FACULTY OF ENGINEERING AND ARCHITECTURE

| RuNNer |

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CAPSTONE PROJECT THESIS

The 3D Android Hyper Casual Game with Unity
to
Heal Mental Stress & Tiredness

Istanbul, June 2023

Preface

In these recent years, when the use of mobile devices has increased, application development studies have increased with mobile phones that have almost come to computer technology. In this context, I designed a game in the Hyper-Casual type game category, which is the most popular genre in the game industry in recent years and takes its basis from the Arcade category. It is obvious that Hyper-Casual games have recently filled the top positions in the Google App Store. It is obvious that these games, which the players play intensely, entertain people instantly and quickly. In this context, I designed a game that can be played on Android mobile platforms with this game, which is my final project.

I would like to thank all my friends, loved ones, all the people in the game industry and everyone else who played my game, who played this game and gave me good feedback. Thanks to my thesis advisor, Dr. Instructor Member Özlem Feyza ERKAN and Prof. Dr. I would like to thank my teacher Shahzad Ahmed MEMON.

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Özet

Bu lisans tezinde Hyper-Casual oyun severler için tasarlanan, insanları eğlendirerek anlık mutluluk kazandırma amacına göre tasarlanmış bir Android tabanlı oyun anlatılmıştır. Yakın zamanda oyun piyasasında iyi bir kazanmış olan Hyper-Casual tabanlı oyunlar anlık olarak oyun oynamak isteyenler için bir vazgeçilmez haline gelmektedir. Bu sebeple bu oyunda bu izlenimler göz önünde bulundurularak çok sade ve anlaşılabilir arayüzlü ve oynanması oyuncuyu zorlamayacak şekilde kendi kategorisine uygun bir şekilde tasarlanmıştır.

Başlangıçta sadece başlangıç noktasından başlayarak bitiş çizgisine en fazla yardımcı karakter ile gitme amacıyla yapılmış olsa da, gerek danışman hocalar gerek ise bana fikir öne süren arkadaşlarım sayesinde levellerin iç kısımları ekstra özellikler ile donatılarak oyuncunun tam bir game challange içerisinde yer olmasını sağlamıştır. Oyuna hem geliştirme esnasında hem de paylaşımdan hemen önce birçok bug bulunmuştur. Bu bugları ile özel olarak ilgilenilmiştir. Gerek script tarafında gerek ise editöryel kısmında geliştirmeler günden güne artmış olup bu süreçte herhangi bir karışıklığa ödün vermemek için içerik temiz ve ayrıntılı bir biçimde tasarlanmıştır.

Ayrı olarak oyunun geliştirilme süreçleri esnasında bir çok kez optimizasyon testlerine girmiş olup, elden gelen maksimum performans büyüklüğü oyuna sunulmuştur. Oyun orta-düşük segment telefonlarda bile rahatlıkla çalışabilecek performansa getirilmiştir. Android sürümü olarak Android 10 ve üstü desteklense bile oyun kategorisinin klasik bir oyun olması sebebiyle performans hep üst düzeyde tutulmuş ve böylelikle ekstra olarak sağladığımız API destekleri ile oyun Android 8 ve üstünde çalışabilecek potansiyele gelmiştir.

Genel olarak oyun paylaşım sürecinde olup beni tanıyan bir çok insana ulaşmış ve güzel yorumları ile bana geri dönüş yapılmıştır. Beklentinin çok daha üzerinde durduklarını ayrı olarak benimle paylaşan kişiler oyunun bu anlamda gayet yaratıcı ve oynanabilir olduğunun bir işaretidir. Geliştirilmeye ve yeni şeyler eklenmeye çok açık olan bu oyunda gelişen ve akla gelen fikirler ile oyunun çok daha iyi yerlere geleceğini umuyorum.

Abstract

In this undergraduate thesis, an Android-based game designed for Hyper-Casual game lovers and designed for the purpose of entertaining people and providing instant happiness is described. Hyper-Casual-based games, which have recently won a good deal in the game market, are becoming indispensable for those who want to play games instantly. For this reason, this game has been designed in accordance with its own category, with a very simple and understandable interface, taking into account these impressions, and in a way that will not force the player to play.

Although it was originally made only for the purpose of going from the starting point to the finish line with the maximum number of supporting characters, thanks to both the mentors and my friends who offered me ideas, the inner parts of the levels were equipped with extra features, allowing the player to be in a full game challenge. Many bugs were found in the game both during development and just before sharing. Special attention has been paid to these bugs. Improvements both on the script side and the editorial part have increased day by day, and the content has been designed in a clean and detailed way to avoid any confusion in this process.

In addition, during the development process of the game, it has entered optimization tests many times, and the maximum performance size has been presented to the game. The game has been brought to a performance that can easily work even on mid-low segment phones. Even though Android 10 and above is supported as the Android version, the performance has always been kept at a high level due to the fact that the game category is a classic game, and thus the game has the potential to run on Android 8 and above with the API supports we provide as an extra.

In general, the game has reached many people who are in the process of sharing and know me, and I have been returned with their nice comments. Individuals who shared with me that they stand above expectations are a sign that the game is very creative and playable in this sense. I hope that the game will come to a much better place with the ideas that come to mind in this game, which is very open to development and adding new things.

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Introduction

With the developing technology day by day, the use of digital devices in many areas is obvious. This usage has increased exponentially today.

Playing games is one of the methods that children, who start to enjoy this technology from a young age, resort to in order to spend time or have fun according to their age. Based on the researches, in which the first experiences in the family environment usually start with a phone or tablet, it has passed the computer with a rate of 64.4%. And this rate is not just limited to children. It is also possible to say that the need for rest in developing societies increases in the same way, especially after work stress or events in daily life. In this case, it is obvious that adult people use their phones instantly when they return home from work or during their breaks in order to distract themselves, get away from the stress of life a little bit and relax mentally. Since 2013, the percentage of adults playing games has increased 6 times, and it is estimated that at least 28% of these games are classic games that can be played immediately and will give quick results. In fact, the addiction of adults to games and the rate of receiving support due to these addictions increased by 2.33% compared to 10 years ago.

Especially as a result of the recent worldwide pandemic, due to spending more time at home, it has caused people to resort to games to spend time. It is worth saying that the rumors that this situation has an effect on socialization and that people reduce this feeling by playing games on the online platform when they feel lonely are somewhat true. According to the research conducted by the Turkish Statistical Institute (TUIK), 86.2% of the people use the internet during the pandemic period and 61% of them are reserved for gaming in this category. As such, in these periods when the interest in the game increased, there were also increases in the game sectors. Based on this, we can observe that game development has reached a certain level.

Definition of the Project

When we look at the meaning of the game in general, the game is an activity that aims for people to have a good time. Since this activity is a fun activity, it can also be used as an education when appropriate, with its easy learning and catch-up. It can be a need for almost every age group, regardless of the age of the child. These games can sometimes be a chess game that can be played against each other, sometimes a hopscotch game played with children, and sometimes a video game that can branch in many areas.

Video games can be a game that people play for fun, or a professional game played by professional players in a particular game. Based on this project, the first thing that comes to mind when talking about video games is computer games, but recently the importance of games on mobile platforms has increased considerably. These games can also be games that can be played to pass time, to achieve a success or even to win a prize.

In this project, an application has been developed in the sense of having fun and spending time. This application can work on mobile-based and android platforms. This project, which is made within the scope of a Hyper Casual game, where the person can get some improvements in his game with the time he will play, is a comprehensive project in terms of both simplicity and fun.

Aims and Goals

In these periods when people work intensively, they want the time they spare for themselves to be spent in the best possible way.

In a busy and stressful work environment where people work for 8 hours in general, people can spare very little time for themselves during their work breaks. This is also the case for 1 day in general. For a person who sleeps for 8 hours on average and plays 8 hours, when we take the other time as they spend in transportation, there is time that a person can spare for 3-4 hours a day. A short slice today. Under these hours, they do not want people who want to play games to spend their time in this way, with high loading times or waiting for minutes from one scene to another in games.

When we look at children, their situation is a little different than normal people. Playing activities, which children are also curious about from an early age, should not go to a very different difficult level. Here, directing them to games with a simple interface that is easy to understand, simple to play and enjoyable, is a beneficial factor for their mental health.

At this point, the general purpose of this project, which was developed, is to relieve the stress and mental recovery, with the aim of relieving the high fatigue of the day, on their phones, which people almost never leave, during any break or on the bus, in the park or at home. And it aims to provide this time by opening the application immediately and starting the game as they wish, by designing a game that can be played at any time and any hour of the day, without spending extra time to learn the game.

Mobile Game Industry & Market Analysis

What is Mobile App?

Smart phones and tablet computers used by almost everyone have been one of the most important developments that have been experienced since computers came into our lives and have entered human life. These devices are generally called mobile devices and the software designed and developed to work on these devices is called "Mobile Application". Mobile applications are written in accordance with the "Mobile Operating System" used by mobile devices and can be downloaded from the application markets provided by each operating system.

There are many mobile operating systems available today. However, two of them have made an impact in the world in the last 2-3 years and are used by many mobile device manufacturers and mobile device users. The applications that will run on the iOS operating system developed by Apple and used in their own mobile devices are available for iPhone, iPod and iPad devices from the Apple App Store, and for devices using the android operating system developed by Google and used by many mobile device manufacturers and mobile device users, Google Play Store. You can get a mobile application from You can download mobile applications directly to your mobile device through these application markets, or, if permitted, you can download the mobile applications to your computer first and then transfer the downloaded mobile applications to your mobile device and perform the installation.

Mobile applications in application markets can be offered for a fee or free of charge, depending on the quality, content, feature of the service they offer and the request of the application owner. Free mobile applications can be downloaded and installed on the mobile device without paying any fee from the application market, and the application can be uninstalled and reinstalled when desired.

In June 2016, Apple announced that there are 2 million apps available on the App Store, and they have been downloaded 130 billion times since the App Store launched in 2008, generating nearly $50 billion in revenue for app developers. The total number of applications in the Google Play Store has long exceeded 2.2 billion. Here, too, the number of downloads has exceeded 50 million, although in a short period of time. Google Play announced that it earned about 92 billion dollars in 2022 revenues. This is an indication of how fast the mobile industry is developing.

Mobile applications in application markets are divided into categories to make it easier to find the desired application. Mobile application categories; We can give many examples such as news, games, music, banking, photography, sports, social networks, entertainment. The mobile application sought among so many categories can be found easily. Mobile devices can turn into an entertainment center thanks to the games available in the application markets. Also, games cover almost half of the game stores. Having a mobile version of the applications used and needed on computers means that this application can be accessed at any time. Thanks to these features, mobile applications are on the way to play a very important role in people's lives.

Hyper Casual Games

If we were to translate the term hyper-casual, perhaps the term we should use would be “very easy game”. Of course, this statement will not be enough to meet the hyper-casual game genre on its own, and sometimes it may even be wrong. It might still help us have an idea. In essence, this type of game aims to offer the player a "quick fun" with its gameplay based on one or two very simple mechanics and its non-tiring flow.

If you haven't heard of hyper-casual games, you probably don't realize that you may have played it at some point in your life. Games like Pong, Flappy Bird, or Pac-Man may have come across at some point in your life. Perhaps you recognized these names as soon as you saw them. It is very difficult to get up from these games. At this point, another feature of the hyper-casual type emerges.

The secret here is that hyper-casual games have a successful game design. These games, which have very easy mechanics, manage to keep the player by producing compelling and generally entertaining content at some point. The fact that the mechanics they use are easily learned by the players and the content they offer can be consumed quickly makes hyper-casual games "quickly entertaining".

Hyper-casual game mechanics

We said that the hyper-casual game genre includes one or two simple mechanics. But when it comes to the variety of these mechanics, there are multiple hyper-casual game mechanics. As simple as these mechanics are in terms of gameplay, they are also simple in naming. For example, "Tap and Hold" is a hyper-casual game mechanic. As it can be easily noticed, the naming is as plain and simple as the mechanics itself.

As you can see, here is a list of hyper-casual mechanics whose name can be understood simply as follows:

- Swerving mechanics
- Drag mechanics
- Tapping mechanics

- Tap and hold mechanics
- Aiming mechanics
- Tap and timing mechanics
- drawing mechanics
- Typing mechanics

To put it very simply, almost all of the mechanics of mobile hyper-casual games start with the simple logic of touching a point on the screen. Afterwards, the mechanics that diversify within themselves welcome us as “different functions of the same thing”.

The Future of Hyper-Casual Game Companies in The Industry

Hyper-casual game genre has the ability to reach too many players in a short time. For these reasons, the number of hyper-casual game developers in the industry is increasing.

Companies that make hyper-casual games should handle the unique features of hyper-casual well in order to get what they want from their games. The games that remain in our minds and still make a name for themselves today have basically two common points:

- Having simple gameplay mechanics
- Keeping the player in the game for long periods of time

We can say that companies that successfully handle these two basic points have managed to make a name for themselves. On the other hand, the popularity of the hyper-casual game genre continues in the world. It is also possible to say that the mentioned game genre is promising. In this case, the factors that will determine the success will be how well the developers know the hyper-casual type and how well they can process the data they have while presenting their products.

RuNNer Game Concept

Theme & Story

Since the aim of this game, which was designed under the title of Hyper-Casual game, was to entertain people and thus to relax people psychologically, many enjoyable elements were included in the user's viewpoint in the game.

In the game, in which the theme of "Nature" is handled in general, besides the presence of elements such as sea, island, mountains, sun, cloud, there is a ground where the player runs along a road called as if in a dream and small pieces of glitter flowing from this ground to the sea, a completely relaxing nature. theme has been followed. In addition, from the opening of the game, specially selected entertaining music contributed to these goals of gaining mental health.

The vivid colors used to support the main theme here, and the fact that these colors are chosen with a brightness that does not tire the eyes while the player is playing, allows the player to focus only on the game.

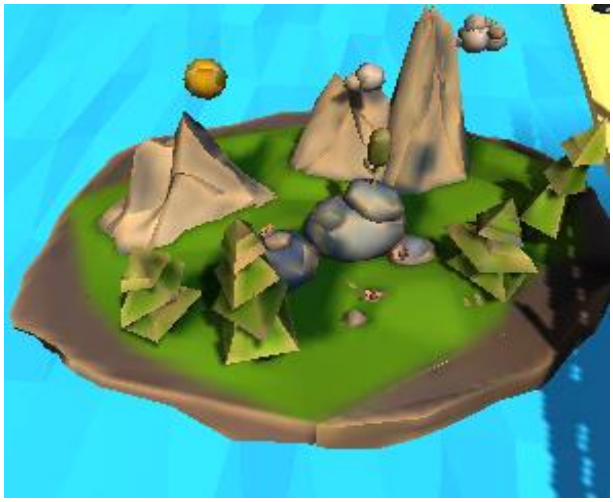

Figure 3.1: Island on the sea

Figure 3.2: Glitters flowing from the ground

The story of the game is to try to pass through this magical nature themed area across the floor. Here, in general, we will have a main character running constantly and supporting characters who will follow him. The aim of our main character is to collect as many friends as possible in the level and to eliminate these friends by escaping the obstacles they encounter throughout the chapter, by gaining numerical superiority over the enemies at the end of the chapter.

Game Mechanics

One of the most important mechanics I mentioned on the Hyper Casual Game Mechanics side, drag or deflection mechanics is used for this game.

These games focus on dragging your finger to avoid obstacles. For the most part, they are avoidance-based mechanics similar to rising and falling, but also focusing more on dexterity than timing. Diversion games make the most of touchscreen controls, so they're hard to remake on other devices. This gives them an original feel and cool use of the touchscreen.

What's important here is that the game focuses on the input accuracy of a player's finger dragging rather than timing a tap. The size of the object and the speed of the object have a great influence on what people can do with their fingers.

Just as sleight of hand games focus on correcting mistakes, diversion games need to focus on the sense of your finger's input. If the game is fun and close misses are felt, players will play longer.

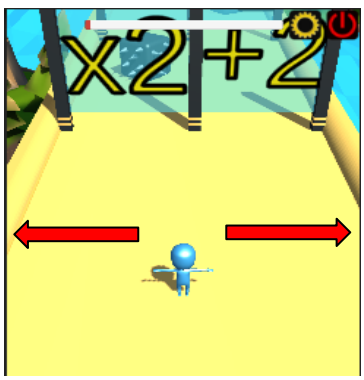

Figure 3.3: Drawing or Deflections Directions (Red Arrows)

In the game, the player has to move his main character along the floor in -x and +x directions in order to avoid obstacles or increase the number of side characters that will support him, depending on the situations. That's why the game needs user input as the scrolling mechanic. When the user swipes left and right while holding down the screen, the character starts to move in these directions [Figure 3.3].

Other mechanics used in the game are running and idle (Stop Position) mechanics. In these two mechanics, it is defined by the whole character and is the simplest basic mechanic to ensure the progress of the game. In the mechanics of running, the character is defined as a person trying to sprint at full speed when viewed from the outside, while the arms and feet move forward and backward in a coordinated manner with slightly bent forwards.

On the other hand, in the mechanics we call idle position, there are characters that are waiting. Here it is observed that the characters seem to be in a state of anticipation, waving their hands and feet intermittently, very inconspicuously.

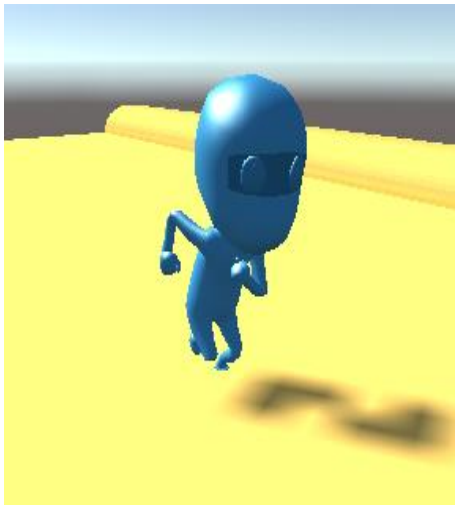

Figure 3.4: Running Mechanics

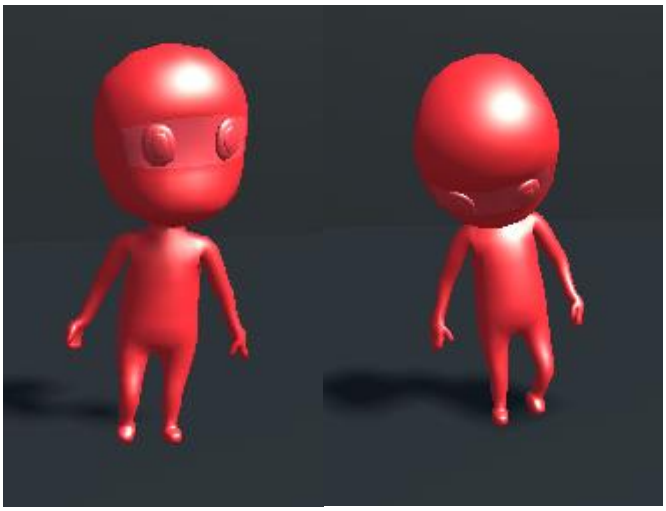

Figure 3.5: Idle (Stopping Position) Mechanics

Level Design

The design of the levels, which are responsible for the smooth progress of the game in Hyper-Casual games, is of great importance for the course of the game.

According to the researches, the levels (Maps) in the game stand out as one of the reasons for keeping the player in the game in popular games. In this context, perhaps one of the longest lasting works after the game has settled will be level design. While the levels are being designed, this job requires a lot of effort as the producer tests the game over and over after each change.

Since our aim in the RuNNer game is to entertain people and to relax psychologically, 10 different map designs have been made between each other, the difficulty of which is increasing slightly. When we categorize these maps, it is possible to divide them into 3 different difficulty categories as small, medium and large.

When we look at the small map design, the main purpose here is to make the player familiar with the mechanics of the game and what exactly the game is. These sections, which have almost no difficulty level and can be progressed easily, are among the sections where the player can be satisfied due to their shortness.

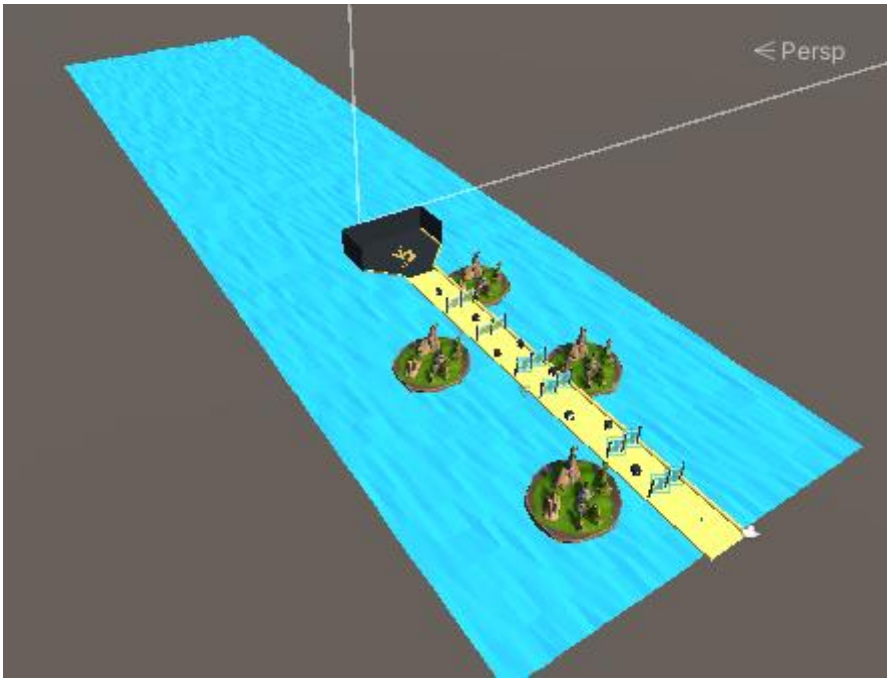

Figure 3.6: Small Level(Map) Design Example

In the medium map design, we can say that it is designed as levels where we assume that the player is now used to the game and we increase the progress one more step. Here the player is first shown some obstacles or mechanics that they have not seen before. Along with these, some dexterity may be required and it may be expected to make things easier by applying different tactics. In addition, the difficulty part has increased slightly and the end time of the game has increased by another level. In this method used, it is aimed to keep the player in the game more.

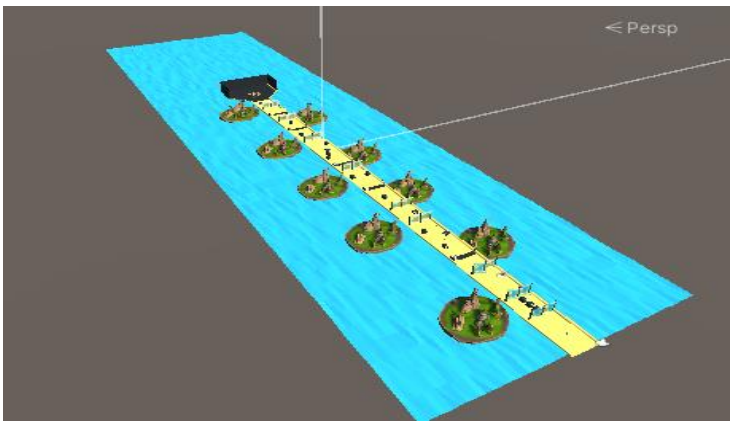

Figure 3.7: Medium Level(Map) Design Example

Finally, the first impression that will stand out in the Large map design may be the size of the maps. Here, it is assumed that the player now knows everything about the game, and one of the features of Hyper-Casual games is that they are games that can be adapted quickly. In this condition, the difficulty has increased a little more due to the fact that the game has the last levels. The player is expected to use the entire section in the most efficient way and to analyze the number of characters well. I think it is the mapler that the player is most enthusiastic about.

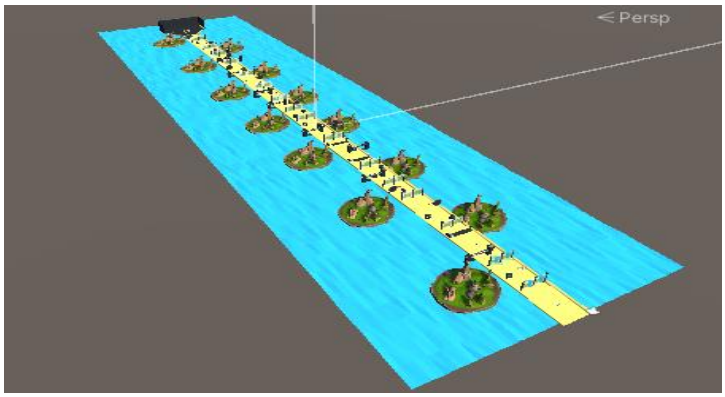

Figure 3.8: Large Level(Map) Design Example

Difficulties can be considered as a key to spending time in the game, since there are 10 levels in the game. For this reason, since it is aimed to spend more time in the game, the most optimal results were analyzed and these results were transferred to the Levels.

I mentioned that the difficulty increases with each level. These levels have been adjusted to be 10 levels from the beginning. In a way, it is designed to support the player in order not to tire the players. No separate program was used to design the levels. I designed it completely again using the structures I created in Unity Editor. As for the difficulty level, for example, when we compare the difficulty levels in a game with 100 levels, I fit this difficulty to 10 levels.

During the design, the advantages that the player can use were taken into consideration. Questions such as places where he can escape, whether there is a place he needs to act suddenly after getting support or whether this is determined or whether the user can use a bug are handled one by one.

Levels have been tested by me many times. In order to see if the game can be passed by another player other than the one I developed, I watched a friend and my brother, who are closest to me, what moves he could do by playing these levels, and analyzed them as well. I saw that they had difficulties in some levels. I wanted them to play these types of levels over and over again. I have identified the problem they are constantly experiencing in the same place and I have performed the designs here again. Thus, I have processed the best result to each level. In the last level, of course, the game may be a little difficult. However, the tests here have been made and are in a playable condition.

Technical Infrastructure

Platform & Development Tools

What is Android OS

Android is one of the most used operating systems in the world, developed by Google. This operating system is used on mobile phones and tablets. It uses the Linux operating system kernel. Thanks to this feature, it enables mobile phones and tablets to be used in many ways. Android is an operating system created by Google and Open Handset Alliance. Developed for mobile devices. It has an open source operating system. Some parts of the codes are kept closed by Google. It has a large group of developers who write applications that enhance the functionality of the devices. There are currently more than 200,000 applications in it.

Figure 4.1: Android OS Logo

Android supports the ".apk" app extension. The people who developed this operating system have written this system using the Java web programming language. It is built on the Linux kernel. That's why middleware language, API and libraries are written in C programming language. Application software also runs on an application framework that includes Java compatible libraries. This operating system has extensive program developers working for the development of applications that increase the functionality of the devices.

The factor that introduced this system and made it so widely used is that it is a platform that changes what mobile devices can do. It supports phone, tablet, automobile, watch, television. This system is behind the communication and technological devices that go beyond simply working and make life easier. Thanks to this system, Google Assistant can answer questions, the watch can send messages and more. Today, this operating system is in more than 2.5 billion devices.

Android Development

- It said hello to mobile devices with Android 1.0. This version supports camera, bluetooth, web browser, alarm clock, gallery, Wi-Fi, gallery etc. defined features.

- The development of Android continued and it released version 1.1 on February 9, 2009. This was created with the aim of fixing system bugs in the previous version.

- The development of Android continued and version 1.5 was released on April 30 of the same year. Bluetooth support, camera recording, predictive keyboard, etc. brought features to mobile devices.

- The development of Android continued with the release of 1.6 version in September of the same year. This version has increased the screen resolution, started to make accurate translations and multi-delete etc. in the gallery. features have arrived.

- Versions 2.0 and 2.1 were released in October 2009. Animated wallpapers, virtual keyboard and high screen resolutions have arrived.

- The development of android continued with the release of 2.2 version in 2010. This version has brought 720p screen resolution support and USB connection support.

- In February 2011, version 2.3 was released and multi-touch support was introduced.
- On the same date, the development of android continued and version 3.0 was released. This operating system is made compatible with tablets.

- Version 4.0 was released in October 2011. Face recognition functions have been added.

- As of July 2012, version 4.1 is on the market. It was introduced with energy efficiency and the ability to open two applications at the same time.

- In October of the same year, version 4.2 was released. 360 degree panoramic photography feature has been added.

- Version 4.3 was released in July 2013. Parental control, automatic Wi-Fi technology, smart bluetooth technology that can be connected to other technological devices have been added.

- In October 2013, the development of android continues. Version 4.4 has been released. Many changes have been made to the visual interface.

- Version 5.0 was released in November 2014.

- In December 2014, Google released the 5.0.1 update.

- In August 2015, Google released version 6.0.

- It released version 7.0 in 2017.

- In August 2018, the development of android continued. Google introduced the 9.0 version to us on this date.

- Android 10 Q versions were released in 2019, followed by 11 R versions in 2020.

- Android 12 was released on October 4, 2021. This version comes with a new interface called 'Material You' that can dynamically change color according to the wallpaper you use on your device, while it comes with features such as Field magnifier, Extra dim, Bold text and Grayscale in the Accessibility area. In the security area, Android 12 comes with a number of additional features where you can let apps access your exact location or approximate location, while lively notifying the user if any app accesses the camera or microphone while it is active.

- On March 7, 2022, Google released Android 12L. It was an interim update with improvements specific to foldable phones, tablets, desktop-sized screens and Chromebooks, and changes to the UI to adapt Android to larger screens. It was released as 'Android 12.1' on devices such as Pixel 6.

- On August 15, 2022, Android 13 was first released for Google Pixel phones. Now, with Android 13, a different language setting can be made for each application. To protect the information on your clipboard with a host of new privacy options, the system will alert you when an app accesses the clipboard and ensure that your clipboard history is deleted after a while to prevent unwanted access.

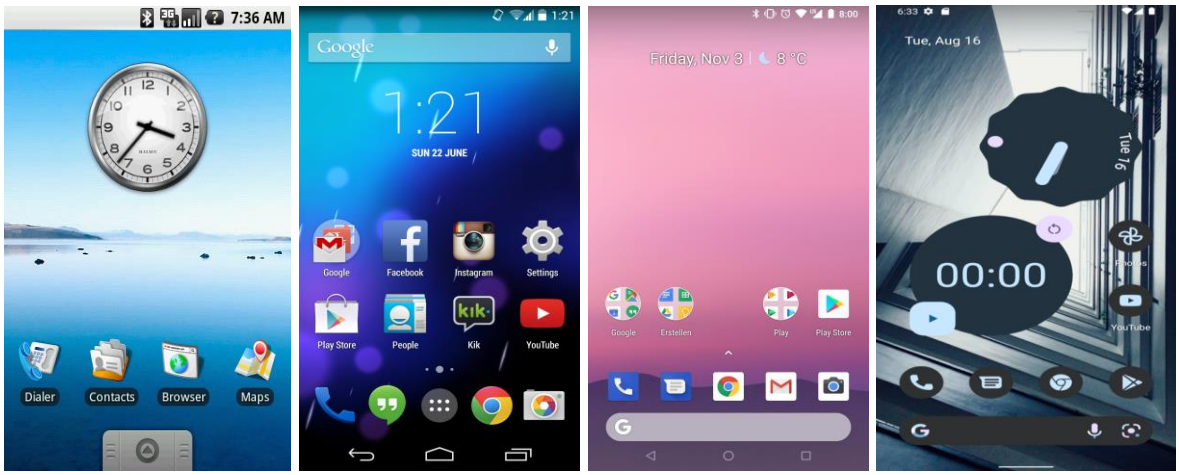

Figure 4.2: Android 1.0 / Android 4.4.2 / Android 8 / Android 13

Unity Game Engine 2021.3.20f1

Unity is the world's most popular game engine, developed by Unity Technologies, containing all the necessary components to build a game from scratch. Unity, which can be used on different platforms, works compatible with Windows, Mac, Linux and mobile operating systems.

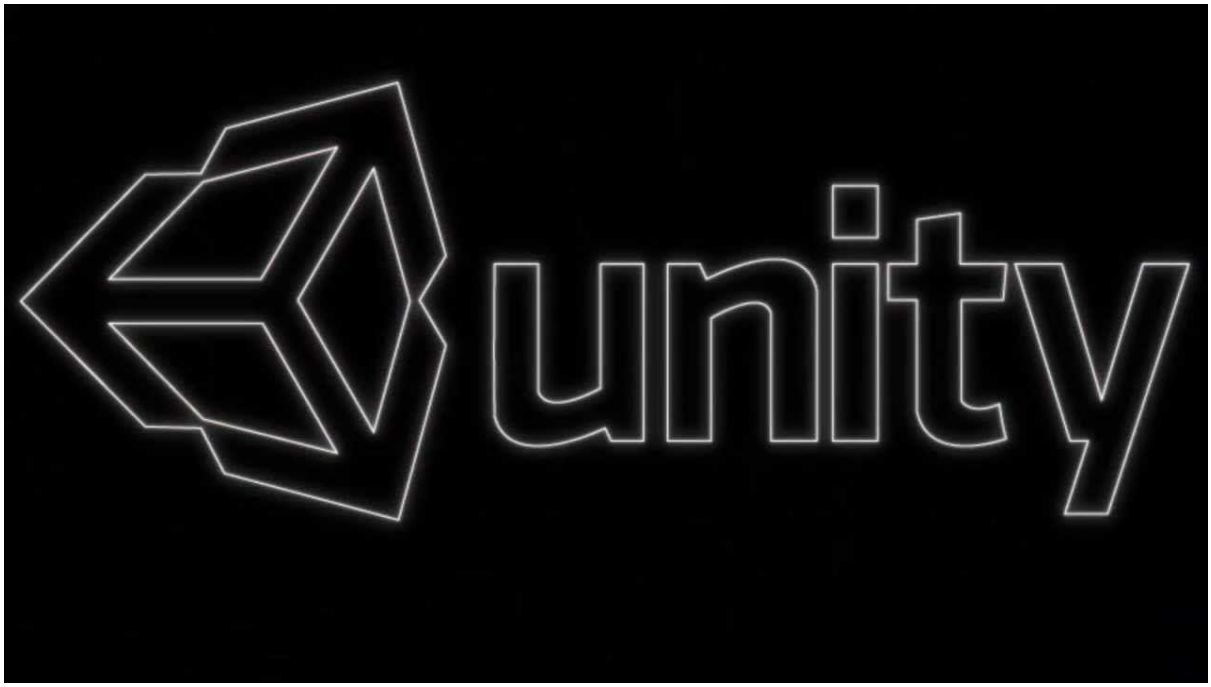

Figure 4.3: Unity Logo

The Unity game engine has been adopted by many different industries. Offering cross-platform game design and development, Unity is a game engine that will make almost any game. It's free and very flexible. Highly professional games can be created with Unity.

Scripts can be edited using the C# programming language, but it is still possible to develop games in Unity without having to deal with a lot of code. So these games can be developed using Unity with much less code.

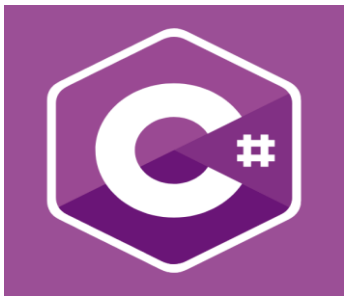

Figure 4.4: C# Logo

Features of The Unity Game Engine

- Graphs are easily created with Unity's drag-and-drop functionality.
- Scripts are edited using the C# programming language.
- It supports APIs such as Direct3D, OpenGL, OpenGL ES, WebGL.
- Allows importing Sprites in 2D games.
- Allows specifying texture compression and resolution settings in 3D games.
- It enables bump mapping, reflection mapping, parallax mapping, dynamic shadows and texture rendering in 3D games.
- Android, Android TV, Facebook Gameroom, Fire OS, Gear VR, Google Cardboard, Google Daydream, HTC Vive, iOS, Linux, macOS, Microsoft HoloLens, Nintendo Switch, Oculus Rift, PlayStation 4, PlayStation Vita, PlayStation VR, Samsung Smart TV Supported on platforms such as Tizen, tvOS, WebGL, Wii U, Windows, Windows Phone, Windows Store, and Xbox One.

Figure 4.5: Unity UI

Why Unity & The Advantages of Unity

Unity is one of the most popular game search engines. Games that currently reach more than 500 million players around the world were created using Unity.

Companies and game developers use Unity in their projects. So why develop games with Unity?

Access to Free Version: Unity is available in both a free and professional version with a variety of features. One of the biggest advantages of Unity is that you have access to its free version. This version includes many functional features such as advanced shader software, animation editor, physics engine. This gives novice developers access to Unity. Feature playback, 3D composition booster, audio channel, etc. Features such as are available in the professional version.

Multi-Platform Compatible: Unity game development engine is compatible with almost all operating systems such as iOS, Android, Mac and Steam. It allows to recompile the same game playable on desktop, mobile, web or game consoles without the need for infrastructure changes. It is very easy to design professional games that work on all platforms using Unity.

Figure 4.6: Supported Platforms of Unity

User Friendly: Unity is easier to use compared to other game development engines. C# or JavaScript is used for scripting in Unity. These are languages that are easy to learn and use.

Large Community: As with programming languages, game development benefits from the support of the developers community. More than 2 million developers are developing games with Unity and the community is growing by the day. Developers can take the support of the community or easily find a code they are looking for on the internet when they encounter any problems.

Rich Asset Store: Unity asset store (Asset Store) allows all developers to display characters, backgrounds, buildings, sounds, scripting languages, pre-designed 3D models, etc. It is a place where they can meet their gaming needs. Developers easily purchase them through the asset store. These pre-designed assets are included in the game using drag and drop. In addition to all this, the Unity asset store offers music artists and craftsmen the opportunity to earn more money.

Multiplayer Game: Some of the most played multiplayer games today were developed with the Unity game development engine. Unity simplifies all game development processes.

Debugging: Errors encountered during game development with Unity are easily detected. This reduces the error rate and makes debugging easier.

Graphics & Animations

Graphics, which are indispensable for games, play an important role in the Hyper-Casual game category, as in every game. The graphic qualities that every player seeks in games have become an important element for the enjoyment of the game.

When it comes to Hyper-Casual games, it is possible to say that graphics fall into the 2nd plan among other game categories. Because when we defined Hyper-Casual, we explained that it is a category that means "Simple and Plain". It is for this reason that the gameplay of the game is of greater importance in this category.

In this game, the graphics part has been redesigned by calculating how much each selected object can meet the needs. Because it should be an "Arcade" game in the game category, and as mentioned before, the goal is to appeal to a multiplayer audience, to ensure that the game works comfortably even on minimum phones in the supported Android version.

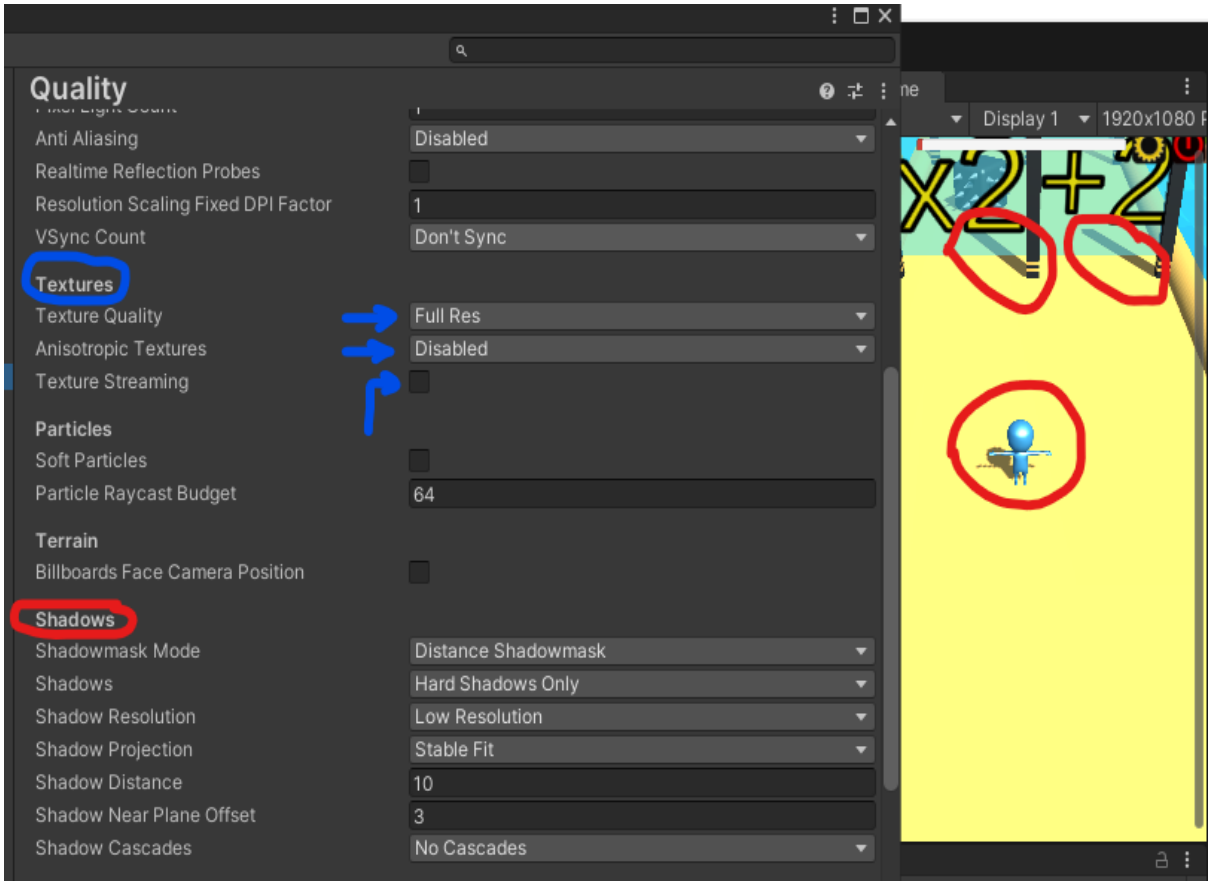

Figure 4.7: Graphics & Quality Options (Including Shadows) on all objects

For example, it was calculated that the island object in each Level does not have any business with this object and since the player sees this object for about 5.5 seconds, it is calculated that it will not attract much attention, and the "Max Size" item has been reduced to around 128 Bit instead of 2048. In this way, we have ensured that the game looks the best in terms of graphics and gets the maximum performance.

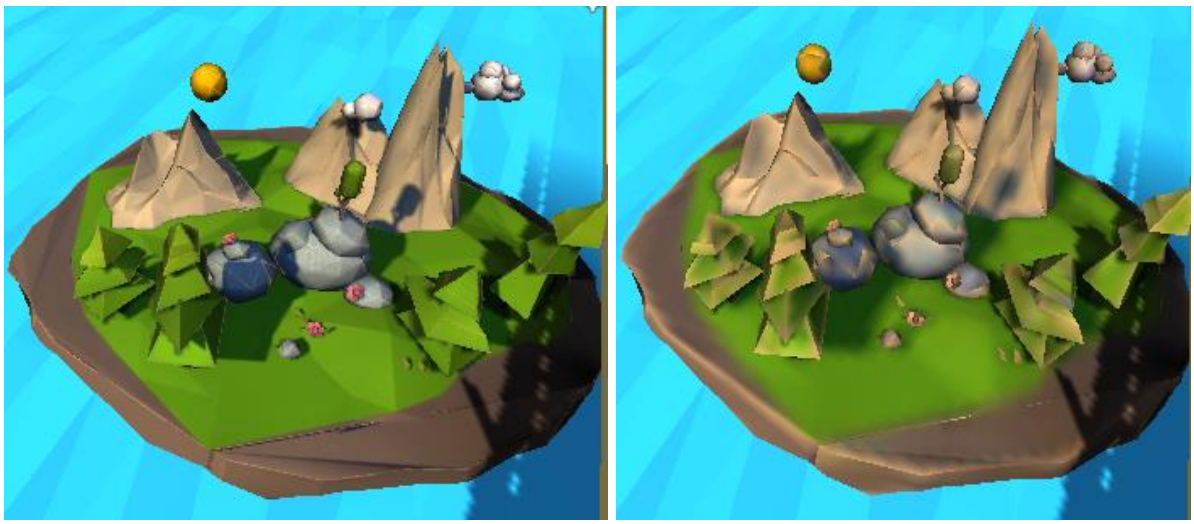

Figure 4.8: 2048 Bit Island Object & 128 Bit Island Object

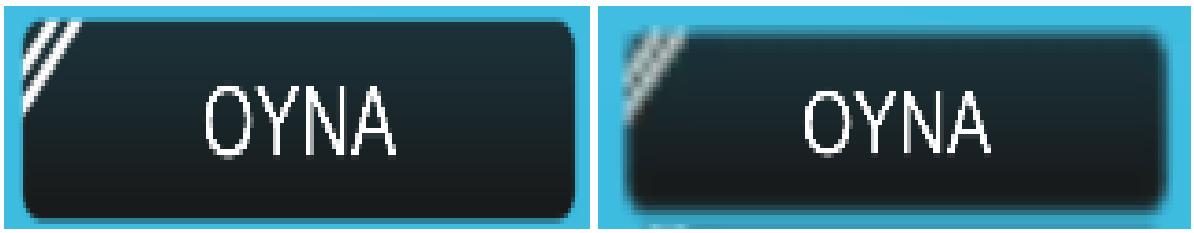

Figure 4.9: 256 Bit Button Image & 64 Bit Button Image (64 bit is very poor quality so 256 is the best choice)

In the “Animation” part, maximum efficiency was taken as the target. Sufficient animations are of course provided to satisfy the players. Every element, from the simple particle system in the creation and destruction of the characters to the ripple animation in the sea theme, has been calculated down to the last detail. The effect of these calculated animations on our performance was checked after each change. For the best results, the FPS tools included in Unity were also used.

An animation system was designed again and again with all the data obtained. Especially the most used animations in the game were studied in more detail. For example, the running of the characters is also considered an animation. Or that the angle of the camera changes after a while is also an animation. All these features affect the performance of the game.

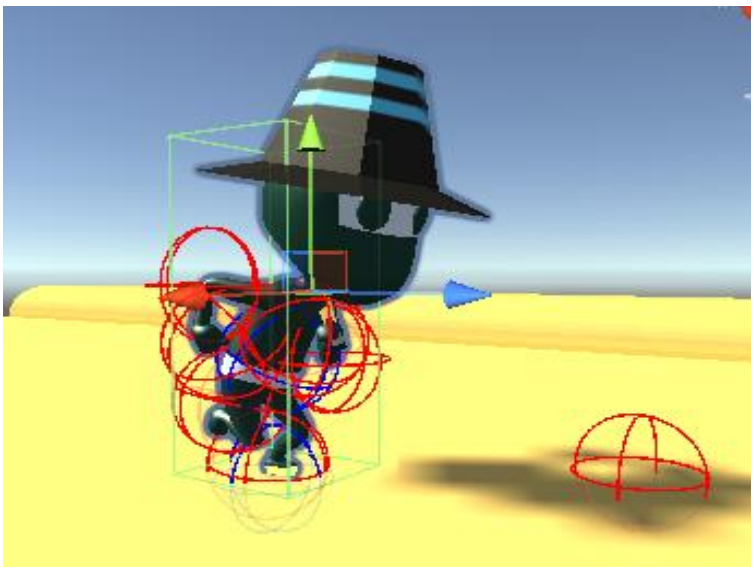

Figure 4.10: Calculating Animations of Run with Every Angle (Including Gravity)

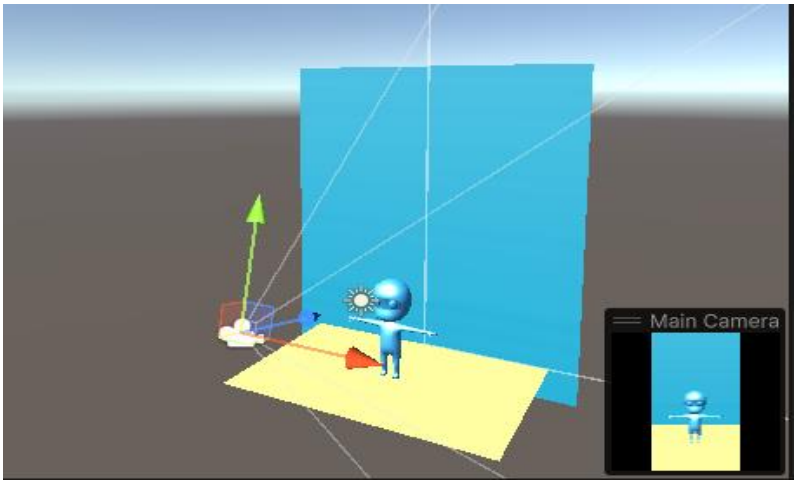

Figure 4.11: Camera Phase Angle Animations

Sound Effects & Music

Publishers are forcing most developer teams to use audio in their games. Developers are now much more aware of the impact of sound in games. That's why we see specially designed voiceovers in most games, even if they are hyper-casual.

The sounds used throughout the game have been specially chosen since they are intended to entertain and not bore people, especially due to the subject matter. It is possible to say that for users who want to play with headphones, these sounds are brought to a 3D helix in special environments and the sound performance is maximized in such a game.

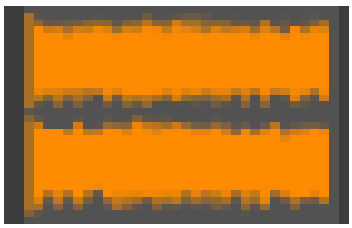

Figure 4.12: Game Sound Infos (Image is blur because of its include some important parts)

If we talk briefly about the sounds used, even in a very simple game like Mario, a separate sound effect has been used for each movement, without making the sound simple. In this game, however, we avoided adding a sound function to any movement in order not to worry the users. For example, the sound of running or stepping was not added to the game because 95% of the game the character is running. But even in the background of the characters being born or the sounds of the buttons or even on the menu screen, fun sounds were chosen, and in this context, the sounds added a different atmosphere to the game.

In an environment where the sounds are this good, of course, the sound level is also important. Necessary adjustments are made in the selected sounds, and there are volume up and down settings for users who want to turn the volume down separately within the game.

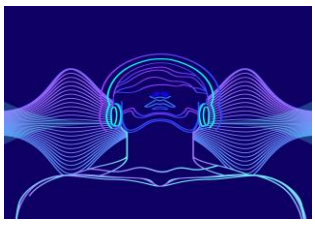

Figure 4.13: 3D Sound Technology

Project Development Process

There were some steps in this project, which was developed in the planning of the project development process, which is an important issue for every project.

After the main subject of the project was determined, some researches were made about the platform to be developed. It was seen that the development of the game on the android open source base was appropriate. After that, the subject of the game to be developed was determined. Then it started to be developed step by step.

Installing Programs

The most suitable platform was searched to prepare the environment where the project would be developed and it was decided that the platform would be Unity Game Engine. After this stage;

- Game engine started to be installed.

- After installing the game engine, the necessary packages (Assets & Store) for the game were installed.

- In addition to designing the game, it was decided that Visual Studio was the best program for editing the script that would be in the background. This program showed that Unity was the best interoperable program on its site as well.

- The Visual Studio Program was installed. Then, necessary arrangements were made in order to integrate with Unity Game Engine. If these edits were not made, it was an important issue as the code suggestions would not be made by Visual Studio at the time of writing.

- With the Installer included in the game engine, the Software Development Kit (SDK) packages of the platform (Android) on which we will run our project were loaded and integrated into the Engine.

Design and development stages

In the development part of the project, many processes were passed. Starting from the most basic issues, it was decided what was needed after each stage and steps were taken in that context. If we talk about the steps;

- *The main character was created:* Since our main character will actually be among the main character Assets in the game, in this context, he went through a comprehensive design such as hand-foot-shoulder-leg.

- *Ground created:* After the character was created, we needed a ground to test our character on. We made some modifications on a floor model included in the unique packages of the Unity engine and made it more beautiful and placed it in our game space in a certain size.

- *Artificial Intelligence System:* It is assumed that starting the installation of the artificial intelligence system in the game early will have minimal errors due to the correction of many errors related to this system in the later stages. For this, the artificial intelligence system was integrated by making calculations on the ground.

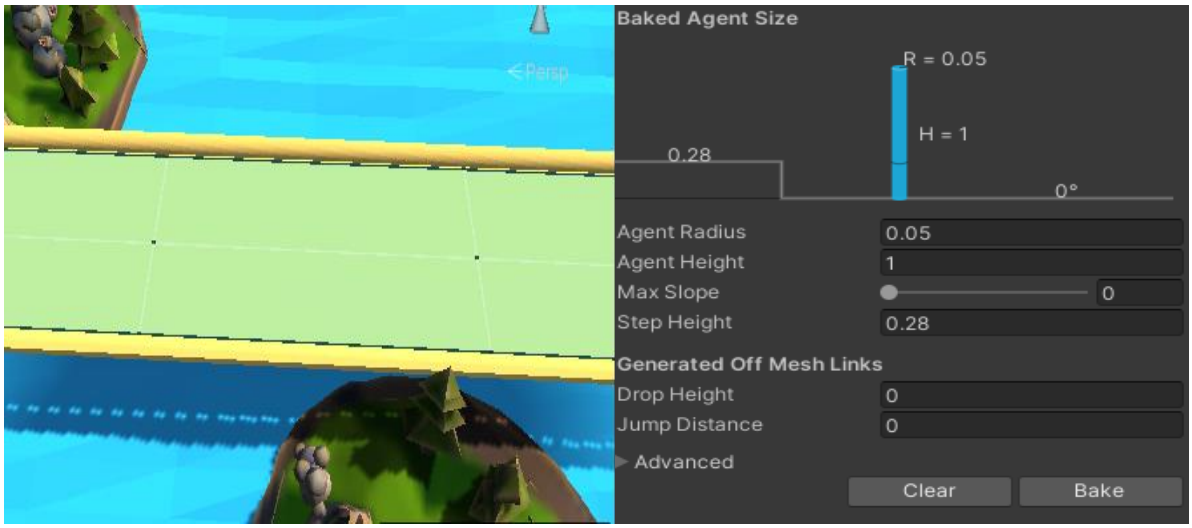

Figure 5.1: Constructing & Calculating The AI System on the ground

- *Supporting Characters:* Since these characters are generally from the character class, they were presented to the game as a copy of the main character created. In this context, it was integrated with artificial intelligence, which was developed to follow our main character in a more scattered way rather than following an army order. Then, these operations were positioned on the main character and the necessary operations were completed.

- *Numerical Blocks:* After the auxiliary characters are installed, the designs of the numeric blocks in which their number will increase or decrease were made. The aesthetic images of these blocks, consisting of 3 flat bars and 2 panels, were arranged and made ready by giving color materials.

- *Operations of Numerical Blocks on Side Characters:* Here, the numerical operations (Addition, Subtraction, Multiplication, Division) functions to be performed when our main character passes through according to the number of instant characters are designed and these functions are integrated into the "Text" part of the numeric blocks.

- *Designing the First Obstacle:* The first obstacle was designed in the obstacle system to bring a challenge to the game. Here, a shape was designed with a cube and a few needles around it. Although it was originally designed to have needles on only 2 surfaces of the cube, these needles were placed on all faces in the future.

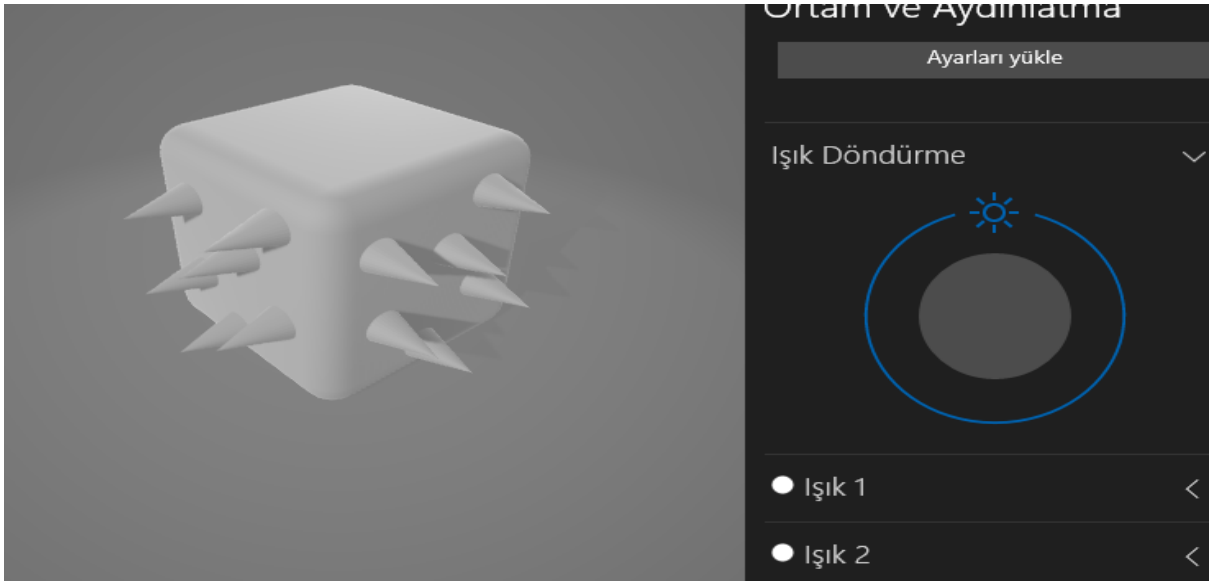

Figure 5.2: Designing First Obstacle “Box with Pins”

- *Construction of Other Obstacles:* When the first obstacle was built, it was decided to design the other obstacles that came to mind while the game was being developed. In this context, the development process of the game has completely stopped and it has been completely focused on the design side. During the construction of other obstacles, attention was paid to keep the obstacles a little more professional by the developer.

- *End-of-Level Scene Design:* In the game, where the pieces slowly started to fall into place, the design continued again. While designing the end of the level scene, which will represent the end of the levels, care was taken to make a simple and understandable platform where the colors would not be overlooked. Added a "vs" sprite after the scene was designed.

- *Adding Vagrant Characters:* The design of the numeric characters scattered in the Levels, which will help the player during the game to motivate the player, can be increased even if they do not pass through the numeric blocks. Here, separately, these characters were given a gray color and effects such as standing position were integrated.

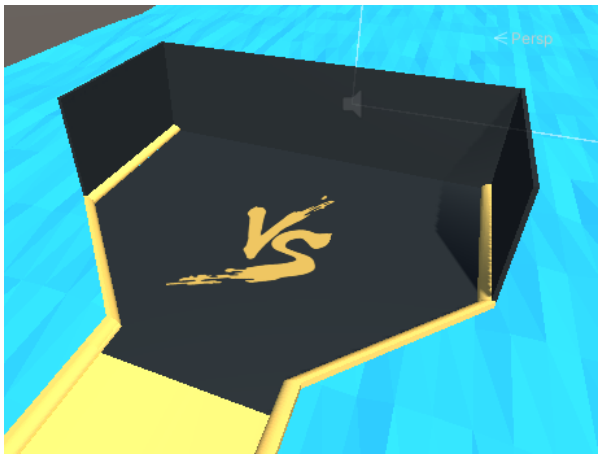

Figure 5.3: The End of The Level Platform

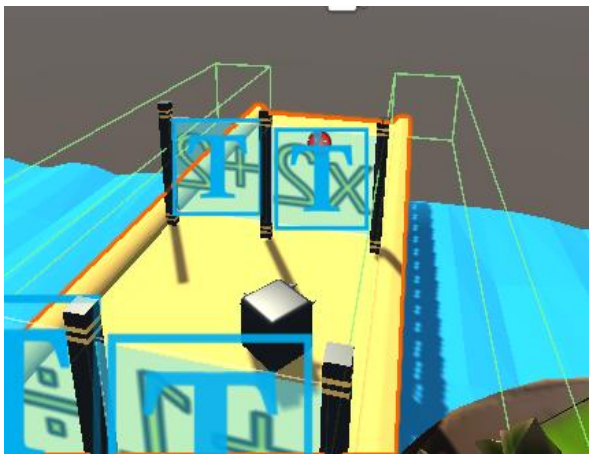

Figure 5.4: Box Colliders next to the ground to prevent the character from falling off the floor

- *Arrangement of Game Sounds:* The selection of the sounds to be used in the game and the modifications of these sounds to suit the game have been made. The point to be considered here is that the tones are given to make the player happy by having fun, and the volume levels of these tones are such that the player is too tired. After checking such issues, these sounds were integrated into the panels opened in the game, making the project more lively.

- *Slider and Point System Setup:* A long bar has been designed throughout the game so that the player can see how much time is left until the end of the level while in the Level. After the necessary technical processes of this bar were done, procedures were made regarding how many points will be earned at the end of the levek. As for what the earned points were earned for, the player would be able to buy the items they wanted from the store with these points.

- *Main Menu Screen Design:* From this moment on, the design of the menu and screen panels rather than the design of the game was entered into a period of time where the design would take the longest. After deciding exactly which options will be on the main panel, the design of the buttons and the general view of the main menu screen began to be drawn and the panel was made ready.

Figure 5.5: Slider on the top of the screen

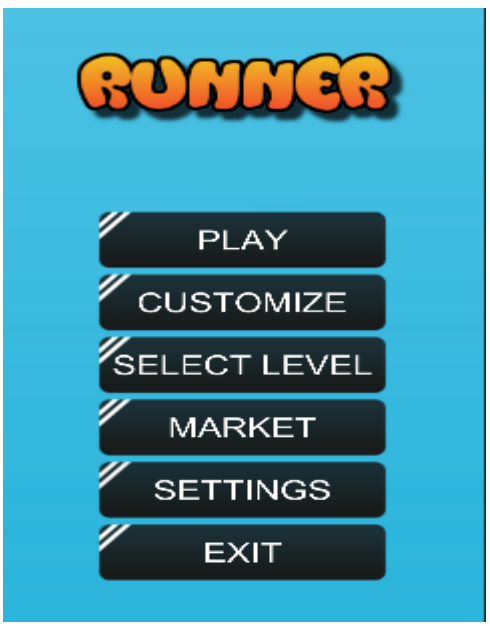

Figure 5.6: Main Menu Screen of RuNNer

- *Design of Other Menus on the Main Screen:* Designs have started to be made within the options determined on the main screen. There was also a need for the design of the items that the player could buy, so some superficial clothing designs such as hats and colors were started for the character. A big part of the project was the design of the items here and adjusting how the purchases here would run in the background. After the order in these places was established, about 80% of the game was completed.

- *Installation of File Read-Write Infrastructure:* A file system was needed to keep information in the game. Among this information, there would be information such as the player's instant score, item information, purchase status. In order to control this system, some adjustments were made on the editor side and the files were created while the game was running.

- *Integration of Settings and Multi-Language System:* Although the game was originally designed in Turkish, the English language had to be added. In this context, editorial and script operations were carried out. Keeping the language data on the script side was prepared with a draft called the array-in-array method and the data was entered here. Then this data would be kept in a file and the game would control reading and writing operations from this file. After the English language settings were made, this system was integrated as an option in the Settings menu.

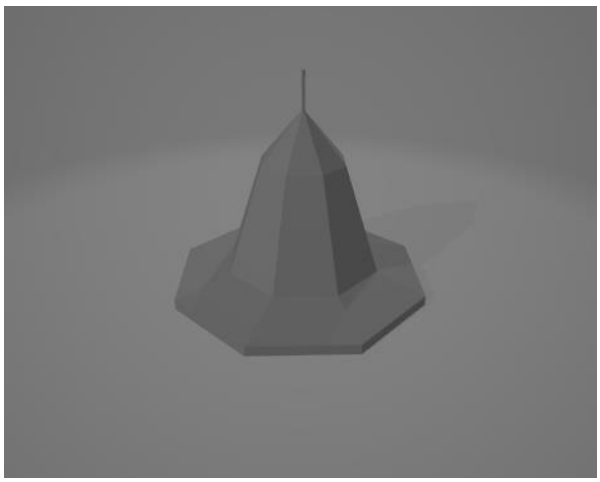

Figure 5.7: Item Design

Figure 5.8: Game Files

- *Win-Lose Panels:* In these times when the game is now in a certain order, work has begun on the construction of win-lose panels. With a green themed screen when you win, and a red themed screen when you lose, it's easy to understand exactly what the result is. With the options in each panel, options such as replaying the game or returning to the main menu were presented to the user. As a result of the design, these panels were integrated into the game.

- *Loading Screen Design:* When the game is loading or when there is a situation that the user has to wait, a special panel has been designed with a screen such as the loading screen to inform you that the game is currently performing an action and that the player should wait. In this panel, the loading data was synchronized with the game data, providing a real environment and integrated into the game.

- *Level Design:* In the level design, which is the last stage of the game, it was decided to have a total of 10 levels in the game. These levels can of course increase. The infrastructure of the game is built on this and is ready. In the level design, it was designed by taking into account the level of difficulty that the game should have in general, and these levels were successfully added to the Built settings. For more information on level design check [Level Design]

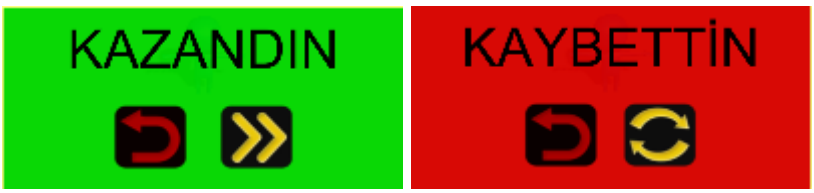

Figure 5.9: Win-Lose Panels

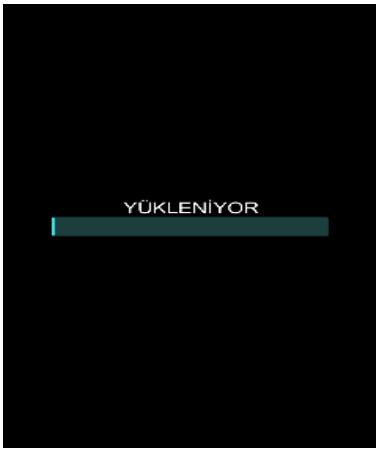

Figure 5.10: Loading Panel

- *Adding Google AdMob Ads:* Advertisements were added in the game with the aim of earning income for the developer. Two types of advertisements are used here. The first one is an interstitial. This type of ad appears at the end of the level and displays ads based on the user's interests. The data collection obligation here belongs entirely to Google and has nothing to do with the game. The second type of ad is Rewarded ad. This type of ad is the type of ad that the player must watch in order to earn more points at the end of a level. The integrity of the advertisements shown here also belongs entirely to Google.

- *Design of the Market Section:* This is the place where the player will apply if he needs extra points to buy items in the design of the Market Section. According to the desired amount of points, the player can add points to himself. After the design of this place was made in the editor, a Google Package was added to unity and the necessary product operations were made on the script side. About ads[Advertising Models]

Figure 5.11: Google AdMob Logo

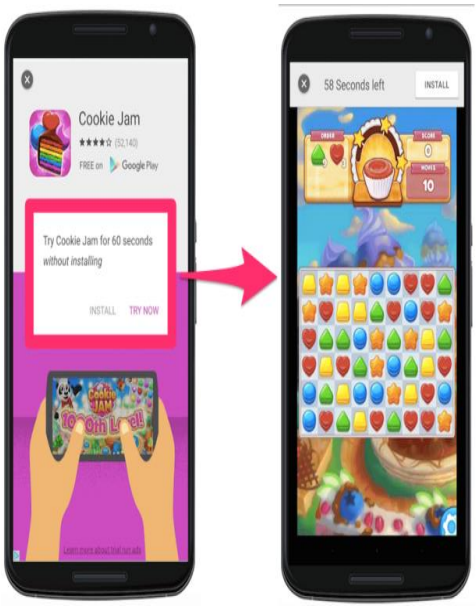

Figure 5.12: AdMob Example

Figure 5.13: Market of RuNNer

Test & Optimization

While a project is being developed, it is tested over time whether this project is at the expected level. If it passes these tests, the project will go forward by taking one more step. Especially in a game development project, the testing factor is much more important. Because a glitch anywhere is not welcomed both by the player and by the course of the game, and it causes a sudden drop in the market and bad comments.

While developing the RuNNer game, each step forward in the game has been tested repeatedly and on all possible possibilities. Although it may seem like an easy process at first, it contains many different functions. The infrastructure, which was established at the very beginning of the game's development phase, becomes more complex as the project progresses. Of course, there may be problems that are overlooked in the meantime. These problems may get bigger in the future and may cause sudden shutdowns of the game (Crash) or some reversible or irreversible errors (Bug) encountered during the game.

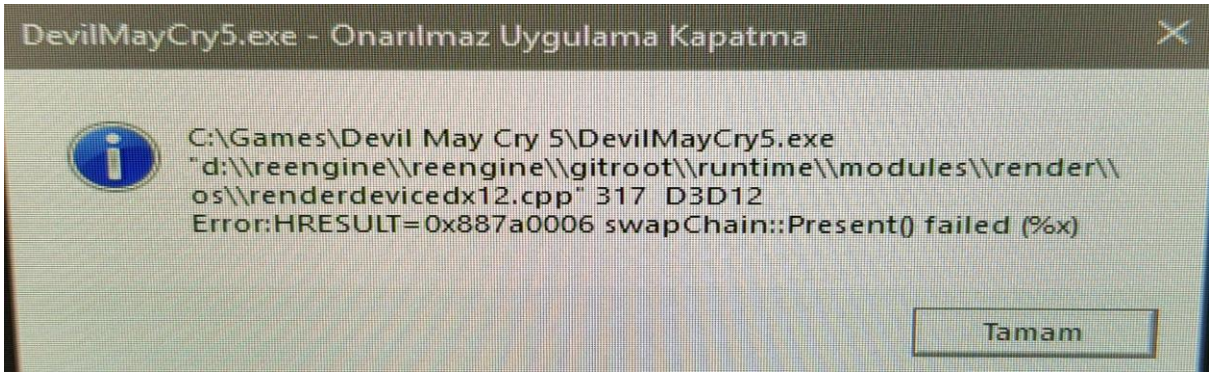

Figure 5.14: A Crash Error Example While Gaming

Figure 5.15: An incorrect character model that is invisible because the character's Mesh object couldn’t loaded.

The Assassin's Creed Unity game, released in 2014 by the world-famous game development company Ubisoft, has gone down in history as the game with the most bugs in the series by the players. It was also reported to the game by the players that the players could not play the game or had difficulties in playing the game due to the bugs they encountered. Because of this, the market share remained low compared to the other series, with the overall bad reviews for the game.

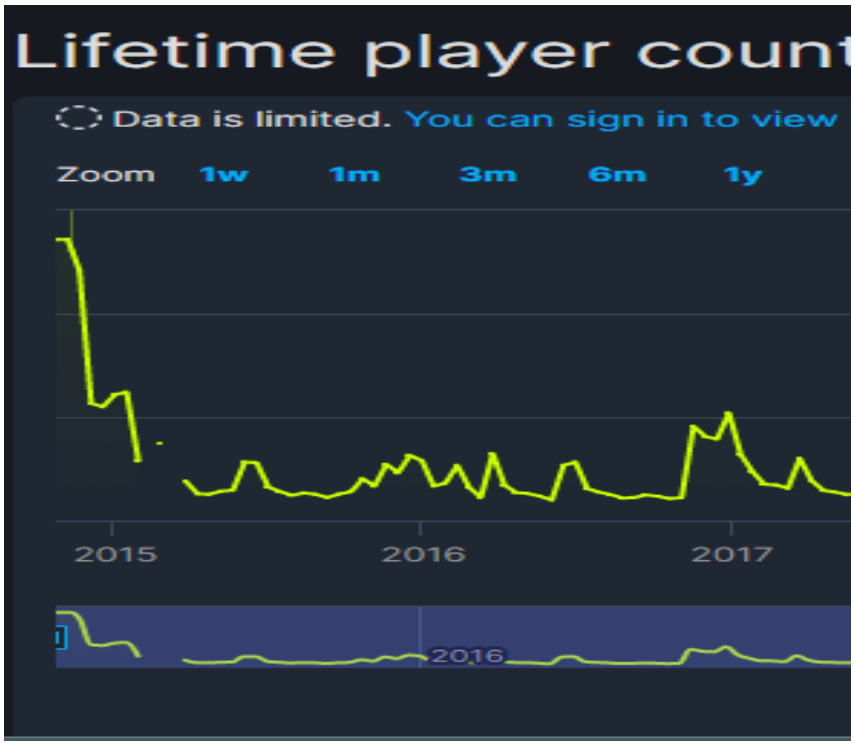

Figure 5.16: The suddenly decrease in market share due to too many bugs since the first release of Assassin's Creed Unity game (Steam Game Platform DB)

In order to minimize such problems, each function added during game development or after each change should be checked before proceeding to the next step. The number of tests carried out during the development of the RuNNer game has been so high that it is not possible to give an exact number. But of course, this is one of the main rules of game development.

Many things have been overlooked or skipped during these test sequences, and it has been explored many times how to fix these errors. Even in the final version of the game, many errors were encountered while the game was being built on the mobile platform. One of them was that the Google AdMob developer ID was not included in the game, and the game suddenly crashed while running. It took about 3 days to solve this problem. Although it is a very simple process, it is obvious what big problems this small detail causes.

The dictionary meaning is to do an event or situation in the best or most effective way. In other words, it is optimizing. The word "Optimization", which is used in many areas, has no different use in the game world, of course. We can say that the concept of optimization, which is often intertwined with the "porting" pattern, is the revision or adaptation of the games for the existing computer hardware during the programming phase. This word is used directly for a game written for a computer, as well as for games translated from consoles to computers. For example, as many game lovers know, when converting a console game to computer format (Windows, MAC), the core of that game is reviewed and edited for up-to-date computer hardware. The result is a computer version of the production in question.

In the RuNNer game, the progress of the project was paused in some regions and the optimization stages were included in the project-based progress step-by-step. The things that are generally checked here were first of all, how to simplify the script of the game or how to make a function work more efficiently. For example, using too many if or else statements in a function on the script side will make the game run slowly on the runtime side. In addition, in cases where many functions actually do similar jobs, bringing them into a single function will introduce the concept of overloading, so that the system will work more stable and efficiently.

One reason why the optimization issue is particularly important in this project is that our goal is to ensure that the game can run on all phones with the supported platform and version. In order to gain as much performance as possible in this product, which is produced for this purpose, optimization processes are frequently included both on the editorial side and the script side. Here, while the project is being developed, the elements such as removing the confusion have been examined and studied in a clean way for the convenience of the developer.

It is useful to explain the importance given to the optimization part of the project as follows. In general, most vital functions and operations are dynamically designed in the project. Hyper-Casual games need to be developed frequently in order to take a place in the market as all their features are consumed by the players very quickly. At this point, when extra features are wanted to be added for the RuNNer project, these features can be easily integrated on the dynamic structure without much effort. As a result of this clean and

optimized work, the existence of such floors is very important for the development of the game.

Monetization

Advertising Models

There has been a study on the use of advertisements in the RuNNer game, as in most android games. As always in the mobile advertising industry, which has developed in the last 6 years, Google has managed to take over the market quickly.

During the game, the player wants the game not to be interrupted even a little bit. The fact that the player is constantly exposed to advertisements every time can bore him or make him angry. Since our goal is to entertain and make the player happy, a general study was made on the game in order to minimize the advertising levels in the game. For these reasons, 2 ads have been added to the game. These are as follows

Interstitial Ads

There is a counter in the background while the game is playing, and this counter displays an advertisement at the end of each level starting from the 2nd level, offering suggestions about a genre that the player has previously searched on Google or any application. Google provides this data entirely from cookies and we do not have a data flow related to this subject. In general, in order not to bore the player, advertisements are set to be skipped directly or skipped after 5 seconds.

Rewarded Ads

This category of ads is generally helpful ads that help the user reach their desired goals in the game faster and achieve this goal by giving more points. However, these advertisements can also be given outside the player's area of interest with a random method. The general viewing time for such ads is between 15 and 30 seconds and is determined entirely by Google. If he/she watches the entire ad, the player will be rewarded instantly.

Income Analysis

According to the agreements provided by Google, a certain fee is provided to the developer for each ad watched. For 2 ad types used in this context, even if the game is not in the Google App Store, income transfer will be provided when you play the game and watch the ads with the apk file. The analysis monitor of the Google AdMob application is used to analyze these revenues. This analytics monitor is only accessible to the developer. The developer can give this right to the people he/she allows when he/she wishes.

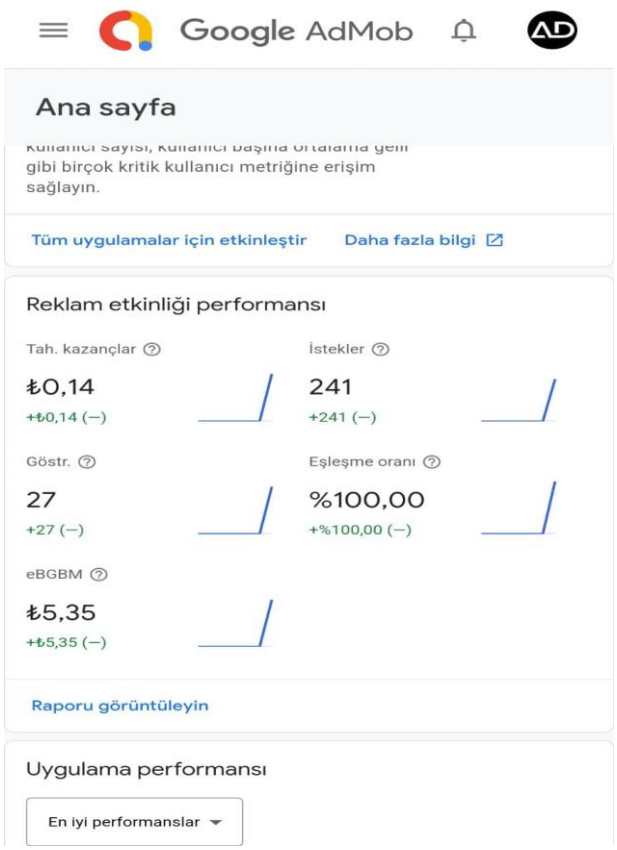

Figure 6.1: Revenue from ads when the RuNNer game is played for the first time.

Results & Suggestions

When we look at the overall project, it is worth saying that the development phase was very entertaining. There have been instances where each advance made things more difficult, and these difficulties hindered progress at times. Of course, some bugs may occur as a result of a sudden undesirable movement during the game. This is inherent in every game. Moreover, this game was developed in just 3 months. Even in games developed for 5 years, it is still possible to have bugs. So there are always bugs in the game market. The important thing is how to solve these bugs and how to minimize them. Thus, your product will be the best. If we look at the advantages of this developed game compared to other games in the world store, all operations are carried out quickly since the game is not too complicated and complex. In addition, the ads that bore the players too much or cause them to cool and delete the game are very few here and allow the player to play the game almost uninterruptedly. On the other hand, I think this game is a plus compared to other games on the market, adding a theme to the game outside of the played part of the game (Ssea, sand, island) and the non-level areas being given a single color as an empty one.

Some aspects of the game that may be missing, for example, are that the number of items may be seen by users after a while. Of course, a dynamic ground has been created in the game for adding items or such operations. But to begin with, I think that the current number of items is sufficient for the first version.

The game definitely has a structure open to development. Since Hyper-Casual games are played and consumed by players quickly, necessary updates or additions should come to these types of applications over time. At the advanced level, the second or third version of the game can be released. Or a game can be added to the multi-platform supported IOS or Steam platform so that it appeals to more users in the market.

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Biography

I was born on October 4, 1999. I was born in Üsküdar district of Istanbul province. I graduated from Etiler Tourism and Hotel Management High School. After graduating one year after high school, I prepared for university in the numerical department. Then I studied Computer Engineering at Beykoz University. Thanks to my achievements in my second year of university, I was entitled to receive a rector's honor certificate. My interest in mathematics has been evident by my whole circle. I have a curious and adventurous personality who is sensitive to the events around me, loves to research, and thinks that a person grows a little more with every knowledge he learns, not over time. I have a character who immediately notices the innovations around me and tries to learn this innovation by doing research on this subject. Thanks to my production that never forgets its mistakes, I learn not to make mistakes over time. I like to talk to people, answer questions with great pleasure, and although I study computer engineering, I am interested in technology and airplanes in general, and I do research on the technical details of airplanes. I have a personality that is responsible and does not defend that he knows a subject he does not know in any way. I am studying in a department that I like and I am happy that my profession is Computer Engineer. Stay well.

Alperen Demirtürkoğlu