

MED10-4 AALBORG UNIVERSITY ESBJERG

# **The effect of multiplayer mode on users' immersion and enjoyment in mobile games**

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## **Abstract**

The purpose of this study is to determine in what way the multiplayer mode of mobile games can influence people's enjoyment and immersion while playing. Also, the study aims to determine if there is any correlation between immersion and enjoyment.

For answering the purposed questions, an Android game with the possibility of playing single player and multiplayer mode was developed. The project was tested on 22 participants with the age between 16 and 28 years. The measurement of users' enjoyment was based on Intrinsic Motivation Inventory (IMI) questionnaire and users' immersion was tested with Immersive Experience Questionnaire (IEQ).

The statistically analyzed results showed that both immersion and enjoyment was higher while playing the multiplayer mode of the game. Moreover the Spearman's Rank Correlation test showed a high level of correlation between immersion and enjoyment, 0.5 while playing single player and 0.9 while playing multiplayer mode.

# Contents

<b>1. Introduction.....</b>	<b>6</b>
<b>1.1. Research Questions.....</b>	<b>6</b>
<b>2. Related Work .....</b>	<b>7</b>
<b>3. Theoretical Framework.....</b>	<b>8</b>
<b>3.1. Immersion.....</b>	<b>8</b>
<b>3.1.1. Immersive Experience Questionnaire (IEQ) .....</b>	<b>9</b>
<b>3.2. Enjoyment .....</b>	<b>9</b>
<b>3.2.1. Intrinsic Motivation Inventory (IMI) .....</b>	<b>10</b>
<b>3.3. Social Interaction .....</b>	<b>11</b>
<b>4. Game Design and Implementation .....</b>	<b>11</b>
<b>4.1. Game Design .....</b>	<b>11</b>
<b>4.2. Programs .....</b>	<b>12</b>
<b>4.3. Game Features .....</b>	<b>12</b>
<b>4.4. Scripting .....</b>	<b>15</b>
<b>4.4.1. Scripting for Bluetooth Connection.....</b>	<b>16</b>
<b>5. Methods.....</b>	<b>18</b>
<b>5.1. Participants .....</b>	<b>18</b>
<b>5.2. Testing.....</b>	<b>19</b>
<b>5.3. Data Gathering .....</b>	<b>20</b>
<b>6. Results .....</b>	<b>21</b>
<b>7. Analysis .....</b>	<b>24</b>
<b>7.1. Correlation between Enjoyment and Immersion .....</b>	<b>25</b>
<b>8. Discussion.....</b>	<b>27</b>
<b>8.1. Consistency with the Related Works .....</b>	<b>27</b>

**8.2. Limitations .....28**

**8.3. Future Work .....29**

**9. Conclusion .....29**

**10. Acknowledgements.....30**

**References .....31**

**Appendix A .....34**

**Appendix B.....38**

# **1. Introduction**

Digital games has shown an increasing growth of use in recent years, almost  $\frac{3}{4}$  of people under 30 years of age played a computer or mobile game (Bryce & Rutter, 2003). Playing video games has become the fastest growing and the most common form of contemporary leisure lifestyles among children, adolescents and adults (Ryan, Rigby & Przybylski, 2006). These can be played on a large range of devices: televisions, smartphones, personal computers, consoles, portable hand-held gaming devices and digital watches. Some of the devices, because of their small size and portability, allows players to play anywhere at any time. Each gamer has his own reasons for playing video games, but the most common reasons, as suggested by Phillips, Rolls, Rouse and Griffiths (1995), are: “to pass the time”, “to avoid doing other things”, “to cheer oneself up” or “just for enjoyment”.

Games are one of the most prosperous mobile applications (Aiolli & Palazzi, 2009). A multiplayer game is a game that allows two or more players to participate in the same game session (Korhonen & Koivisto, 2007). Many of the new developed games supports different options for playing multiplayer mode: playing with a co-located (player in the same room) player, with a mediated (online player) player or playing against the computer (Martin, 2010).

Multiplayer games are more interesting, pleasant, challenging and attractive than single player. The reason for this is the social interaction side of the game, the possibility to compete with real persons, which makes the game more unpredictable and entertaining (Korhonen et al., 2007).

Because playing digital games has become a prominent form of entertainment and because the result of a good game experience is immersion (Jennett, Cox, Cairns, Dhoparee, Epps, Tijs & Walton, 2008), it is necessary to examine how these notions, as enjoyment and immersion, are influenced by the social aspect of the game, namely multiplayer mode.

## **1.1. Research Questions**

The main purpose of this research is to find what impact has the multiplayer mode on gamers' immersion and enjoyment. Therefore, the following research questions were formed:

1. In what way does multiplayer mode of a smartphone game influence player's immersion?
2. In what way does multiplayer mode of a smartphone game influence player's enjoyment?

Brown and Cairns (2004) stated that immersion is not a necessary element for enjoyment, but on the other hand none of the participants in his study claimed that they didn't enjoyed the experience of immersion. This claim served as a base for the third research question, which is:

3. Is there any correlation between immersion and enjoyment?

## **2. Related Work**

The following chapter discusses previous studies that were carried out regarding social aspect of gaming, immersion and enjoyment in games.

Martin (2010) investigated the role of physical presence in multiplayer games. She conducted an experiment for three different conditions: playing against the computer, against a co-located person and against a mediated person. The outcome from her study showed that playing against a real person (mediated or co-located) increased the player's level of immersion, which demonstrates that social aspect of a game has a direct effect on immersion. One reason for this could be that the stimulation offered by human opponents will capture player's attention into game and they will pay less attention to the surrounding environment (Ravaja, Saari, Turpeinen, Laarni, Salminen & Kivikangas, 2006). Findings of Weibel, Wissmath, Habegger, Steiner & Groner (2008) are also in agreement with these assumptions, moreover, they reported that playing against human beings also increased the flow and enjoyment, it also leads to more excitement and more engagement. Furthermore, De Kort, IJsselsteijn and Poels (2007) found that the degree of enjoyment and immersion is higher if the co-located player is a friend than an unknown person. Fang and Zhao (2010) stated that social aspect of the game can even impact and shape user behavior, which can lead to positive or negative emotions. Besides all the positive effects of social interaction on players' emotions, it can also has a negative effect, which leads to decreasing the level of immersion. As stated by Sweetser and Wyeth (2005), real people can provide a link to real world, thus making players to shift their attention from the virtual world to real world.

From the above studies it is already known that playing computer games against a human being increases gamers' immersion and enjoyment, but it is still a guess if playing mobile games has the same outcome. Moreover, in the reviewed literature it was not found if immersion and enjoyment are two correlated terms. Therefore, this study will try to provide a clear idea about the

mobile game experience, namely the differences in immersion and enjoyment while playing mobile single player and multiplayer mode, and to investigate the correlation between immersion and enjoyment.

### **3. Theoretical Framework**

In order to answer to the research questions it is needed to understand the terms, immersion and enjoyment, and to understand what factors influence immersion and what aspects of the game experience leads to more enjoyment. Therefore, this chapter will cover the fundamental information regarding immersion and enjoyment, and the impact of social interaction on these.

#### **3.1. Immersion**

For a better understanding of the notion “immersion” and its perception by users, Brown et al. (2004) carried out a qualitative study by interviewing gamers about their experience of gaming and what they meant by using the term immersion. They found that gamers used this notion to express their feeling of being involved in a game. Based on the outcome from this study, they divided immersion into three degrees: engagement, engrossment and total immersion.

In order to reach the first level of immersion, engagement, the player must overcome some barriers, which are: the game genre should be the one preferred by user; the user should be familiar with game controls; the player should invest time, effort and attention/concentration. Once the engagement is reached, the user can become further involved and feel the second level of immersion, which is engrossment. The barriers to engrossment are directly linked to the game construction, more precisely the emotionally contact between the game and the user. The player’s emotions should be directly affected by the game, which makes him to want to keep playing. At this stage of immersion, the player’s attention is totally attached to game features, graphic, audio and controller. To achieve total immersion, third degree of immersion, gamers should overcome the barriers of empathy and surroundings. At this stage they feel that they are present in the virtual world and the game is all that matter. At this point of immersion, their attention, thoughts and feelings can be influenced only by game atmosphere.

There are some factors in a game that are believed to influence player’s immersion. The first one is *score*. As stated by Brockmyer, Fox, Curtiss, McBroom, Burkhart and Pidruzny (2009),

a person with a lower score is more likely to achieve a lower level of immersion. The second factor is visual graphics. Even though the graphics are very simple it still can offer the same immersive experience as advanced graphics (Jennett et al., 2008). The third factor is controllers. By being simple and intuitive, the controller can improve gamer's immersion (Cairns, Li, Wang & Nordin, 2014).

### **3.1.1. Immersive Experience Questionnaire (IEQ)**

The Immersive Experience Questionnaire (Appendix A) was applied as the only tool for measuring the level of immersion whilst playing the smartphone game. It is an available and well-validated questionnaire. It was developed by Jennett et al. (2008) based on previous related studies and based on the five dimensions found by Agarwal and Karahanna (2000), which are: temporal dissociation, focused immersion, heightened enjoyment, control and curiosity. Agarwal et al. (2000) defined these dimensions as being a state of deep involvement with software, and named them cognitive absorption.

The IEQ consists of 31 questions scored on a seven-level Likert scale. The questions are divided into 5 essential components of immersion: 3 person and 2 game components. The person factors are: emotional involvement, cognitive involvement and real world dissociation, while the game factors are: challenge and control.

Compared to the Game Experience Questionnaire (GEQ), IEQ contains both positive and negative statements. For each positive statement, there is a negative statement, which makes the result more accurate (Nordin, Denisova & Cairns, 2014). Moreover, the GEQ questionnaire focuses more on evaluating the game, while IEQ focuses on measuring the user experience whilst playing the game (Norman, 2013).

This questionnaire has been used to measure immersion in many studies, under different conditions and settings (Martin, 2010; Nordin, Ali, Animashaun, Asch, Adams & Cairns, 2013; Nordin, 2014).

## **3.2. Enjoyment**

According to Lyons (2015), enjoyment is formed by three components: rewards, feedback and challenge. Rewards can be expressed through health packs, keys, points, score, power ups and trophies. Feedback represents the information provided to users regarding their progress. It can be

auditory, visual or sensory. Challenge is the third component that produce enjoyment by overcoming and mastering it, also it is one of the reasons that make the user retry the game (Lyons, 2015).

Lazzaro (2004) conducted a study with 45 participants (15 non gamers, 15 hardcore gamers and 15 casual gamers) in order to find the importance of emotions during and after playing video games. She found four keys that leads to a more enjoyable game experience. The first key is defined as “*hard fun*” and it is created by challenges and rewards. This key is linked to the users’ feelings of frustration and personal triumph. The second one is “*easy fun*”, which focuses more on capturing the users’ curiosity and attention. Enjoyment occur from experiencing the game activities, from sensations of awe, wonder and mystery. The third key is named “*altered states*” and it is based on changing the users’ mental state (internal state) during and after playing the game. Gamers will play to combat boredom and they will experience feelings as excitement and relief. The fourth and final key is “*the people factor*” and is created by playing with other people, more precisely by such aspects as: competition, cooperation, performance and spectacle. At this point, enjoyment is influenced by emotions as amusement, rivalry, teamwork and camaraderie.

Another element that affects players’ enjoyment is “social interaction”. It is considered one of the core elements that influence player’s enjoyment (Sweetser et al., 2005). This element is highly related to user experience, and not to the game itself (the game genre, visual and audio effects of the game) or to the device on which the game is played (the screen size, controllers and the device’s power to run the game).

### **3.2.1. Intrinsic Motivation Inventory (IMI)**

In order to test the player’s enjoyment, it was decided to use the Interest/Enjoyment subscale of the IMI questionnaire (Appendix B). IMI is a multidimensional measurement device intended to measure participants’ experience with regards to specific experimental tasks. It consists of seven individual subscales: interest/enjoyment, perceived competence, effort/importance, value/usefulness, pressure/tension, perceived choice and relatedness. The order and the number of questions for each subscale, as well as any exclusion or inclusion of a specific subscale doesn’t influence the final results of the remaining subscales (McAuley, Duncan & Tammen, 1989).

Interest/Enjoyment subscale consists of 6 questions and in order to answer to these questions it was used the same 7 Likert-scale, as in case of IEQ questionnaire, which means that users had to choose a number between one for “not at all true” and seven for “very true”.

### **3.3. Social Interaction**

The ability to interact with other players is considered to be one of the outstanding motivations to play video games (De Kort et al., 2007). De Kort et al. (2007) suggest that games are played to enrich social interaction and not for personal enjoyment. This has to deal with the willingness of players to prove to other people who has the best skills, fastest strategic thinking, reaction and logical problem solving (Sherry, Lucas, Greenberg & Lachlan, 2006). Malaby (2007) believes that gaming is not a form of entertainment but a form of interacting and socializing in modern society. People will interact and play games together, even if they do not like the game or even when they do not like to play games at all (Sweetser et al., 2005).

## **4. Game Design and Implementation**

In this section of the report, the main phases of the game development will be described. Also, it will contain a description of the used programs, the game features, game design and the main scripting functions.

### **4.1. Game Design**

The game concept was based on some leading games on Google Play charts, like Flappy Bird and Jetpack Joyride, while keeping in mind the idea that the game should make sense while playing single and multiplayer mode. This game is easily learned, this was especially important for participants who were not avid gamers, the likes of which made up a substantial proportion of the individuals recruited for this study.

This game contains all the factors, enumerated in section 3.1 that can influence immersion. Besides these elements it also contains some challenges, like: beating your own high score/opponent's score and keeping away from missiles which are believed to be another factor that influences immersion. Based on findings from Sanders and Cairns (2010), it was decided to not include a background music into this game, because a bad choice of music can influence negatively gamer's immersion.

In this project the elements that provides feedback are: users' score (reward intended to increase the player's enjoyment when surpassing the second player's score or his own high score), visual, audio and sensory (vibration) output (bang when the player collides with a missile or with the upper/bottom border).

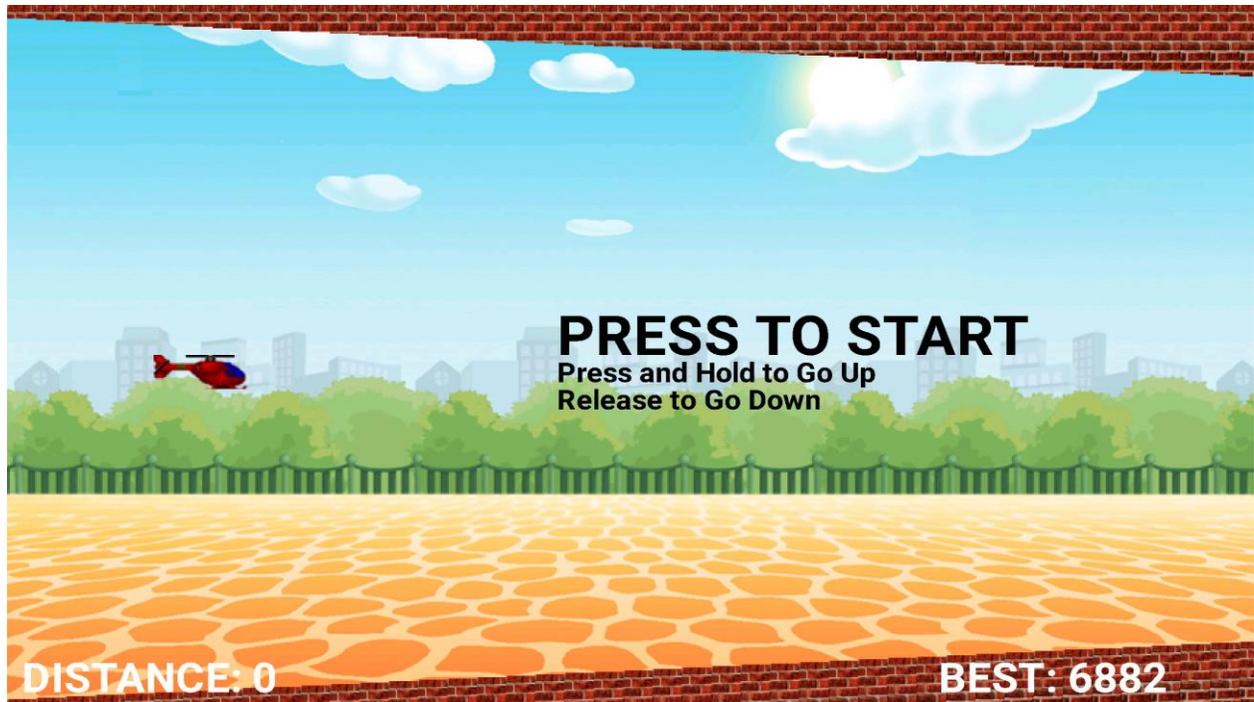
To support social interaction, this game has multiplayer mode (two players). Multiplayer mode in games can be of two types: competitive and collaborative. As stated by Vorderer, Hartmann & Klimmt, (2003); Gajadhar, de Kort & IJsselsteijn (2008) social competition has been proved to be more enjoyable and more interactive, thus this type of social interaction was implemented in the current game.

#### **4.2. Programs**

The main software used for developing this game, was Android Studio, which is the official integrated development environment for creating applications for the Android platform. The Android Studio is available for free to download on all platforms, and it contains all the needed libraries and packages. It was used for developing the whole game and for building the executable file for installing on other android devices.

#### **4.3. Game Features**

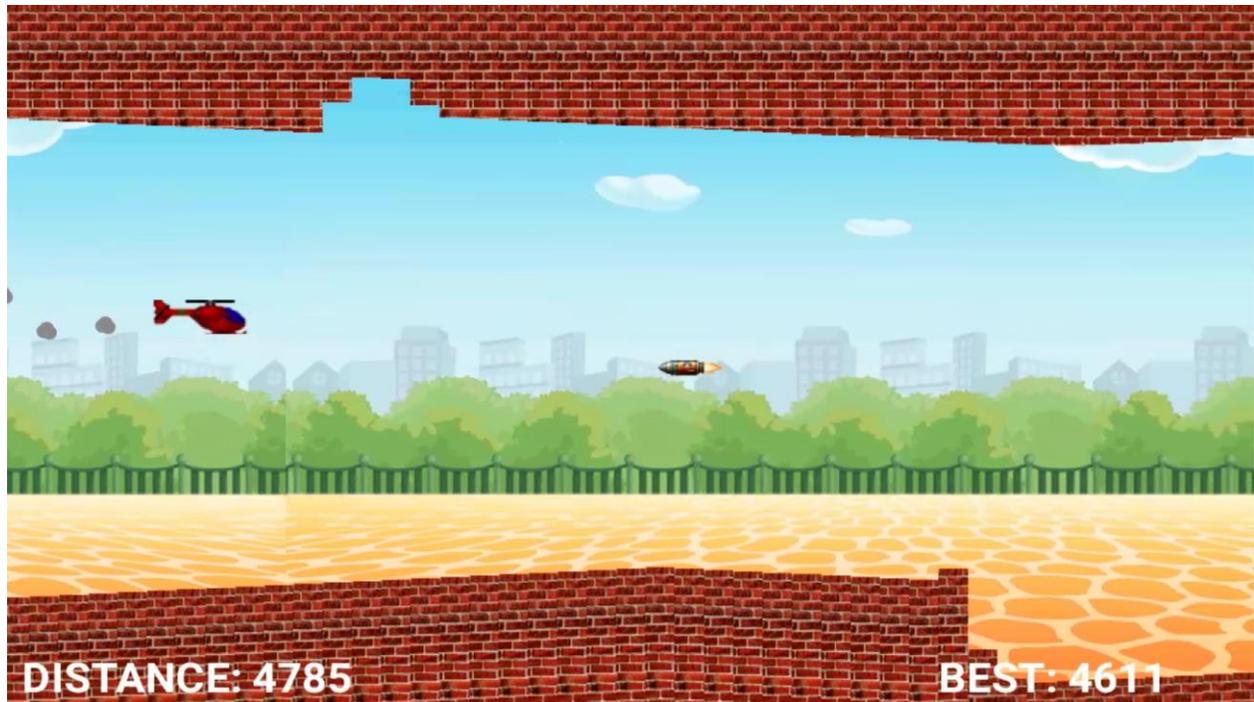
The primary goal of the player in this game is to avoid collision with missiles, with the upper and lower border and to beat own high score or the opponent's score in the multiplayer mode. This represents the challenging part of the game. Figure 1 represents the start screen (main screen) of the game.



**Figure 1.** Game's Start Page.

In the lower-right corner the user's best score is displayed, which is stored on his/her device; and in the lower-left corner the current score is displayed. The controllers in this game are very natural: user have to hold his/her finger on the screen in order to go up, and release the finger to go down. The helicopter can move only on y-axis, the x-axis position will always remain the same.

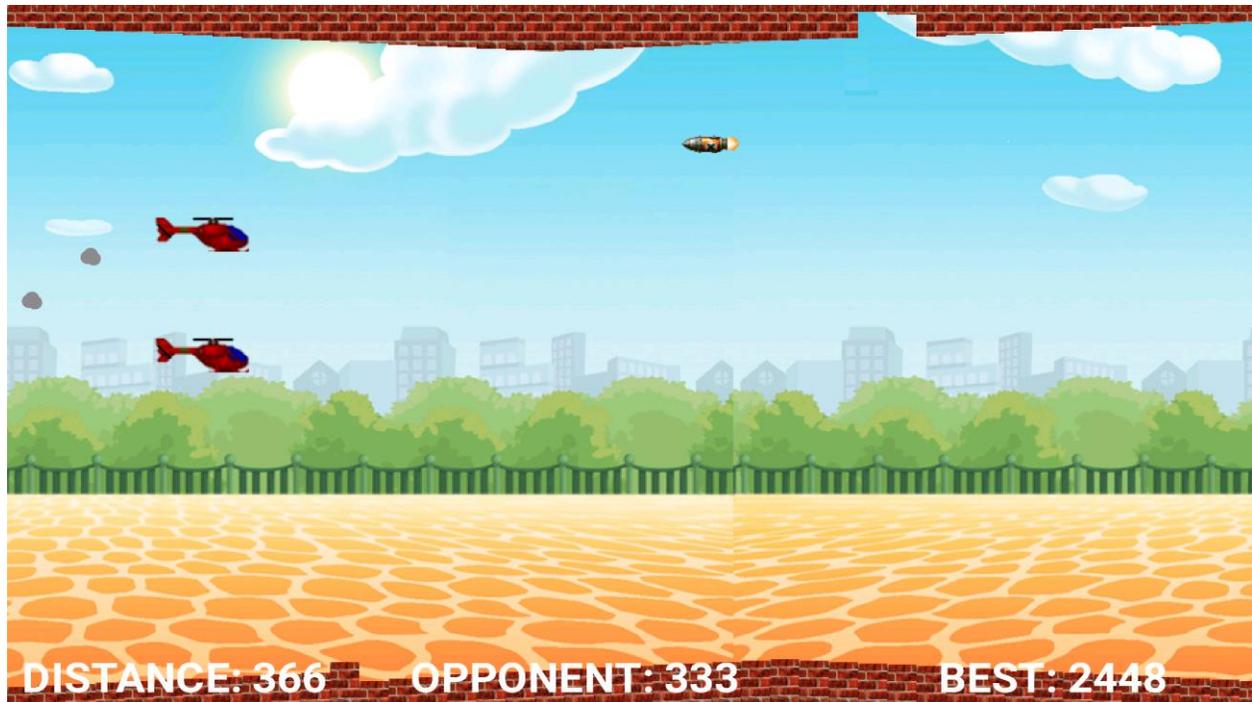
The missiles' speed and borders are directly proportional with the players' score, which means that the border will become more tight (Figure 2) and the missiles will come faster and faster if the user's score becomes higher and higher.



**Figure 2.** In-game screenshot in single player mode.

The multiplayer mode (Figure 3) is played on two different android devices. Each player will see on his device's screen his and the opponent's helicopter in real time, and also the opponent's current score. Each player has different randomly generated missiles, which means that missiles will appear on each screen in different positions and with a different speed. In case one of the players dies in the game, then his/her score will be reinitialized to zero ("0") but the game will continue and the playing user will continue to raise his/her score. The game will only stop when both players decide to quit the game and then players will compare their best score in the lower-right corner of the screen.

As can be seen in Figure 3, both helicopters are red and the only way to differentiate them is by smoke puffs that appears after the helicopter, i.e. smoke puffs will appear only after the current user, the opponent's helicopter will not have any smoke puffs. It was not possible to change the color of the second helicopter because of the game construction.



**Figure 3.** In-game screenshot in multiplayer mode.

#### 4.4. Scripting

This section will cover the main functions and objects that were used in developing the functionality of the game. All the code behind each action and each object were written in Java programming language, as Android Studio recognizes only Java.

Each game object has its own java class and constructor. The objects of this game are: Player, Background, Missiles, Smoke puffs, Top Border, Bottom Border and Explosion. All the classes have the draw function to draw the object on the screen and the update function to update the coordinates of the object.

Another important function is *collision()* which will check the collision between the player and other game objects, and in case it will return *true* then it will draw the explosion in the position where the collision happened and it will call the *reset()* function, which will reset the score and the initial values of borders.

```
public boolean collision(GameObject a, GameObject b)
{
    if (Rect.intersects(a.getRectangle(), b.getRectangle()))
    {
```

```
        return true;
    }
    return false;
}
```

Another important action is saving the player's best score. For this purpose, Android Studio provides five options: *Shared Preferences*, *Internal Storage*, *External Storage*, *SQLite Databases* and *Network Connection*. In this project, the first option was used because it is the most convenient method to save data as key-value pairs. The following code demonstrates how to save data with Shared Preferences:

```
SharedPreferences prefs =
this.getContext().getSharedPreferences("BEST",
Context.MODE_PRIVATE);
SharedPreferences.Editor editor = prefs.edit();
```

The *editor* variable, of type *Editor*, has predefined functions for reading all types of data, like: *String*, *Boolean*, *Integer*, *Long* and other types. The following line of code will show how to save an *Integer*.

```
editor.putInt("key", best);
```

In order to save or update these values, it is necessary to call the *commit()* function every time a value was created or changed.

```
editor.commit();
```

#### 4.4.1. Scripting for Bluetooth Connection

Bluetooth technology was chosen for connecting two devices, because it is accessible on almost all smartphone devices and its use is free of charge. Moreover, it does not require any access points or game servers to work, because one of the mobile will act as a server and the second one as a client (Aiolli et al., 2009).

The implementation of the connection through Bluetooth requires to follow some steps in a certain order. In order to perform any activities with Bluetooth it is required to get the *BluetoothAdapter* by using *getDefaultAdapter()* method, which will return the device's own Bluetooth.

```
BluetoothAdapter mBluetoothAdapter =
BluetoothAdapter.getDefaultAdapter();
```

```
// If the adapter is null, then Bluetooth is not supported
if (mBluetoothAdapter == null) {
    Toast.makeText(activity, "Bluetooth is not available",
Toast.LENGTH_LONG).show();
}
```

After getting the *BluetoothAdapter* object it is possible to interact with it from the game according to the game requirements. The first step will be to check if Bluetooth is enabled on the device and if not to ask the user's permission to enable it through a popup window. This is done with the following lines of code:

```
if (!mBluetoothAdapter.isEnabled()) {
    Intent enableIntent = new
Intent(BluetoothAdapter.ACTION_REQUEST_ENABLE);
    startActivityForResult(enableIntent, REQUEST_ENABLE_BT);
}
```

The next step is to check if the device is set to be discoverable, if not, ask the user's permission to enable it. The following code performs this action and will ask the permission to make the device discoverable for 300 seconds:

```
if (mBluetoothAdapter.getScanMode() !=
BluetoothAdapter.SCAN_MODE_CONNECTABLE_DISCOVERABLE) {
    Intent discoverableIntent = new
Intent(BluetoothAdapter.ACTION_REQUEST_DISCOVERABLE);

discoverableIntent.putExtra(BluetoothAdapter.EXTRA_DISCOVERABLE_D
URATION, 300);
    startActivity(discoverableIntent);
}
```

Now it is possible to check if the device is already paired with other devices and to discover new devices. For finding paired device it is necessary to call the *getBondedDevices()* function, otherwise it should call the *startDiscovery()* function for finding new devices that have Bluetooth enabled.

After following all the above steps, it is necessary to create a thread that will perform the connection and another thread that will manage the connection once it is connected.

```
public ConnectThread(BluetoothDevice device, boolean secure) {
    mmDevice = device;
    BluetoothSocket tmp = null;
```

```

// Get a BluetoothSocket for a connection with the
// given BluetoothDevice
    if (secure) {
        tmp = device.createRfcommSocketToServiceRecord(
            MY_UUID_SECURE);
    }
public ConnectedThread(BluetoothSocket socket, String socketType)
{
    // manage the connection
}

```

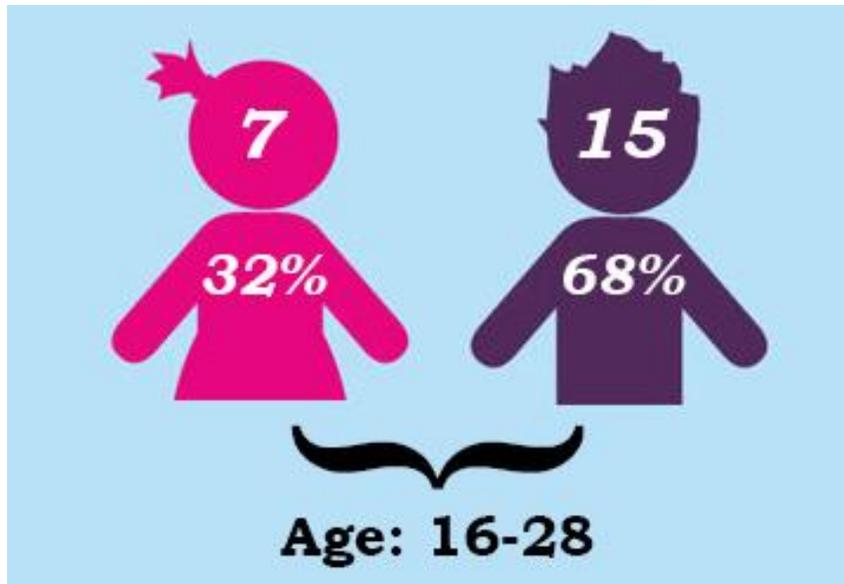
In the *ConnectedThread* it is possible to perform actions like sending messages between devices, exchanging some files, accessing the content on the connected device. In this project, actions like sending the current score of the second player and its position on y-axis were implemented.

## 5. Methods

This chapter of the report will cover information about the participants, the testing procedure and about the methods used for gathering data.

### 5.1. Participants

This research was conducted to find if users' immersion and enjoyment differ from single player to multiplayer mode of the game, also to check if there is any correlation between these two terms (enjoyment and immersion). In order to meet the goal of this study, 22 participants were enrolled, 15 males (68%) and 7 females (32%) (Figure 4). All of them were with the age between 16 and 28 years, with the mean age being 22 years. Since the test process was divided in two different sessions, the same person was tested in both conditions for obtaining comparative material. All of the participants finished the whole testing session.



**Figure 4.** Participants' distribution of gender and age

## 5.2. Testing

The testing session took place at College of Informatics from Chisinau (Moldova) and at the Denmark's language center "Lærdansk". In both places an available classroom were provided for testing purposes. There were not any requirements regarding participant's game experience, therefore random students that were met on corridors were asked to participate in the experiment. The only condition that were applied as a requirement to participate was their availability for the next 30 minutes, which made a lot of the potential participants to refuse to take part in this research.

Once the user accepted to participate in the current research, they were informed about the purpose of this study and they get some instructions regarding the testing procedure and the game itself. Afterwards, they were asked to fulfill a short questionnaire that contains questions regarding their age, gender, frequency of playing mobile games and the average time of playing. This kind of data were gathered for having an overview about participants' background in gaming. If the results will be unclear then these information will be used for filtering data, i.e. choosing only test participants that played at least once a month, and data will be analyzed again.

The testing part consist of two conditions, both played by the same participants: in the first one the tester will play the single player mode of the game and in the second condition there will be two friends, both present in the same room, which will play the two-player mode of the game. The test setup of the second condition of this experiment (two-players), allowed the paired

participants to verbally socialize and to express their feelings. Before starting each session they were informed that the game session should last between 5 and 10 minutes, and for this a chronometer was used. This interval of time was used because it is enough for a user to reach total immersion, which is the last degree of immersion (Nordin, 2014). After each gaming session they were asked to complete the IMI and IEQ questionnaires.

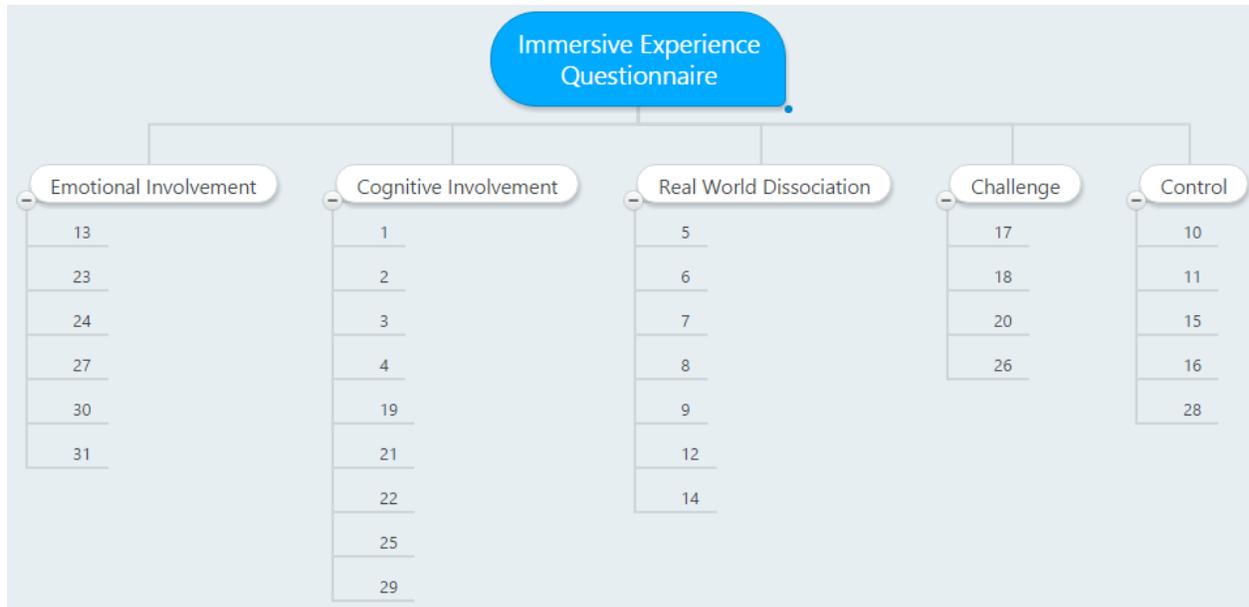
The two testing conditions (single player and multiplayer) were counterbalanced, which means that half of the participants first played the single player mode followed by the multiplayer mode, and the other half tested the multiplayer mode followed by the single player mode. This was done in order to avoid confounding variables and to get more trustworthy results.

### **5.3.Data Gathering**

To collect data for answering the research questions a quantitative approach (questionnaires) was used. Questionnaires are a useful research method to directly evaluate the subjective player experience because they are both easy to deploy, and provide a standardized instrument for quantifying the particular aspect of experience under consideration (Adams & Cox, 2008)

As was discussed previously in section 3.1.1, the IEQ questionnaire (Figure 5) was used as the only tool to measure immersion. It is an ideal tool for determining immersion after short periods of consecutive game playing, because of its ability to assess the player's level of immersion at any time during playing.

The minimum score of IEQ is 31 and the maximum score is 217. The score will serve as an indicator to see what level of immersion was achieved by participants. It is considered that participants engage if the score is between 31 - 110, engross if the score is between 110 - 160 and are total immersed if their score is between 160 - 217. It took between 5 and 8 minutes to complete the questionnaire.



**Figure 5.** IEQ Questionnaire

In Figure 5 are presented the component parts of the IEQ questionnaire. Below each subscale the number of the questions from the questionnaire are presented.

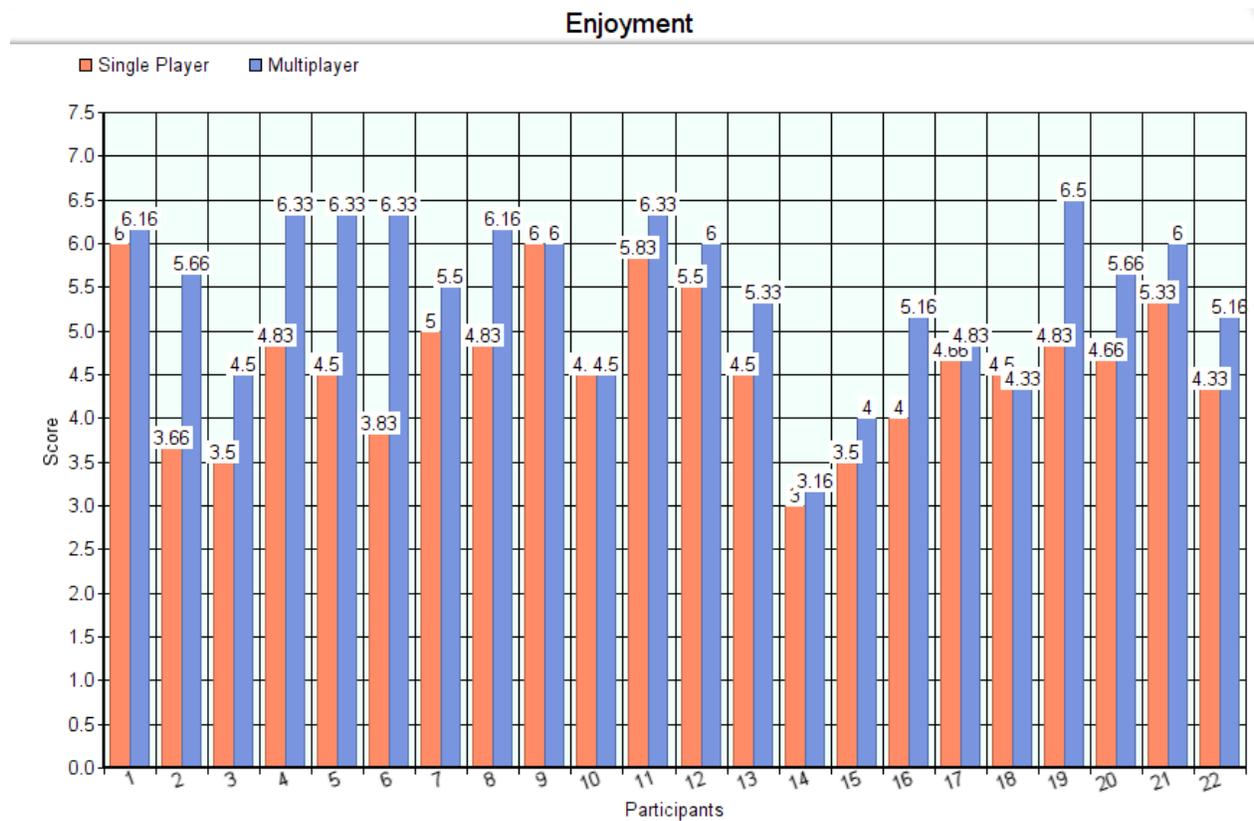
## 6. Results

The questionnaire data were utilized to assess the players' subjective experience of playing the game, such as how fun the game was and how immersed they were. Based on the answers from the IMI and IEQ questionnaires the below results were constructed. The average score for each question and each of the subscales was calculated. For obtaining the final score, questions from the same subscale were grouped together and averaged again.

The same IMI and IEQ questionnaires were given to participants after each testing condition. In order to create an overview of the obtained results, the data was stored into a table and diagram was created.

The results from IMI questionnaire are presented in Figure 6. In order to differentiate the results different colors were used, red for single player mode and blue for multiplayer mode. Participants showed an increase of enjoyment when playing the multiplayer mode, except the

participant number 9 and 10 which have the same average results in both condition and the participant number 18 which showed a decrease of enjoyment while playing the multiplayer mode.

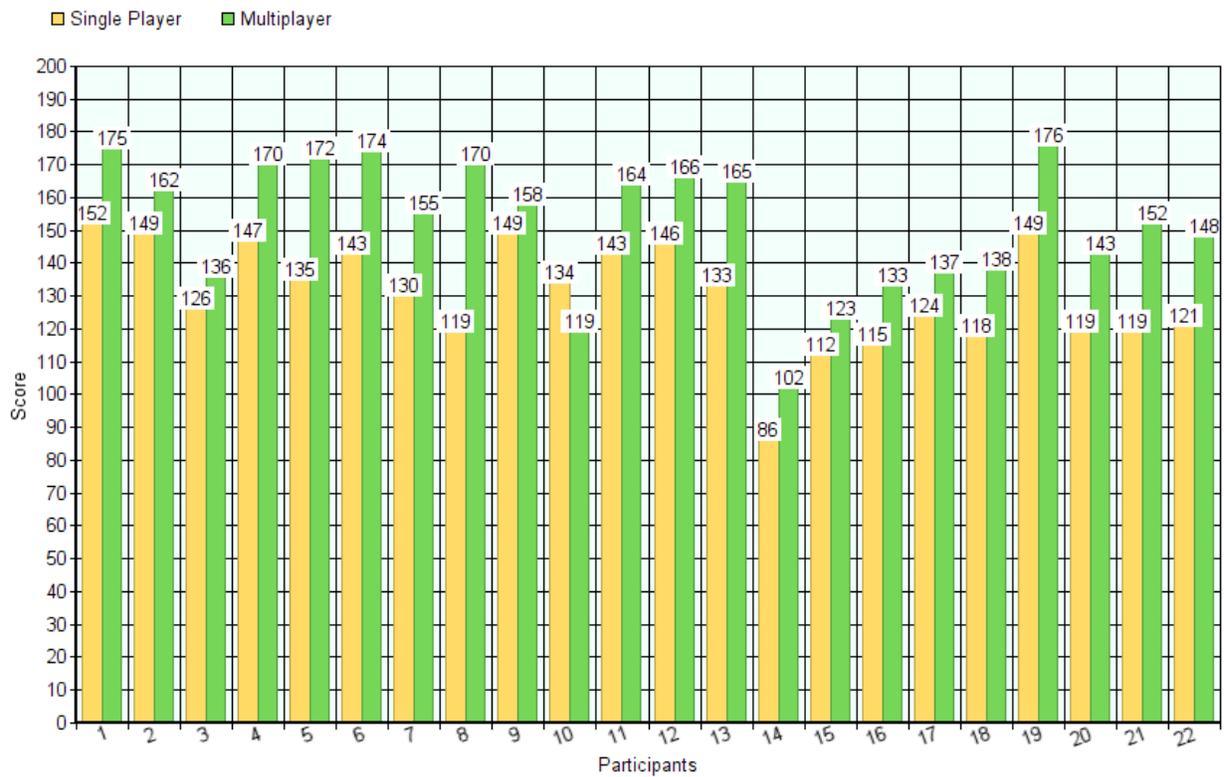


**Figure 6.** Results from IMI Questionnaire

The minimum score of IMI questionnaire is 1, while the maximum is 7, therefore the mean score is 4. Based on the results from IMI questionnaire from both testing conditions (Figure 6), 17 (77%) participants showed the enjoyment score equal or higher than the mean, therefore it can be claimed that the game was quite enjoyable.

The results from IEQ questionnaire (Figure 7) also showed an increase in immersion while playing the multiplayer mode. In Figure 7 the yellow color is used for single player and the green color for multiplayer mode. The minimum and maximum score of this questionnaire is 31 and respectively 217, which means that the mean score is 124. The results from single player mode shows that 13 participants are above the mean score, while in multiplayer mode 20 participants are above the mean. Only the participant number 10 showed a decrease in immersion while playing the multiplayer mode.

## Immersion



**Figure 7.** Results from IEQ Questionnaire

As the IEQ questionnaire consists of 5 subscales, questions from each subscale were grouped and the results are displayed in Figure 8. As can be seen in the figure below, all 5 components shows higher score for multiplayer mode.



**Figure 8.** Results for each subscale of IEQ Questionnaire

## 7. Analysis

In this chapter the results of the data analysis are presented and discussed in light of the study's research questions. Results presented in chapter 6 reveal visible difference between the immersion and enjoyment of the two testing conditions, but there is no statistical evidence if this difference is significant. Therefore, this chapter tends to statistically prove or disapprove this difference. Moreover, the correlation between enjoyment and immersion is calculated.

This research used repeated measure design, also called within-subjects design, which means that the same participants were tested in two different conditions. This type of design imply a carryover effect, which means that participants may influence results of the second testing condition, by being accommodated with game controllers or by creating some strategies of gaming. In order to minimize this effect, also mentioned in section 5.2, half of the participants started with first testing condition and the other half started with the second testing condition.

In order to check if the difference between immersion and enjoyment is significant, statistical tests were applied. Before applying any statistical calculations data needs to be checked

for normality. The Shapiro-Wilk normality test was used in the current study as Ghasemi and Zahediasl (2012) claimed that it is the most powerful one. This test consists of rejecting or accepting the null-hypothesis, which is that the data is normally distributed, i.e. the data came from a normally distributed population.

The Shapiro-Wilk test were applied on all four datasets, which are: enjoyment single player, enjoyment multiplayer, immersion single player and multiplayer mode. The results showed that for 3 of them the null hypothesis was accepted, which means that data is normal distributed, while the fourth dataset (enjoyment multiplayer mode) is not normally distributed. Therefore, the data for enjoyment is further analyzed with a non-parametric test, because the parametric tests requires that all datasets a normally distributed, while the data for immersion is analyzed with a parametric test.

The non-parametric test Wilcoxon Signed-Rank is used to statistically determine whether the population's mean ranks differ. It is based on rejecting or accepting the null-hypothesis which is that there is no significant difference between users' enjoyment while playing single player and multiplayer mode. In other words, the multiplayer mode is not more enjoyable than single player. After applying this test on enjoyment datasets, the null hypothesis was rejected with a probability of 95%, as the obtained statistic  $W = 3.5$  with  $p < 0.05$ , is smaller than its corresponding critical  $W$  value of 52. These results shows that there is statistically significant difference, which means that the multiplayer mode is more enjoyable.

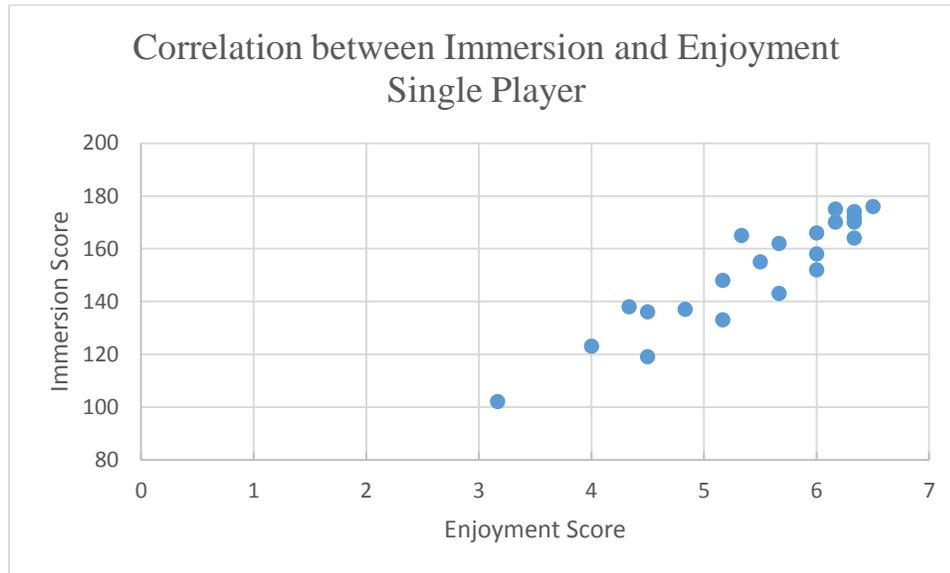
The parametric dependent t-test compares the means of two groups and it was used to determine if there is any difference between the two normally distributed datasets, namely participants' immersion while playing single player and multiplayer mode. This test, as the above one, is also based on null-hypothesis, which is that there is no significant difference between users' immersion after playing single player mode and users' immersion after playing multiplayer mode. The obtained p-value, which is 0.00001 is less than  $p=0.05$  which demonstrates that there is statistical significant difference between immersion of the two testing condition, i.e. the immersion increased while playing the multiplayer mode.

### **7.1. Correlation between Enjoyment and Immersion**

In order to find if there is any correlation between enjoyment and immersion it is necessary to apply a statistical test, in this case a non-parametric test, because enjoyment dataset is not normally distributed. The non-parametric test used in this study is Spearman's Rank Correlation.

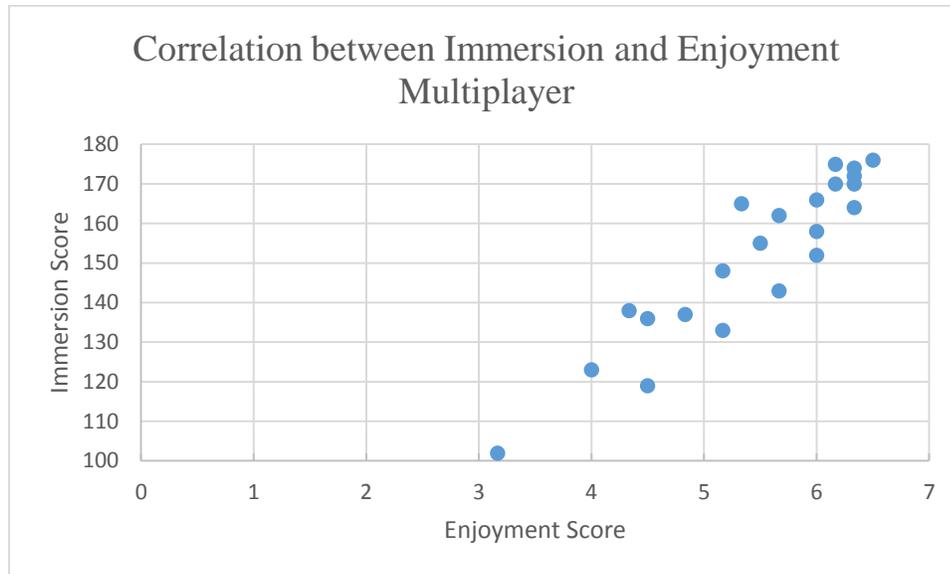
This test will return a correlation coefficient, which can have values between 1 for positive correlation, -1 for negative correlation and 0 for non-correlated data.

This test was applied on both pairs of datasets (single player and multiplayer mode) and the result are illustrated in the diagrams below (Figure 9 and Figure 10).



**Figure 9.** Correlation between immersion and enjoyment in single player mode

The correlation coefficient returned by Spearman’s test for single player datasets is 0.5, which means that data is positively correlated. Moreover, from the graph’s trend in Figure 9 it can be seen that if one value is high, the corresponding one will also be high. For the multiplayer sample (Figure 10) the correlation coefficient is 0.9, which means that data is almost perfect positive correlated.



**Figure 10.** Correlation between immersion and enjoyment in multiplayer mode

In the end, it can be concluded that the level of enjoyment and level of immersion in this mobile game are highly correlated. These findings show that those game elements that influences immersion will also increase enjoyment and vice versa.

## 8. Discussion

After a detailed presentation of the obtained results and a thorough analysis, it becomes necessary to discuss about several points: consistency with related studies, limitations and future work. Therefore, the goal of this section is to clarify each point, the revealed details of the approached topics.

### 8.1. Consistency with the Related Works

This project is similar to other products and other studies that have been done. Below is described in what way the obtained results are consistent with the results from the related studies.

Martin (2010) tested the importance of physical presence on user’s immersion in multiplayer games. She found that playing against a real person (mediated or co-located) increased the player’s level of immersion. The test setup of her study did not allow users to perform any type of communication while playing the multiplayer mode, and she stated this aspect as a point for future work. Findings from the current study are in line with Martin’s (2010) study, which showed

that playing against a real person increases user's immersion. Moreover, as the test setup allowed people to communicate between them while playing the multiplayer game, it can be concluded that the communication did not decrease gamers' immersion, but there is no clear proof if it improved or not.

The findings from Weibel et al. (2008) indicate that the type of opponent influences playing experiences, thus playing against a human-controlled opponent leads to a more engaging gaming experience. The outcome from the current study supports Weibel et al. (2008) findings, as the level of enjoyment increased significantly while playing the multiplayer mode of the game.

Findings from this study rejects the claim of Sweetser and Wyeth (2005), which is that real people can provide a link to real world, thus making the user switch his attention and not be immersed anymore. As can be seen in Figure 8 the charts for real world dissociation subscale of IEQ questionnaire also showed a small increase, which means that playing mobile games against real people is not a negative aspect for gamers' immersion. Of course, further research is needed to completely approve or disapprove this statement, as the testing group consisted only of 22 participants.

This study did not test the difference in enjoyment and immersion while playing multiplayer mode against a friend or against an unknown person. Based on the outcome from De Kort et al. (2007), that found that the degree of enjoyment and immersion is higher if the co-located player is a friend than an unknown person, it can be hypothesized that enjoyment and immersion increased because participants played against their friend.

## **8.2. Limitations**

One of the limitation of this study is the small sample size. It is hard to make any assumptions regarding all mobile games, because of the small number of participants. Moreover, the sample consisted only of persons with the age between 16 and 28 years.

Another limitation was that in this study only quantitative data was gathered. The results could be more reliable if after each session the gamers were interviewed for gathering qualitative data. This could help for a better understanding if their answers referred specifically to immersion and enjoyment and not to other dimensions like: flow, motivation and other.

### **8.3. Future Work**

This study revealed some dimensions for future research, which is based on three aspects: the game, the test participants and the used methods.

An interesting point to research is multiplayer mode with more than 2 players. It will be an important point for game developers, which will take into consideration creating the possibility to play mobile games with more than 2 players, if it will be found to be more enjoyable, interesting and immersed.

The test participants of these study were with ages between 16 and 28 years, thus the outcome is viable only for this range of age. Further research is needed to determine if the outcome depends on participant's age, gender and game preferences.

Future research efforts could potentially develop other versions of the game where the multiplayer mode will consist of collaborating together and not competing like in this study in order to see whether the results replicate in noncompetitive game environment.

## **9. Conclusion**

The goal of this research project was to determine how the multiplayer mode of a mobile game influences player's immersion and enjoyment. This was realized by creating a smartphone game with the possibility to play single player and multiplayer mode via a Bluetooth connection. 22 participants played both multiplayer and single player modes, continuing by fulfilling the same IMI and IEQ questionnaires after each game session. The gathered data was analyzed and the results revealed answers for the next research questions:

1. In what way does multiplayer mode of a smartphone game influence player's immersion?
2. In what way does multiplayer mode of a smartphone game influence player's enjoyment?

The statistically analyzed data showed that gamers' immersion and enjoyment significantly increased while playing the multiplayer mode of the game.

Further, the obtained data from both questionnaires were grouped, as it is data from single player and data from multiplayer mode. The obtained pairs were checked for correlation, by using the Spearman's Rank Correlation, in order to answer to the third research question, which is:

3. Is there any correlation between immersion and enjoyment?

The obtained correlation coefficient is 0.5 for single player mode and 0.9 for multiplayer mode. It can be concluded that the terms immersion and enjoyment are strongly positive correlated while playing the multiplayer mode.

## **10.Acknowledgements**

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## Appendix A

### Immersive Experience Questionnaire

1. To what extent did the game hold your attention?  
*Not at all*    1    2    3    4    5    6    7    *A lot*
  
2. To what extent did you feel you were focused on the game?  
*Not at all*    1    2    3    4    5    6    7    *A lot*
  
3. How much effort did you put into playing the game?  
*Very little*    1    2    3    4    5    6    7    *A lot*
  
4. Did you feel that you were trying your best?  
*Not at all*    1    2    3    4    5    6    7    *Very much so*
  
5. To what extent did you lose track of time, e.g. did the game absorb your attention so that you were not bored?  
*Not at all*    1    2    3    4    5    6    7    *A lot*
  
6. To what extent did you feel consciously aware of being in the real world whilst playing?  
*Not at all*    1    2    3    4    5    6    7    *Very much so*
  
7. To what extent did you forget about your everyday concerns?  
*Not at all*    1    2    3    4    5    6    7    *A lot*
  
8. To what extent were you aware of yourself in your surroundings?  
*Not at all*    1    2    3    4    5    6    7    *Very aware*
  
9. To what extent did you notice events taking place around you?  
*Not at all*    1    2    3    4    5    6    7    *A lot*

10. Did you feel the urge at any point to stop playing and see what was happening around you? *Not at all*    1    2    3    4    5    6    7    *Very much so*

11. To what extent did you feel that you were interacting with the game environment?  
*Not at all*    1    2    3    4    5    6    7    *Very much so*

12. To what extent did you feel as though you were separated from your real-world environment?  
*Not at all*    1    2    3    4    5    6    7    *Very much so*

13. To what extent did you feel that the game was something fun you were experiencing, rather than a task you were just doing?  
*Not at all*    1    2    3    4    5    6    7    *Very much so*

14. 14. To what extent was your sense of being in the game environment stronger than your sense of being in the real world?  
*Not at all*    1    2    3    4    5    6    7    *Very much so*

15. At any point did you find yourself become so involved that you were unaware you were even using controls, e.g. it was effortless?  
*Not at all*    1    2    3    4    5    6    7    *Very much so*

16. To what extent did you feel as though you were moving through the game according to your own will?  
*Not at all*    1    2    3    4    5    6    7    *Very much so*

17. To what extent did you find the game challenging?  
*Not at all*    1    2    3    4    5    6    7    *Very difficult*

18. Were there any times during the game in which you just wanted to give up?  
*Not at all*    1    2    3    4    5    6    7    *A lot*

19. To what extent did you feel motivated while playing?

*Not at all*    1    2    3    4    5    6    7    *A lot*

20. To what extent did you find the game easy?

*Not at all*    1    2    3    4    5    6    7    *Very much so*

21. To what extent did you feel like you were making progress towards the end of the game?

*Not at all*    1    2    3    4    5    6    7    *A lot*

22. How well do you think you performed in the game?

*Very poor*    1    2    3    4    5    6    7    *Very well*

23. To what extent did you feel emotionally attached to the game?

*Not at all*    1    2    3    4    5    6    7    *Very much so*

24. To what extent were you interested in seeing how the game's events would progress?

*Not at all*    1    2    3    4    5    6    7    *A lot*

25. How much did you want to "win" the game?

*Not at all*    1    2    3    4    5    6    7    *Very much so*

26. Were you in suspense about whether or not you would do well in the game?

*Not at all*    1    2    3    4    5    6    7    *Very much so*

27. At any point did you find yourself become so involved that you wanted to speak to the game directly?

*Not at all*    1    2    3    4    5    6    7    *Very much so*

28. To what extent did you enjoy the graphics and the imagery?

*Not at all*    1    2    3    4    5    6    7    *A lot*

29. How much would you say you enjoyed playing the game?

*Not at all*    1    2    3    4    5    6    7    *A lot*

30. When it ended, were you disappointed that the game was over?

*Not at all*    1    2    3    4    5    6    7    *Very much so*

31. Would you like to play the game again?

*Definitely no*    1    2    3    4    5    6    7    *Definitely yes*

## Appendix B

### Intrinsic Motivation Inventory Questionnaire

1. I enjoyed playing very much.

*Not at all*    1    2    3    4    5    6    7    *A lot*

2. It was fun to play this game.

*Not at all*    1    2    3    4    5    6    7    *A lot*

3. This game didn't hold my attention at all. (R)

*Not at all*    1    2    3    4    5    6    7    *A lot*

4. I would describe playing this game as very interesting.

*Not at all*    1    2    3    4    5    6    7    *A lot*

5. I thought playing this game was quite enjoyable.

*Not at all*    1    2    3    4    5    6    7    *A lot*

6. While I was playing this game, I was thinking about how much I enjoyed it.

*Not at all*    1    2    3    4    5    6    7    *A lot*