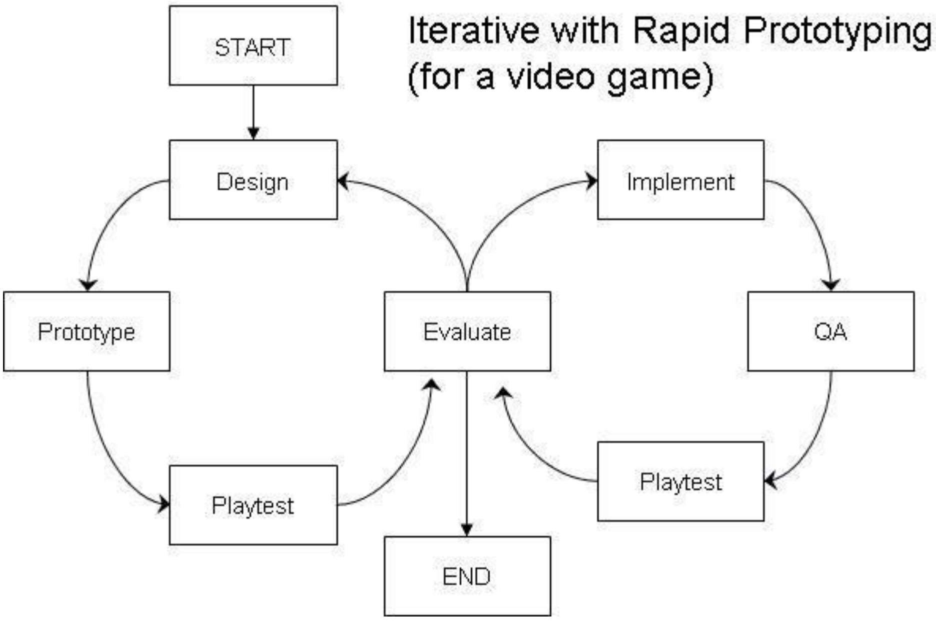

Figure 3. Iterative approach with rapid prototyping.

The difference between iterative prototyping and waterfall models is that the latter has sequential direction in the development phases, which leaves no steps to go back to and reviews the work done. The former, iterative prototyping approach, as it states, is iterative, meaning that there is always a possibility to follow the previous steps, review and evaluate the work done, and make the appropriate changes if needed.

Here are some of the game prototyping tips which Jesse Schell (2008) suggests:

- When creating a prototype, one should think of a question, which the prototype will answer. This way the prototype becomes “time-saving experiment”, instead of time-wasting work.
- One should also forget about the quality of the prototype, since the point is to make the prototype answer the question as soon as possible.
- The prototype should be viewed as a temporary product and a learning opportunity, instead of the finished product. Many developers would tend to stick to their prototypes, not willing to put them away, and move to other questions and prototypes.
- Prototypes should be prioritized in a way that biggest risk is faced first and according to their dependency on each other.

3.5 Level design

Ernest Adams (2009) divided level design process into planning phase, prototyping, level review, level refinement and lock-down. The planning phase begins with documenting gameplay, art, and drawing a possible sketch. It also covers discussions of issues related to performance and coding the unique events in the level. The prototyping continues with the creation of the level with simple geometry models and temporary textures.

The level review examines the prototype’s potential problems and tries to address the following issues (Adams, 2009):

- Scale of the level
- Pacing - frequency of challenges in the level, which the player encounters
- Placement of objects
- Code issues – are there any issues representing a problem for the programmer
- Aesthetics of the level – if the level is being attractive to the player

In addition, Ernest Adams (2009) introduced several level design principles, which should be taken into an account when creating a gameplay and a level.

- Vary the pacing of the level, especially in physically challenging games

- When the player surmounts a challenge that consumes his resources, provide more resources
- Clearly inform the player of his short-term goals
- Primary objective is to give players an enjoyable experience
- Build more rewards into your level than punishments
- Reward maneuvering in vehicle simulation games

3.6 Testing the game

Every game should be tested before being released. There are four different types of testing which include: focus groups, Quality Assurance testing, usability testing and finally playtesting. One of the emphasis of the current project is put on the playtesting. It is never possible to fully predict what the experience the game will bring and if the players will actually have fun playing the game (Salen, et al., 2003). This is where the playtesting comes in handy. It helps to find problems in early development stages and build the confidence that the right game is built for the right audience (Schell, 2008).

According to Jesse Schell (2008), there are many questions, which have to be answered before doing the actual playtesting; however, they all could be split into five categories:

1. Why question – a list of questions with specific goals
2. Who question – answers the question who is going to test the game
3. Where question – answers where the testing is going to be held
4. What question – answers, to question what are the things that the designer will look for
5. How question – answers the questions how the observation of the player being playing will be accomplished

3.6.1 Possible list of interview questions

Below is a list of some of the interview questions Jesse Schell (2008) proposes, which the playtesters could be asked during the interview:

1. Do you understand how to play?
2. Do you want to play the second time?
3. When do you get bored?
4. When are you feeling frustrated and confused?
5. What are the hidden bugs?
6. What part of the game are the most fun to play?
7. What part of the game are the least fun to play?
8. Is the level too long?

3.6.2 Choosing the play testers

The playtesters are usually selected from a target demographic; however, even then there are options from whom to pick (Schell, 2008):

1. Developers - people easy to reach, able to play a lot, and require no worries about signing NDA. However, developers are the closer to the game than the real player will ever be, so their opinions might be distorted.

2. Friends – people who are comfortable with talking. In addition, friends could suggest new ideas. However, they would not like to hurt the feelings of the designer of game, as well as they might have predisposition to like the game because of being a friend.

3. Experts – people who have played many games similar to the one which is developed, and who could give a very detailed report about the game. However, they often demand more difficult play challenges than the average player.

4. Tissue Testers – the players who have never seen the game before. This kind of testers are good to ascertain usability, communication and initialappeal questions. As a negative side, the games usually have nature to be played multiple times, meaning that testing the game with only “tissue testers” could influence the game to have strong first-time appeal, but a way to get boring after sometime as well.

3.6.3 Choosing the testing place

The playtesting session can be held in different places (Schell, 2008):

- Studio (or wherever the game is actually made). This way the testing is very convenient for the developer, since the game and the other developer team is there. Though the cons are that playtesters might feel not very comfortable, unless they playtest in a private room.

- Playtesting lab – a special lab for playtesting purposes. In-house or third party, that kind of lab has all the required facilities to accompany playtesting session. It is very expensive though.

- At a public venue – e.g. a public event, shopping mall. It does not cost much and there are good chances to get many testers. As a con, the players might be distracted if there are other events going on near the place. In addition, it could be difficult to target playtesters for you chosen demographic.

- At the playtester's home. This way the designer is able to observe how the game is played under natural conditions. However, the playtest is limited in a way that there could be very few designers observing the play, as well as very few people, who could playtest the game in one session.

- On the internet. This way many players with different machine configurations will test the game. However, the quality of playtesting suffers and the designer is not able to get the same insight, as he or she could get while being in the same room with testers and observing the play.

3.6.4 What to look for in the playtest

There are two things, which the designer will look for in the playtest: things that he expects to get answers for which come from the "why" list of questions and things that he or she does not know to look for. The key to the latter is to be prepared for the surprise. One should have an understanding about what actually will happen in the game, e.g. players will attack at level two. This way when unordinary things happen the designer is able to notice them. (Schell, 2008).

3.6.5 How should the playtesting be held

Jesse Schell (2008) suggests that the designer should be present during the game session instead of just watching the recorded video of the play session, since in this way he or she is able to get much more insight. The designer could give the players some hints about their goal in the game at the beginning of the playtesting session, but he or she should be careful not to spoil the whole game experience by telling them extra information or information which could mislead players.

During the playtesting session most people who are attending look at the screen where the game is being played, however, by looking at the faces of the players one could possible see much more than just what the player is doing, but instead see how they feel when they are doing it. (Schell, 2008)

According to Jesse Schell (2008), disturbing the players during the playtesting session could cause a potential risk that the players might run off their natural playing behavior patterns. On the other hand, the right question asked at the right time could bring an insight to the designer, which otherwise he or she could have possibly never thought of. Another methodology that experts in computer interaction suggest is the “think-aloud” technic. During the play, the player speaks aloud what he or she thinks and why he or she acts that exact way. However, some people could change the behavior of their play if they begin to “thinkaloud”. In addition, if the game becomes stressful, the player could suddenly become silent, which in turn becomes frustrating for the designer, since at that moment designer would most like to get an insight about player’s thoughts.

The data could also be collected after the playtesting session by conducting a survey or interview. Surveys are good in that they are straightforward and easily quantified. Interviews, in turn, are a great way to ask players questions that are more complex and that do not fit the survey format. Interviews is a good way to see emotions from the players’ faces and get a sense about what they truly felt about the game. Jesse Schell (2008) gives several tips about conducting such an interview:

- Have a script of questions
- Interview privately – people will speak more honestly
- Playtesters could avoid hurting designer's feelings if they know that the interviewer is the designer
- Avoid memory tests – ask questions which require memories during the gameplay
- Ask more information that you need

3.7 Types of video gamers

To understand for whom the video game is made, the target audience should be defined. ("Define your target audience", 2008). One way towards defining the target audience is to understand what types of video gamers there are.

The most commonly distinguished types of video gamers are ("Gamer"):

- The casual gamer is a gamer whose time or interest in gaming is limited. These types of gamers usually play games with simple rules, or games that are more complex, but in small groupings of time.
- The midcore or Core gamer has more interest in playing games than casual gamers. They are more likely to play different kind of games, though they do not have too much time to play games such as MMO games. They are often perceived as target consumers.
- The hardcore gamer is a gamer who spends a lot of their time playing video games. These gamers often prefer games with high complexity and depth to master their skills in the game and often seek game-related information.

4 GAME DESCRIPTION

This chapter describes the chosen tools used in the development of the prototype and introduces the high concept idea of the game, its progress and its monetization model.

4.1 Chosen development tools

The implementation of the prototype has been accompblished with the support of software development and word processing tools. This chapter describes these tools.

4.1.1 Unity 3D as a game engine

Unity is a cross-platform computer software game-engine and IDE developed by Unity Technologies. It is used to create and build-games for different platforms such as web, desktop platforms, consoles and mobile devices. It has a free version, intuitive interface, rich documentation and plenty of tutorials, which makes it perfect choice for beginners and indie-developers.

One of Unity's important development directions is the mobile market. According to Unite 2014 (Unity's annual conference) presentation, almost every second mobile game (more than 45%) created with third party engines has been built with Unity. According to the same report, 47% of mobile developers use Unity and 8.7 billion mobile apps are built with Unity3d installed. The above numbers prove that possibilities that Unity brings when creating mobile games.

4.1.2 Other tools

3ds Max is a software program for making 3D models, animations and images. It has great modelling capabilities and many different features. In the scope of the project, it is used to create and modify 3D models for the game.

Microsoft Word is a word processor or a text editor. It is used to document game design. It is also used create a flowboard of the game.

Git is a free source-code management system. Git helps to save and manage specific versions of the project, meaning that it is always possible to always revert to the previous version of the whole project or just a specific project file.

4.2 High concept idea

The game is a 3D sports game in which the player is playing from the behalf of the motorcyclist who rides a motorcycle, trying to reach the end of the level at the lowest amount of time.

The gameplay involves riding on platforms, jumping between them, collecting bonus scores and boost items. The gameplay challenges involve overcoming obstacles and gaps, maneuvering on the platforms and trying not to fall down from them.

The camera model in this game is a 3D third person view.

The interaction model is avatar-based, where the player controls the avatar, and therefore influences the region of the game world where the current avatar is currently situated.

The game world consists of different blocks, loops and platforms. The setting and the surrounding environment vary upon in each section of the game.

The genre of game falls in the platformer-race game category.

This game primarily targets casual type gamers; however, mid-core gamers should enjoy some of the elements of the game, which require more time and skills to advance in the game. Therefore, a game will suite people who do not tend to spend a lot of time on a play session and those who prefer uncomplicated, but exciting gameplay. The target audience would be the fans of the arcade race and specifically motorsports games aged from 12+ years, primarily male audience.

The game is developed for mobile devices such as smartphones and tablets. The target platform is Android, though using the Unity3D engine, it would be possible to port the game to other platforms such iOS or Windows Phone. The target device, also known as device with minimum requirements, is an Android smartphone with the screen resolution of 800x480.

4.3 The game progression

The game is broken into several sections where the action takes place. Each section contains a set of different levels. The victory condition for completing each level is to reach the end of the level while collecting maximum amount of star items. This way the level completion could be rated by counting collected items in relation to the overall level items.

After all levels for the section have been completed, the overall items collected are counted. If that amount does not meet the requirements to unlock the next section, the player has to replay some of the level to collect the needed amount of score items to continue to the next section. The game victory condition is the completion of all levels for all sections with preferably maximum collected items.

4.4 The monetization model

The game could be converted to a source of income by developing and publishing it in two versions:

- lite version with limited amount of available levels and advertisements included
- full version with all levels unlocked and advertisements disabled

5 IMPLEMENTATION

The implementation methodology which has been chosen, is iterative prototyping. The implementation has begun with defining the initial questions to define gameplay in the game, which are discussed later in the next subchapter.

5.1 Initial game design questions

With the given concept design description, questions have arisen which can be answered by testing the game in its early stages. Since the size of the project is relatively small, the draft prototype does not require a lot of time to make. The very first playable prototype is developed for PC desktop, and after that, it is ported to mobile. This way the time for making the first prototype can be significantly saved.

Below are the few initial questions that arose during the concept stage:

- The duration and size of each level
- What are the additional items which the player can collect
- What additional challenges should the player face

5.2 Gameplay

According to the Jesse Schell's (2008) prototyping tips, every prototype should answer a question. The very first prototype's aim is to find out the approximate size of the level, and possible entertaining action and challenges when riding a motorbike.

During the first prototype phase a simple 3D model of a motorbike has been found on the internet as well as a simple motorbike controller script which reproduced the physics of motorcycle faitly enough, though it has had some issues to be manually fixed.

Unity's built-in modelling tools allow creating of simple 3D objects as cubes, spheres, capsules or planes straight in the editor. For the first prototypes, the quality of details is not an important aspect at all (Schell, 2008). Therefore using these tools, platforms, ramps and box-shaped collectible items have been created for the first draft prototype of the level.

It has been possible to estimate the level size by going through the whole level area and estimating the time it takes to do that. Therefore, for instance, the time to make a full loop when driving closer to the level boundaries takes about 30 seconds. The approximate time to approach platforms, obstacles and collecting items could be up to 5 minutes.

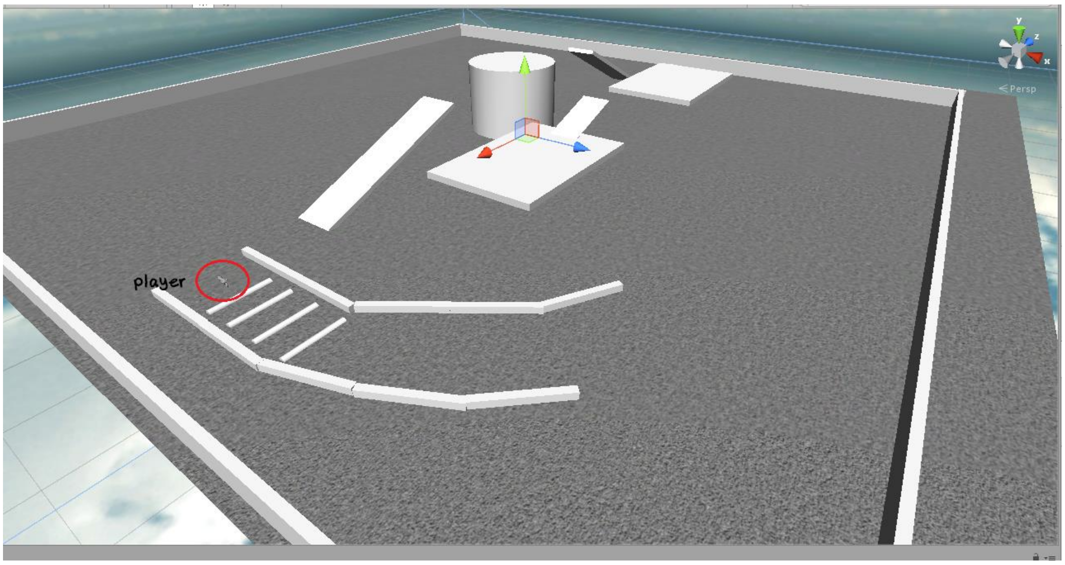

Figure 4. The first prototype

Trying to play the first prototype has showed the following fun and entertaining moments:

- It is fun to play to jump between platforms
- It is fun to maneuver on a narrow platform
- It is fun to approach obstacles as trunk-like cylinders (wooden logs)
- It makes a challenge and entertain when the player at height on a platform and tries not to fall down
- It is fun to accelerate
- It is fun trying to collect score point items, especially if they are placed in the air

The idea that has arisen during the creation of the first prototype has been to clarify the goal of reaching the end of level by putting a special object which would represent a final level point. This item has been placed at the final level point which the player should reach. By introducing this idea, the time trial challenge could be implemented, however, it should be tested in the future according to the level design.

After the main game mechanics have been established, the prototyping has been proceeded with the level design.

5.3 Level design

In fact, when prototyping gameplay mechanics, a level prototype has been created and the level size has been established. That very first prototype has been further expanded and fulfilled with simple modeled 3D geometry and dummy textures.

To vary the pacing of the level as suggested by Ernest Adams (2009), the three main sections have been created. In each one, the difficulty increases. The player’s initial goal was to collect the score items represented by star objects. However, after the prototyping and testing it is clear that the time trial is necessary and will make the game more challenging and entertaining. To make the time trial a competitive challenge, the two results could be shown at the end of the level; the current time elapsed to complete the level and the best lowest time.

The prototyped level has quite dangerous paths along the way where the player could easily fall down and would have to start the level from the beginning. That is why the save checkpoints have to be placed along the way. That way the player could restore the saved checkpoint position and try to overcome the section again. Otherwise, it would difficult for the player to complete the whole level at once. To reward player’s maneuvering as recommended by Ernest Adams (2009) the star collectible items are placed along the way those dangerous paths.

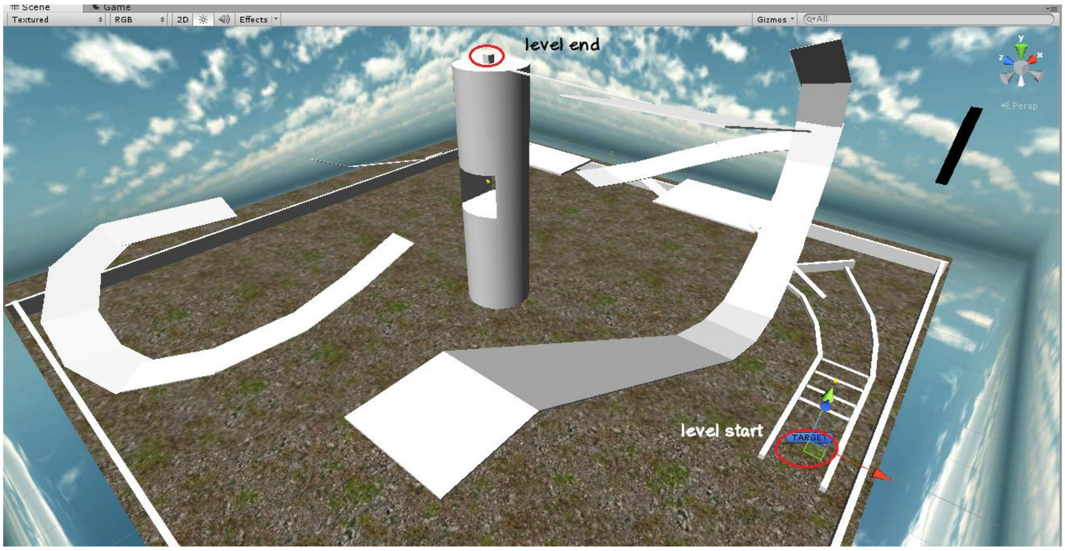

Figure 5. Level design draft: start and end points.

5.4 Porting to mobile

On a mobile device, the controls are different compared to a PC. Therefore, the playing experience for the player is somewhat different. To adjust this experience as early as possible, the game prototype has been ported to a mobile device at this stage.

The porting has started by adding controls to the screen and amending the scripts to handle controls using touch gestures on the mobile phones.

Unity Technologies has developed an easy tool for prototyping and testing games on mobile phones called Unity Remote. Unity Remote is an Android or iOS application, which is created for playing the game on the mobile phone straight from the Unity game-engine editor on a PC. The game itself is run by PC, but the the image and all the controls are displayed and accessible through mobile. This way there is no need to compile (build) the game, transfer it and then install on mobile device. All that is needed is to plug-in the mobile device to PC using the cable and hit the play button in the Unity3D editor on the PC.

On the PC, the camera has had a so-called “Orbit script” attached, which means while controlling the mouse it is possible to orbit around the bike (i.e. camera target). On a mobile device, there is no mouse pointer device, that is why the camera model is changed to always follow the target - the bike’s backside.

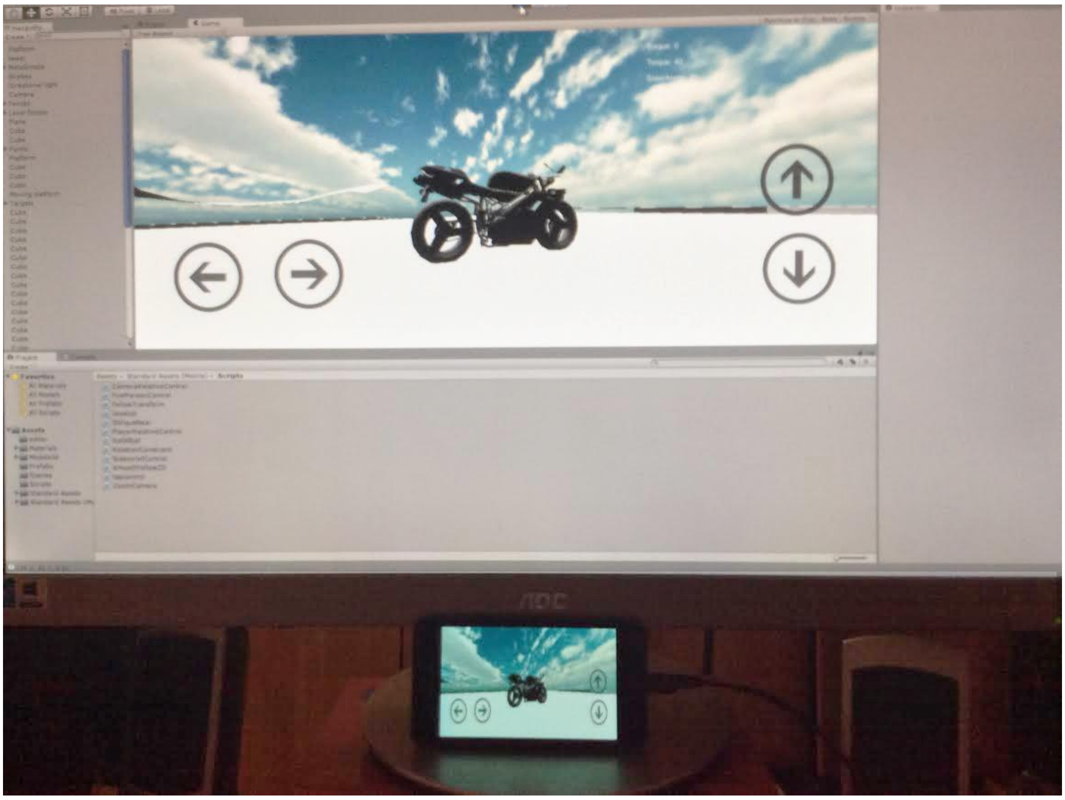

Figure 6. Unity Remote on a mobile phone connected to Unity3D engine on PC

Upon changing the camera model and doing initial play testing on a mobile device, it became clear that some of the level objects have to be moved, or increased in size due to the new restrictions of the camera view. For example, the amended objects are the track roads in some parts of the level.

5.5 Finalizing gameplay features

Before starting working on adding details to the level and texturing objects, the game level itself has been lacking the following features:

- Checkpoints
- Reset button, so the player is able to reset the motorbike to the last saved checkpoint or to the game start position at any time
- Time counter and statistics at the end of level
- Invisible obstacle to restrict the player moving outside of the level

After the following features were added to the game, the game prototyping has proceeded by adding level details.

5.6 Adding more details to the level

To make the game look more interesting, entertaining and give it a more finished-like look the additional details have been put into the game.

Those details are:

- textures for all the objects on the map
- additional details on the terrain, e.g. hills
- replace simple geometry objects with made 3D models

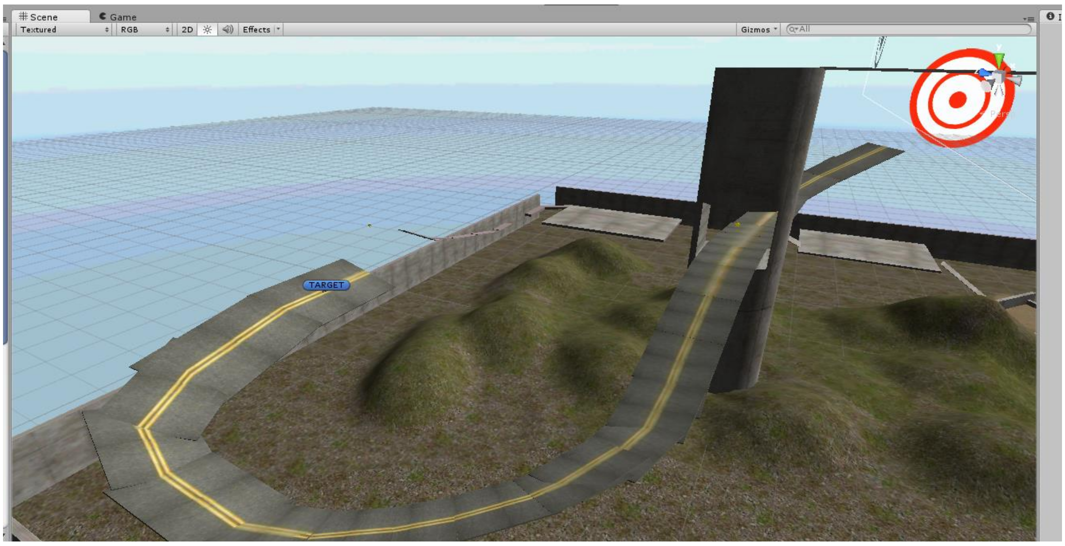

Figure 7. New look of the level after it has been textured and details have been added

6 PREPARATION FOR PLAYTESTING

The playtesting was in a way that at the beginning the invited playtesters played the game, while the developer made observations and after that, the interview was conducted. The list of interview questions, which was prepared for the playtesting interview are based on suggested list by Jesse Schell (2008) and can be found in the appendix. Using the theory for playtesting by Schell (2008), the playtesters, which have been selected for playtesting, are the friends of the developer. This selection has been made due to the scope and limited resources of the project. In addition, selected players have fit the target audience, described in the game description chapter. The players have been invited separately to the developer's apartment (game development studio). Each of the players has been given a smartphone with the game prototype pre-installed as well as basic introduction information about the game (e.g. its genre). The developer has been observing how the game has been played and sometimes has asked players the questions for insights about what they have been doing and why they have been doing a particular thing. The game designer has helped players to overcome obstacle in some places in the game.

7 OBSERVATIONS

This chapter lists the observations made from conducted playtesting sessions after the prototype has been developed.

Table 1: Collected data. Player’s information and information.

	Player 1	Player 2
Player’s information	A male, 25 years old, who plays strategy video games on PC no more than three times per week. Has almost zero experience on playing games on mobile devices (Casual / Midcore gamer)	A female, 18 years old. Like computer games, but not often. (Casual gamer)
Observation	On the road track (Section 2), which goes through the tower, the player went very slowly. The player asked if there is a bike control while it is in the air. After too many attempts to pass the loop, the developer had to do it for the player, so he could finish the game.	It is not clear for the player where to go and what to do. The player set her aim to collect star point and moving further. When fell down, the player tried to get into the target teleport by jumping from the hills. The player asked if there is bike control while it is in the air. After many attempts to pass the loop, the

		designer had to do it for the player, so he could finish the game.
Player’s comments	Wanted to accelerate on the the road track, but it was very easy to fall down, it would be good if there were protection fencing (Section 2) Reverse movement is very sharp, the platform itself is difficult and confusing because it was not clear that the platform itself goes without motorbike even motorbike is standing on it. I would like to have a checkpoint after the platform (Section 2) At first, it was not clear that the loop is actually the loop. (Section 3)	It is good that checkpoints exist. Would love to ride on hills with high speed and collect stars there. Psychologically the bike assosicates with a high speed, but in lots of places in the level you have to go slow. Would be good to have direction pointers, especially in the areas near the moving platform and platform after the loop.

	It is interesting what is after the loop (Section 3) Would like to see more objects on the level.	

Table 2: Collected data. Interview questions.

	Player 1	Player 2
1. Do you understand how to play?	Yes	After a while, it gets clear what to do and where to go, but it is better to have pointers.
2. Do you want to play the second time?	Yes	No, (the game is difficult)
3. When do you get bored?	It became boring on the loop because the camera view stopped showing the motorbike (it actually showed wall) On the platform (“Section 2”), it also became boring after many attempts because it was not clear that the platform is moving and the bike	It was too hard to get on the moving platform. I thought it was impossible to pass the loop.

	is not while standing on it.	
4. When are you feeling frustrated and confused?	I was confused because I did not realize that the loop was not smooth and could not pass that part of the level.	The bike slides down on the platform after the loop. The moving platform is moving while bike is not.
5. What are the hidden bugs?	When I fell on the bike’s top, the bike did not turn back to stand on wheels.	The bike did not turn back to stand on wheels on the platform after loop. Sometimes the bike gets stucked in objects. Road track is not very smooth (there are holes).
6. What part of the game are the most fun to play?	The road track with yellow stripe. Enjoyed riding on green hills. (when felt down)	The best part was with the moving platform. Enjoyed jumping on the hills.
7. What part of the game are the least fun to play?	The platform on the top after loop. Bike starts to slide down,	The most confusing part with the loop. (Section 3)

	instead of standing still.	
8. Is the level too short?	No, it is OK.	No.
9. Where would you like to have checkpoints?	After the loop, on the platform.	Checkpoint after moving platform.

8 ANALYSIS OF THE PLAYTESTING DATA

The analysis has started with the data collected from the observations. From these observations and players’ comments, it became clear that both testplayers wanted to accelerate on the bike more than they could. The road track in Section 2 as mentioned by Player 1 is a dangerous path and needs protection fencing in order to accelerate and not to fall down. Although Player 2 mentioned that it is a good fact that checkpoints are present in the game, Player 1 commented that the checkpoint is missing after the moving platform. That moving platform had very sharp reverse movement and the bike did not stick to the platform while being on top of it. It was noticed that Player 2 did not have any clue where to go in the beginning of the level. This was proved by the corresponding comment made by the player later. The loop at the final section was seen as the most difficult part of the level for both players. The designer helped both players to overcome this section.

The data collected from the interviews confirmed some of the analysed data from the observations. For example, both players confirmed that they were bored or frustrated by the problem of the bike falling down while standing on the moving platform. It got bored at the final section with the loop, since it was difficult or impossible to pass as mentioned by both players. In addition, Player 1 mentioned that least fun to play part in the game was the platform after the loop section. The bike slided down and after that the player had to overcome the loop again. When answering the question “what was the most fun part of the game”, Player 1 mentioned that it was fun to ride on the road track with yellow stripe in Section 2 and after he fell down it was fun to ride on the green hills. Player 2 also mentioned the fact it is fun to ride hills. In addition, she mentioned that moving platform was one the best parts in the game, even though earlier she commented that moving platform was frustrating. When asked about hidden bugs in the game, Player 2 answered that bike got stuck in the ground sometimes, and Player 1 answered that the bike did not turn back to stand on wheels when he fell on the bike’s top. Finally, in the interview and during the observation Player 2 commented that it is better to have direction pointers in the level to understand where to go.

The list of main problems, which the game has had, and solutions to overcome them has been created based on the analysis of the collected data:

Table 3: List of problem and solutions based on analysis of collected data.

Problem	Solution
Not clear what to do, and where to go at the very beginning	Show introductory text saying what to do. Add directional pointers at some places.
Hills are fun to ride.	Use hills as part of the track.
On the road track (Section 2), it is very easy to fall down. In addition, player is willing to accelerate on it.	Fix holes (create decent 3d model) and put fencing around it.
Not clear if the loop is actually the loop. The loop surface is not smooth. After the loop the platform is tilted and it is very to fall down.	Build a decent 3d model of a loop. Change the part with the platform after the loop to something easier.
The moving platform is moving without the motorbike and it is hard to determine that.	Fix the platform or bike settings and physics.
The bike sometimes gets stuck at objects.	Check the physics and the engine settings and try to fix the problem.

9 CONCLUSIONS

The analysis of the observations and interviews has shown that some modifications must be done to the game in order to improve the gameplay experience. Based on the analysis of the observations and the feedback gathered from the players the following changes were made to the game:

1. The level start position has been moved and placed to the level corner and is laid through the hills. The player can see a straight path to go. In addition, direction pointer arrows have been placed across the level to show the player the path.

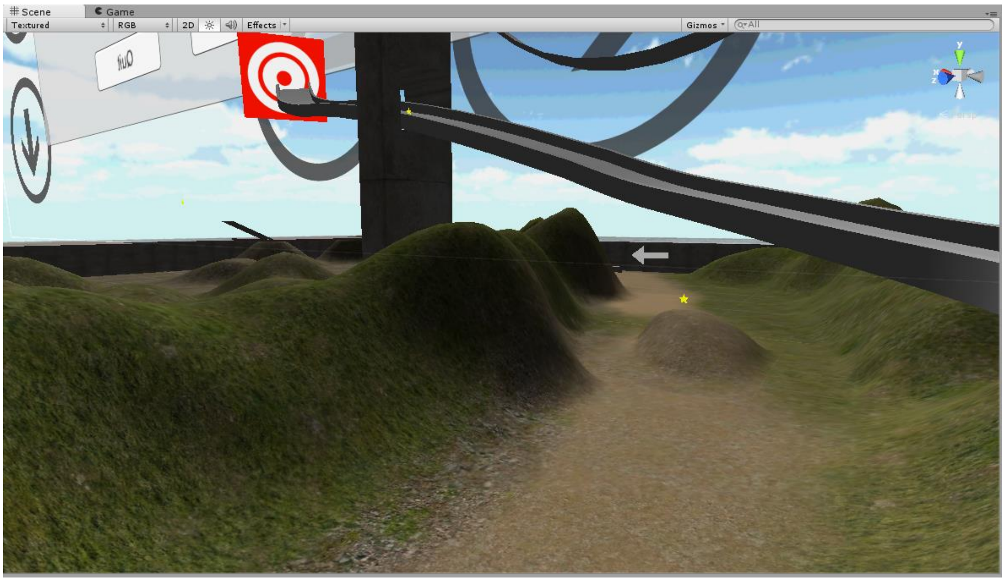

Figure 8. Level new starting position.

2. The road track has been completely rebuilt – i.e. it has been created as a decent model using 3ds max modeling software. In addition, the fencing has been added, meaning that for the player it would not be that easy to fall down.
3. The moving platform has been fixed thus the player is not able to move while being on the platform, which has been the desired and expected behavior.
4. The final loop section has been completely rebuilt. The loop object itself has been created using modeling software. The motorbike now teleports at the platform with the proper rotation, so that the bike is faced towards the

loop. In addition, the loop beginning part is now visible straight after the teleport, which would give the player a hint about the way to go. At the end of the loop, the player jumps straight to the end of the level, which is represented by a rectangle with the “finish flags” texture put on it.

By the modifications listed above it is easy to see that the data gathered from observations and analysis in the playtesting phase helped to see and determine the problems which the game has had. In addition, it brought new ideas, which are supposed to make the game more interesting, entertaining and less frustrating. It has been very important to see how the game is perceived from the side view, because otherwise it would be impossible to notice all the issues the game has had by the developer alone.

The iterative prototyping approach in the game development showed its benefits as well. The prototyping approach helped to find many answers to the questions, which were raised before and during the implementation phase. After each prototype was developed, the designer tested the prototype. The results of such tests helped to bring new ideas and eliminate some of the drawbacks of the game. The iterative approach proceeded through the whole implementation phase. The development continued within the same areas of the game a few times and in this way the improvements and the contents of the game were gradually created, which in turn helped to focus on more important things at the required time.

10 SUMMARY

The objective of this study has been to find out what benefits do playtesting and iterative protyping approaches bring to game development. This chapter reviews the whole paper.

The research was begun by gathering background information about the current situation on the mobile game market. The work proceeded with planning the research. For the case of the study, it was decided to develop a mobile game prototype using the selected methodologies. The research continued with studying theoretical information about the current methodologies in game development, specifically the game design, prototyping and playtesting approaches. Thereafter, the high concept of the case study – a mobile 3D game, as well as the chosen development tools were described. The research then continued with the implementation phase, where the prototype of the game was developed using the selected iterative prototype methodology. After that, the playtests for developed prototype were organized. The organization of the playtests and selection of the playtesters were based on the playtesting methodology. The data for analysis of the playtesting was using the observations and the interviews. The analysis of the collected data raised a number of issues, ideas and thoughts about how the game could be improved. These improvements have been applied after the analysis stage.

The findings of the study have shown the benefits of the studied methodologies: the playtesting and iterative prototyping approach.

The iterative prototyping approach helped to answer the game design questions, determine and eliminate the flaws of the game on the early and middle stages. The selected approach also helped to stay focus during the whole development.

The playtesting has shown its benefits and important role in development of the game. The observations and analysis helped to find weak points of the game. In addition, it helped to bring in new ideas and thoughts for futher improvements of the game. It gave an overview how players think and react to certain events in the game. These findings helped to improve and polish the game.

10.1 Limitations of the study

The aim of this study was to explore the way that the playtesting and the prototyping approaches help to benefit in game development. Even though the study findings successfully tested the theory in practice and gave an understanding of how these methodologies work, there are several limitations to the research. The development of the game prototype has been done by a single person, who has been playing several of the roles in the development, specifically, the game designer, the art designer and the programmer. It is more common that the development of the game is accomplished in a team. It is possible that the cooperation with other people from the development team brings its own unique approach to the prototyping and the playtesting, though there should not be any strong deviations according to the theory found in the literature. Another limitation is the number of interviews and observations conducted. Due to the scope and limited resources of the project, the playtests have been limited to two sessions.

10.2 Reliability and validity

The reliability and the validity of the current research have been ensured by reliable literature sources. The process of prototyping and conducting the playtesting phase has been followed by corresponding research methodologies. Therefore, the research can be seen as reliable and repeatable. The validity of this research is confirmed by comparing the results of the study and the literature review. The results of applying the iterative prototyping approach are very close to results found in the literature. The observations and the interviews have yielded similar results between different playtesters. Playtesters had differences in their target audience characteristics as gamer type category, gaming experience, gender, etc.

10.3 Future study suggestions

As already mentioned the project was limited by the research scope and limited resources, therefore the recommendations for future studies include the research of chosen methodologies for a bigger project, possibly with a greater number of development team members. In addition, the project of the current research has not reached a final ready-to-be-published state. That could be another challenge for the research. Finally, the number of the respondents interviewed and observed as well as the testing groups from which these respondents were selected could be extended to gather broader results.

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APPENDICES

APPENDIX 1

List of playtesting interview questions:

1. Do you understand how to play?
2. Do you want to play the second time?
3. When do you get bored?
4. When are you feeling frustrated and confused?
5. What are the hidden bugs?
6. What part of the game are the most fun to play?
7. What part of the game are the least fun to play?
8. Is the level too short?
9. Where would you like to have checkpoints?
10. Any additional comments on how the level or game could be improved