Abstract

"FAR Studios" means Final Air Reality is name of game which presents the development of augmented reality and the development of 3D video game. This game is completely developed at superior university Lahore as a part of final year project. This 3D video game is single-player first shooter game creating using C# in unity 3D and Vuforia studio.

This report starts with the introduction of our project. We first discuss about the technologies and inspiration of the project that project is based on and why we are doing this project and then the processes and implementation are discuses in detailed.

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1. Introduction

"FAR" First Air Reality is a 3-d Augmented Reality game that builds as a Final Year project in the Faculty CS & IT at Superior University Lahore. The purpose is to describe the aim and background of the project that why we choose this project and which game is inspired us and involves us in augmented reality and in the gaming world.

1.1. Background

Millions of peoples are playing video games in their free time. It is not wrong to say that video games become the part of our life. The analysts published that the game industry has grown at a rate of 66% in 2016 surprisingly which means that millions of users are coming day by day. The game industry flow up day by day and become most popular in global wise. The recent advance stage in video game industry has integrated with virtual reality and augmented reality in their design.

Actually, at the beginning of this project we have no experience in gaming development; it's a big risk for us. So develop a game in augmented reality like first person shooter is a big challenge for us. But at this time we are more determined than ever. This was an opportunity for us to learn something big and something new in the face of final year project. So, we decided to achieve this opportunity.

1.2. Motivation

We review and survey about augmented reality and we are inspired by how multi-user can interact within a same platform while they are in different place. We also found that the concept of combining reality and computer graphics to enhance user experience in the Augment Reality projects very interesting. We play multiple games that are developed in augmented reality previously like Pokémon go, Zombies, Run and Spec Trek Light. Hence, we came up the raw idea of the project. Here are some examples that motivate us to choose this project

Pokémon go was released in 2016 by Niantic became a milestone in the history of augmented reality game. The term Pokémon refers to "pocket monsters" from a popular Japanese anime and card game. Pokémon-themed traditional video games featured digital battles between Pokémon. Pokémon GO used AR technology to merge the "Pokémon world" with reality. Players use their smart phones to detect, capture, and collect Pokémon from real-life locations

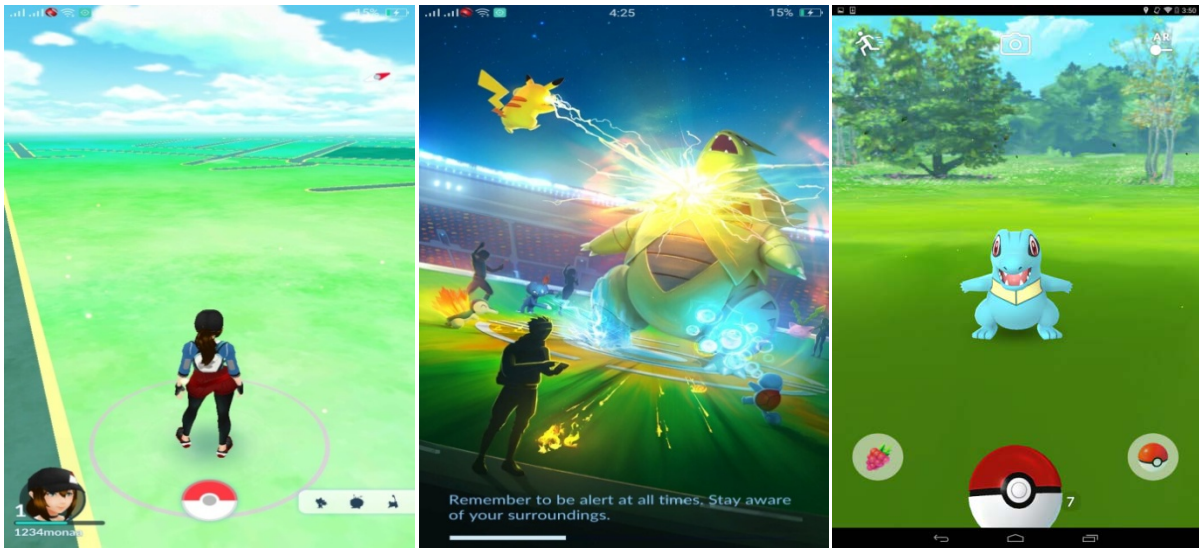


Figure 1.2.1 Examples of Pokémon Go

Next example is zombies run! Zombies Run is also augmented reality game. In game players run for their lives as the app turns Google Maps into a nightmarish land of the dead with zombies roaming around in search of the living. Google maps are integrated in this game which shows the run map online.

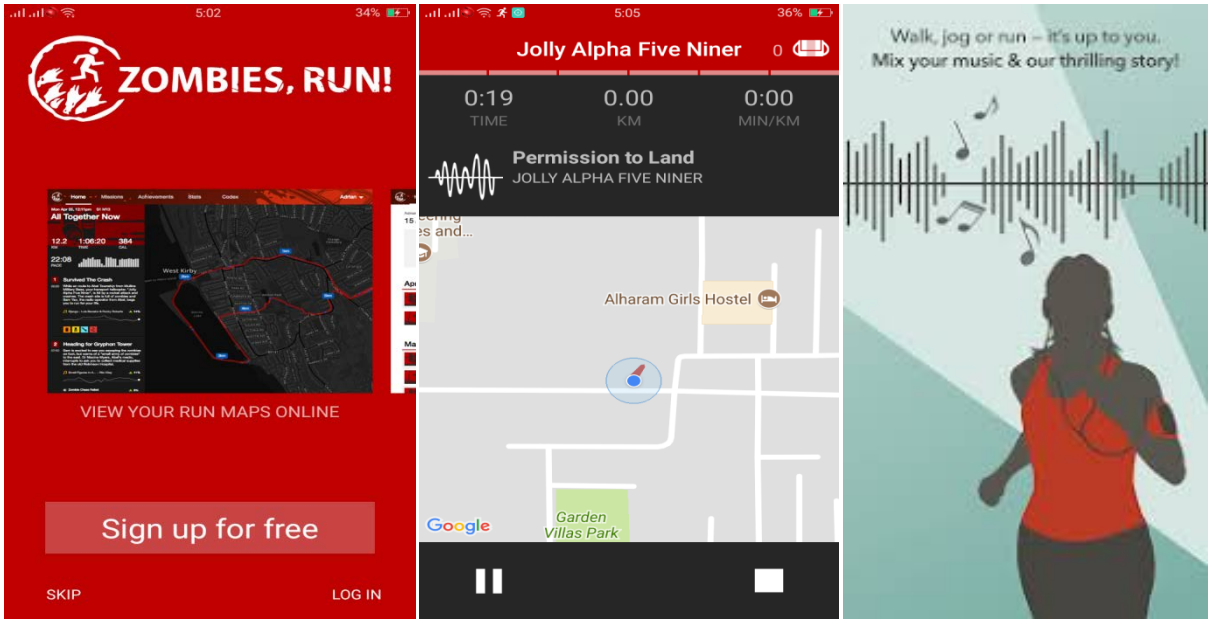


Figure 1.2.2 Examples of zombies run

Another example is Spec Trek Light. The app is clever enough to recognize your location and places where it can spawn digital ghosts and other bonuses on your phone. The object of the game is to find ghosts and capture them.

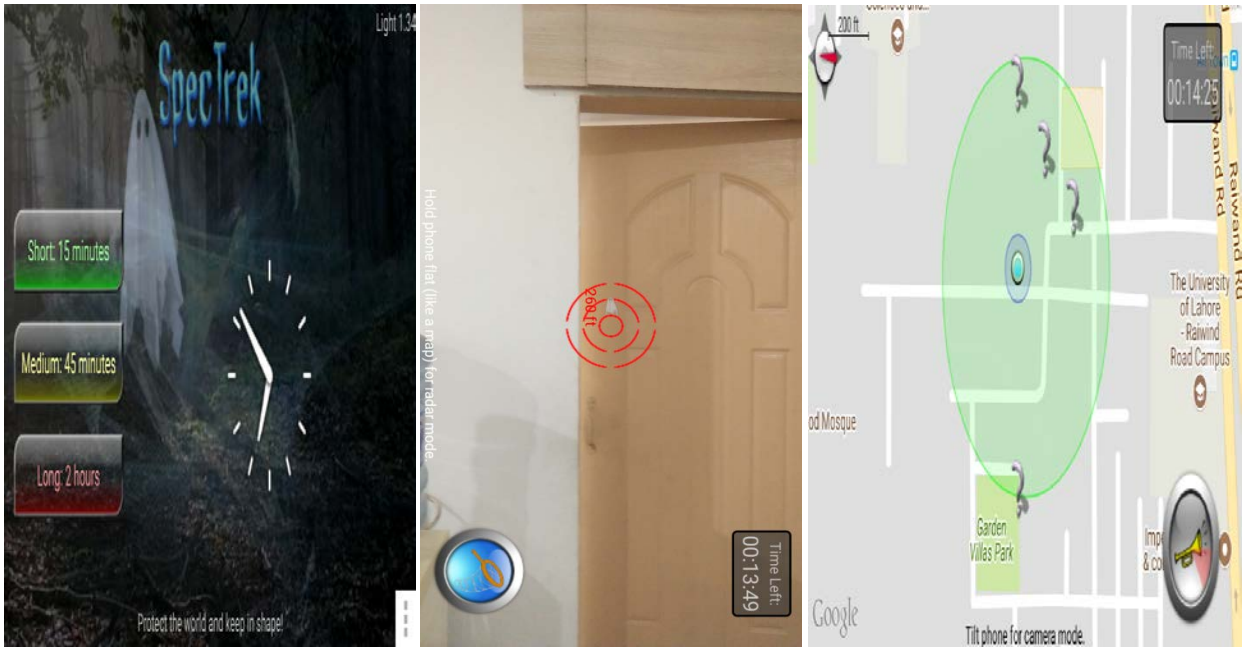


Figure 1.2.3 Example of Spec Terk Light

After the observation of different ARGs we decided to introduce a game which is combination of virtual and augmented reality in the game. A first person shooter game which could be play by interacts with real world and also play digital in our smart phones.

1.3. Project purpose

We developed a 3D augmented reality game using camera, GPS navigation as final year project. This 3D video game is single-player first shooter game creating using C# in unity 3D and Vuforia studio. The purpose is to achieve goals by visiting real world locations to locate and interact with objectives inside the game. The aim of this project is to gain and improve our knowledge in the field of game development as well as integrate with Vuforia and new emerging technology that is "Augmented Reality".

1.3.1. Project objectives

- To develop an augmented reality game environment for the smart phone.

- Integrate Google maps and application should load a real time map and display the current location of the player and target.
- To design a model of player and enemy.
- To create 3D video effects, animation or sound effects are another objective will make the game more interesting for users.
- To design a simple UI for gamers.
- Enhance the entertainment and advancement in augmented and virtual reality of game industry.

1.4. Project Organization

Our team consist of five members, we didn't specify specific role for any member because we all are new in this gaming field. Everyone is responsible for every phase of development. After the detailed discussion and knowledge about game development we specify the roles for our team.

Name	Role	Responsibilities
M Rehan Arshad	Project manager	Will be responsible for project plan & managing schedule
Hamza Bin Babar	Developer	Will be responsible for implementing code and maintain coherency in the code
Tehmina Iqbal	Game and Art Designer	Responsible for creating the 3d assets for the game

Aqsa Maryam	Tester	Responsible for finding the bugs and reporting them
Zahra Gulzar	Documentation	Responsible for creating the Game design document

1.5. Definitions, Acronyms and Abbreviations

Terms	Definitions
FAR	Final Air reality
ARG	Augmented reality game
FPS	First person shooter
3D	Three dimensional

2. Deliverables and Documentations

2.1. Scope

2.1.1. In Scope

The game will base on full requirement of First Person Shooter needed with the goal in mind of being fun.

- *Single Player*
- *Mobile Based*
- *Single Level*
- *Action Based*
- *3D Platform*
- *2D Platform of GUI for menu system*
- *Science Fiction*
- *Written in C# for Unity*
- *Plugin with Virtual Reality*

2.1.2. Out of Scope

- *No Multilevel*
- *No Multiplayer*
- *No Console Based*

2.2.PLANS

2.2.1. Milestone Plan

The milestones of the project are given below in the form of a table.

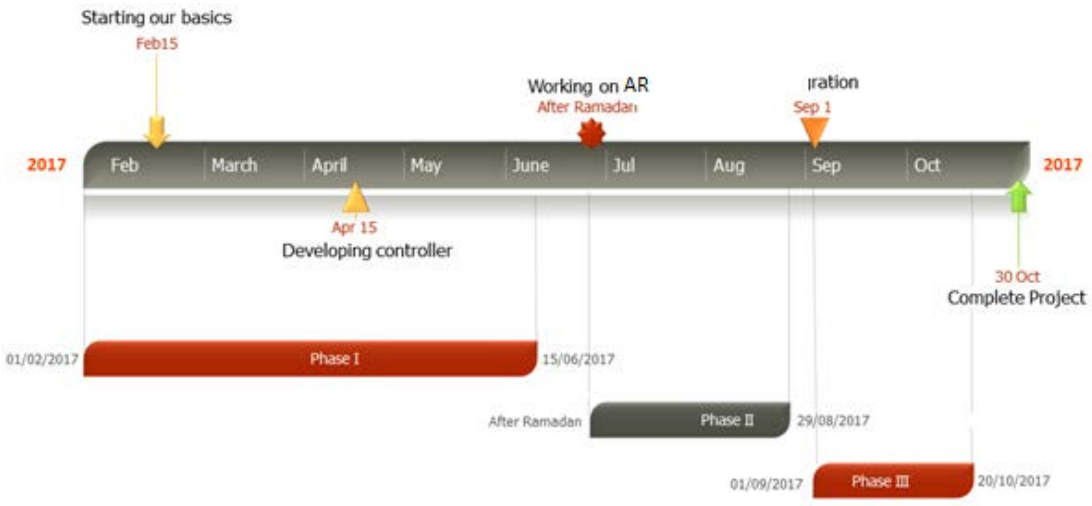


Figure 2-1.2.1: Milestone

2.2.2. Phase 1

Milestone	*Scope*	*Output*

Milestone 1	*Pre-Production*	*Project Plan*
Milestone 2	*Game Design*	*Create Environment*
Milestone 3	*Test Planning*	*Test plan*
Milestone 4	*First playable*	*Working Prototype on game*

2.2.3. Phase 2

Milestone	*Scope*	*Output*
Milestone 5	*Usability Testing*	*Taking feedback/conclusion from users.*
Milestone 6	*White Box Testing*	*Checking of code(programming language).*
Milestone 7	*Integration Testing*	*Testing done with gyro*
Milestone 8	*Unit testing*	*Testing done by division into small parts*
Milestone 9	*User Testing*	*Testing done with different Users*

2.2.4. Phase 3

Milestone	*Scope*	*Output*
Milestone 10	*Game Release*	*Test Report/Final Production*
Milestone 11	*Post Production*	*Final Report/User Manual*

2.3.Phases

The table of Project phase shows the complete information of activities and expected documented output.

Phase	*Activity*	*Output*
Documentation Phase	*Project Plan*	*Project Plan*
Game Design Phase	*Game Design Document*	*Game Design Document*
Testing Phase	*Test Plan, Basic world, Controls*	*Test Plan*
Postmortem Phase	*Bug fixed, Integration Test, System testing Bug fixed, Integration Test, System testing*	*Test Report*
Post-Product Phase	*Final Report, User manual*	*Final Report*
Presentation Phase	*Present the project*	*Presentation*

2.4.Documentation Plan

The table below provides information on dates when the documents related to the project will be delivering**.**

Name	*Purpose*
Project Plan	*Organize the project*
Game Design Document	*Describe the design of game*
Test Plan	*Define all test activities*
Test Report	*Define all test cases*
Final Report	*Summarize the project*
User Manual	*Describe how to play the game*

3. Study on Augmented reality

Augmented reality is the combination of virtual and real world. The application of AR technology to video games began in 2000. In the past, video games are played virtually on computers. AR games allow users to see and interact with enhanced images of real-world environments. AR application are involved in different fields include entertainment, education, Art, visualization, military, robotics and medical. In recent years, games growth is increased for smart phones.

3.1.Types of Augmented Reality

3.1.1. Marker Based AR

Marker based AR uses camera as image reorganization and use some type of visual marker such as QR code which is called AR marker. It recognizes the marker and replaces the real object.

Figure: 3.1.1 Example of Marker Based AR

3.1.2. Mark less AR

Mark less augmented reality is one of most widely used type of AR. It also called location based, position based and GPS based augmented reality. We used mark less augmented reality in FPS game.

3.1.1. Projection Based AR

Figure: 2.1.2 Example of Marker Based AR

In Projection based augmented reality human interactions send the artificial light on the surface of real object and then sensing the human interaction of that projected light.

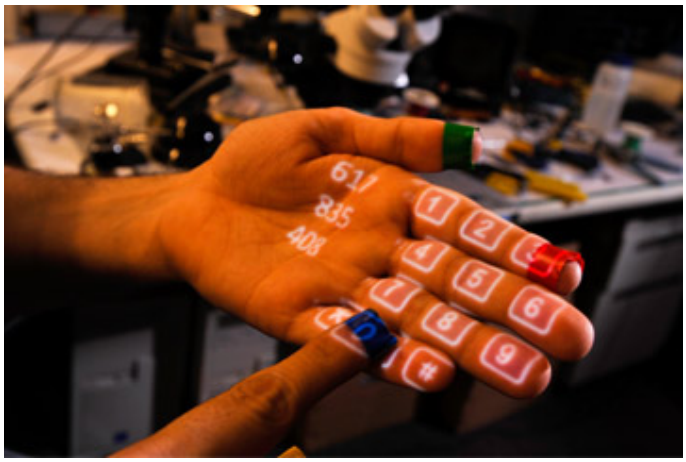


Figure: 2.1.3 Example of projection Based AR

4. Requirement and analysis

4.1. Introduction

This section explains the requirements of our project. Platform and map service. The platform that we used is beneficial for the game and the mapping sort that is used how it works and how it integrate with the interface of the game to make it perfect . For the user's understanding, requirement analysis is very necessary. Buy this we can developed such a game that attract the user's need.

4.2.Target User/ Stakeholders

Primary stakeholder: Students

Secondary stakeholder: Teachers

Facilitating stakeholder: project supervisor Fawad Naseem

4.3. User requirements

The application should have one interface of location-based over map service and second interface over augmented reality.

- Game run on android 5.0 or above.
- The system should be able to render 3-Dimentional models.
- System should be able to load images..
- System with GPS and map facility.
- Availability of internet to load map.
- The functions and attributes should be consistent.

4.4. Requirement Gathering and Analysis

Requirement gathering is a process in which we take requirement from client, this stage play an important role in developing process.

As previous we discuss that we are not experienced in augmented reality games. We analyze the requirements of recently developed games. And which kind of game the users prefers and finally to analyze the potential of Unity3D to build a game based on GPS, and the usage of mobile device sensors.

In gaming world fighting games are very popular and we observe that persons like action and more action. So we decided to build the first person shooter game to in augmented reality. Thus, the game will allow users to use different weapons and shoot his friends in real world that would be create more entertainment and interact with virtual 3D characters.

There are many techniques in requirement gathering which are defined below

- **Document Analysis**

Document analysis is a procedure in which analyst analyze the document of user requirements.

- **Focus of Group and Brainstorming**

The main focus of our group is to learn and improve our self in the field of game development as well as Augmented Reality.

- **Reverse Engineering**

In this phase of reverse engineering we learn about the Unity Game Development Platform that how it works and how we can utilize existing code samples from previous related projects in reverse engineering, for make it easier in development phase.

Requirements were gathered according to the needs of our game which we want to build. We analyzed and compared previously developed first-person shooter games and gather common features from every possible resources which were related to our desired game and can make our work easier.

5. RISK ANALYSIS

5.1. Overview

The major risk of this project is time, and whether the objectives of the vision will be succeeded. If some objectives is not achieved on time it causes the drop of project. But we done it according to our decided time and remain safe from this cause. Due to fixed time, the amount of man hours needed for the completion of project increased to achieve the destiny.

5.2.Project Risks

5.2.1. High Risks:

- New to programming for Unity
    - Find more sample games built in Unity and try to understand

- Problems with meeting the milestone deadline
    - Work harder to meet the deadline

- Unrealistic project scheduling
    - Unrealistic project scheduling

5.2.2. Medium Risk

- Problems with audio and graphics
    - Try to find eligible audio and graphics

- Problems within development environment
    - Review and re prioritize functional requirements

5.2.3. Low risks

- Insufficient effort of team members
    - Take a little break for motivation

6. Methodology

In implementation phase we add many features according what we need to make some new modifications on game design and requirement analysis. One of the most suitable development methodologies for game development is Doppler GDLC iterative approach. The Doppler GDLC is

applied an iterative approach to develop a game.. In iterative approach the large projects breakdown into smaller chunks in this approach the features code is designed, developed, tested in iterative cycles.

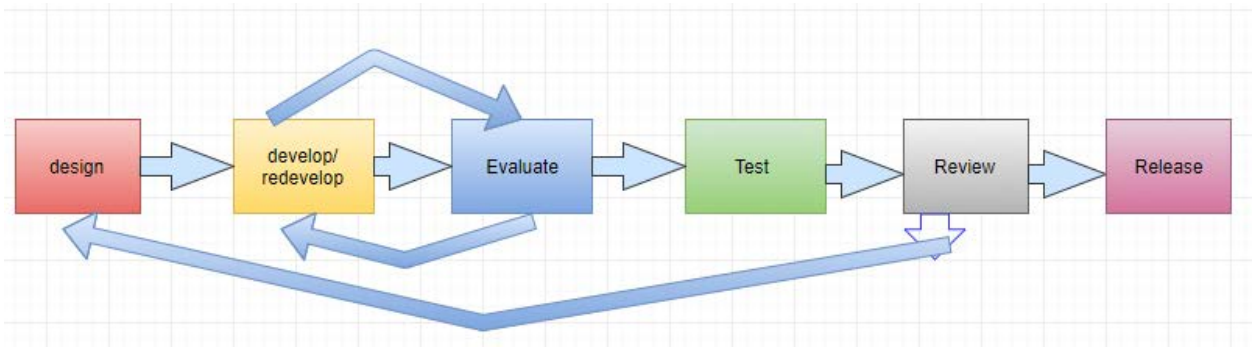


Figure: 4 Doppler Game Development Life Cycle

There are six phase work in this iteration.

1. Design
2. Develop / redevelop
3. Evaluate
4. Test
5. Review / release
6. Release

6.1. Design

In this phase design the game according the requirement, design the architecture of game. Design phase is a transformation phase because the idea is actually work in the real word. All data are formed into charters, making tools and technique according to the game requirement.

6.2. Develop /Redevelop

In this phase the real code is return about your designed document. In this phase we check that the process of the system is properly organized. Focusing on training can be a huge benefit for us during this phase.

The developers develop the game according game requirements and checking that the process is work properly.

6.3. Evaluate

In this phase evaluate the quality, accuracy, speed, reliability, quality of output and cost of operations, capacity, and compatibility with other games. It also evaluates the performance of the game.

Evaluation does not mean to check the improvement of the system that you are evaluated; it's actually means that serves to improve the next system you will work on. Just make sure that the specifications you evaluate are related to the goals the system was supposed to have when it was originally analyzed. Check the flexibility that can be upgraded, modified, adaptive and configured.

6.4. Test

In this phase analysis the game and find out the errors.

6.5. Review/Release

After developing the structure review the functionality of the game and recover the faults.

6.6. Release

After completing all the phase release the game.

7. Requirement Specification

7.1. Functional requirements

This section describes the basic needs for the game that are required in order to run this game up in the time.

Main Menu

A responsive main menu for the game where the gamer can choose and click the given options to instantiate.

Splash screen

Splash screen show the initial logo of the game FAR studios

Camera

The player should be able to use the camera and interact with real world to play the game.

Play Game

This option will display on the main menu to start a new game or either to continue from the stage you quit.

Weapon

User should play the game with the provided weapon cockpit to kill and damage an enemy.

Distance

Cockpit shows the distance of enemy that how far and near the enemy from you.

Shoot enemy

Player enables to shoot the enemy using the weapon cockpit button and kill the enemy.

Freeze enemy

The main feature we added in the game to increase the entertainment in the game is to freeze the enemy. Player can freeze the enemy and enemy would not be able to move from his position.

Location service

GPS enables the player location where the map shows the location of the player. And also show the moments of the player of current location.

Quit Game

This option will display on user's screen to quit or leave the game. . Once you click the game will close and need to restart the game in order to play again.

7.2.Non Functional requirements

User interface

User interface should be simple, clean and compatible with device screen.

Performance or response time

It is necessary to maintain that the game doesn't create any performance or graphical problems as this can lead to a depreciative game play. Response time is important. Be. Game needs to run in a run time to ensure that the animations and graphics remain simply smooth. The game needs to run at a persistently and consistently game app. The game should be immediate to the response time so that whenever the player starts an action in the game, the response will also be immediate.

Availability

After download and install the game from play store into smart phone it will be playable when the user want to play. The game can be constructed for play keep on smart phone with a purpose to make the game without difficulty available.

Security

To install and run the game user should read and allow the policy to play it. Only the users location and the camera is needed for game. No background app settings will affect the users privacy.

Reliability

After downloaded and set up the game app onto their smart phones it ought to be available to play on every occasion they need.

Maintainability

Video games may be effortlessly maintained after release via play store updating release. Those updating may be used to fix errors or bugs. If there are several bugs then an update could be launched with the purpose of addressing and fixing those.

Portability

Users can play the game via their Google play store. The internet player would permit users to play the game over the internet so they might play on any device connected to the internet.

Extendibility

Extendibility is a option for further addition with new trend. According to user's need we can add options in our game. Development for the game takes no longer need to end and this could be launched within the form of an expansion on the way to goal to enhance general game experience.

Reusability

As we are developing every other fps / horror or myth game, we ought to reuse maximum of the code. We could also reuse the graphics in our game.

8. Design and architecture

In this section, we explain the design of the game that which tools are used to develop the game. The design of software could be very essential in implementation approach of the challenge that glad the purchaser want.

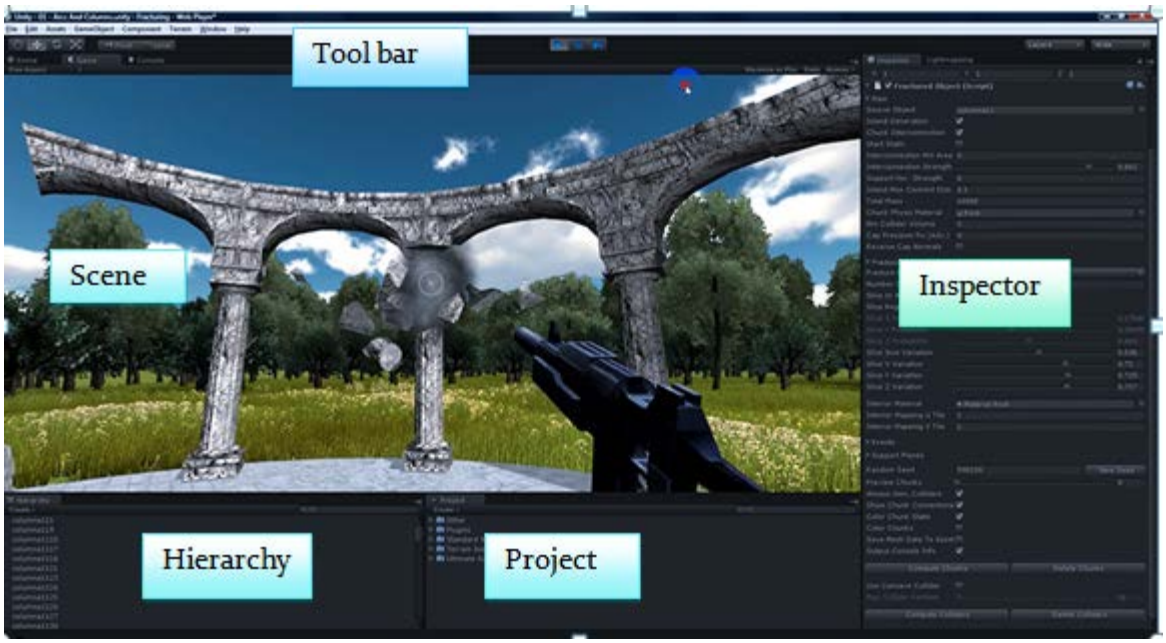
8.1. Tools

Tools used in all the process of development of this game are discussed below.

8.2. Unity 3D

Unity is the mostly in 2D and 3d tool gaming development that was used to create this project. Cohesion permits the introduction of a virtual environment by using setting numerous sport gadgets in a scene. Because of the reality that it's far unfastened to use and it has the feature of collaboration crew work .we labored collectively to develop this recreation. These features enhance the team work as well as saving time and money.

Unity 3dimensional interface allow operating with numerous tabbed windows, known as views. There are several sorts of perspectives in team spirit; they all have precise functions that are beneficial. The Unity views are the following.



` Figure5.1: Unity 3D interface and their respective views.

- Project Browser
- Hierarchy
- Toolbar
- Scene View
- Game View
- Inspector

Scene View

A tab that permits the user to add and layout game gadgets in the scene. The most crucial functionalities are let's in an clean way to place, choose, circulate or removes sport gadgets.

Game View

This tab affords the very last view of the sport. It calls for at the least one virtual Camera, a recreation item with some particular scripts in an effort to force it to act as a virtual Camera.

Hierarchy View

The hierarchy lists all the game objects in the scene. it's miles robotically up to date every time a game object is brought or removed from the scene

Project View

Provide a hierarchical illustration of the folders and belongings.

Inspector View

Whilst a sport item is chosen all scripts attached to it'll be indexed interior this tab. Those scripts specify the conduct of the selected recreation item.

Cohesion makes adding imported artwork assets to the sport scene as easy as drag and drop in the desired area.

Solidarity's scripting is based totally in most cases on monodevelop that is an open supply implementation in the .internet framework. While working with solidarity, you are given the option of the use of JavaScript or c#. Cohesion uses Monodevelop, even though developers are loose to apply something scripting device they choice. Cohesion supports task deployment on more than one system. while a challenge is finished, developers can pick out which platform they would really like their task to run on play station four, , Window, Xbox one, Linux, IOS, Android, and many others. We are presently the use of solidarity model five.6.1 f1 within the development of my recreation.

Monodevelop

Monodevelop is used for scripting. C# and JavaScript and all other programming is used in Monodevelop. It is different from the same old idea as it has in-constructed features and vehicle-of entirety with coding especially regarding harmony. Monodevelop is able to interact with the game items utilized in solidarity.

C#

C# is a programming language which allows develop/create programs that allow you to then run at the .net framework. We use C# language in our seventh semester project of organization software improvement challenge. It's also a reason to select team spirit 3D in our final year project.

Vuforia SDK

Vuforia is an Augmented Reality software development kit for smart phones merge with unity that allows developing the augmented reality game. Vuforia use the advance vision technology to recognize the object, images and interact spaces with real world. Vuforia SDK uses 2d and 3d targets.

8.3. System Architecture

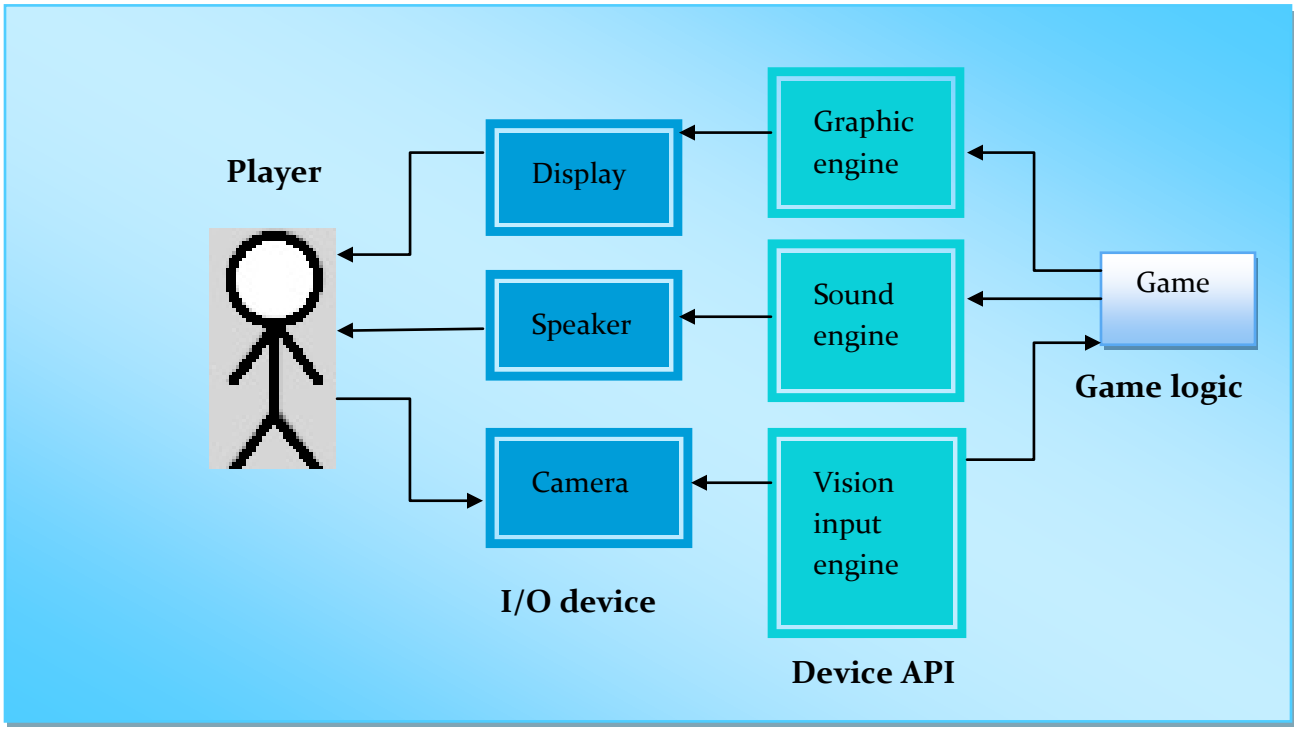


Figure: 5.1 Game Engines

Every game has the following components:

I. Graphics Engine
II. Sound Engine
III. Vision-Input Engine
IV. I/O Devices
V. Device AP

These entire components combine together to make a game playable with its all its functionality. Game engine are processed by itself and they can drive automatically behind the original process.

8.4.Use Case diagram

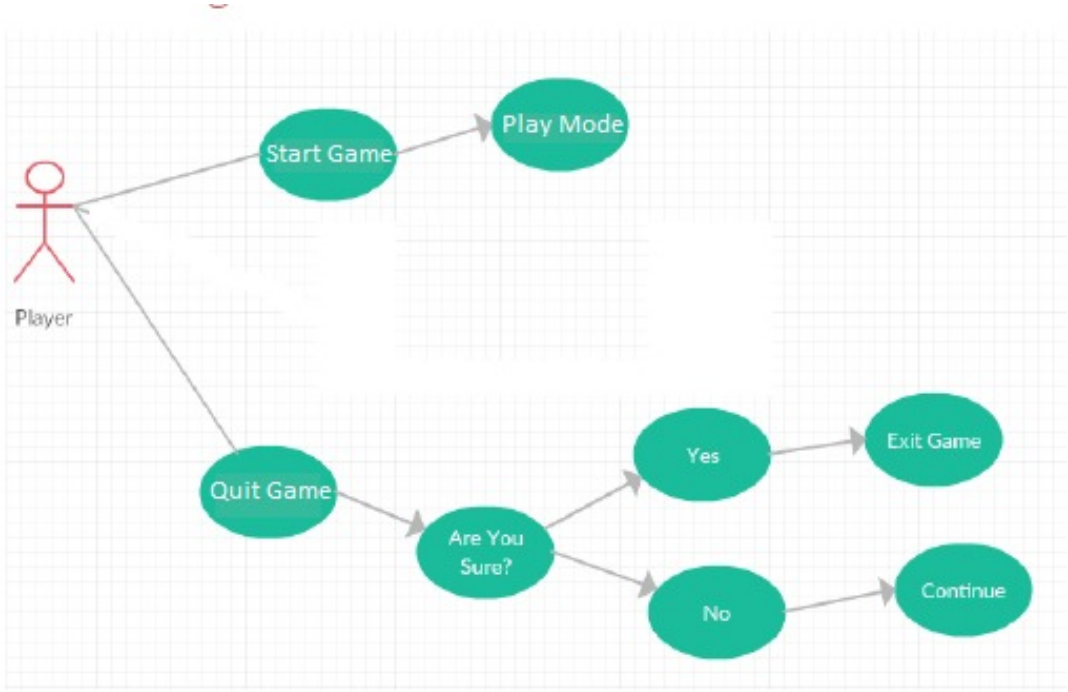


Figure: 5.2 Use case diagram

In this, game flow is show step by step for the better understanding of someone's who don't know the game. This became very helpful for better development. According to our game ,when the game is started , a button on screen occur "play game" and "quit game". If you go thru with play game then the game started and you enjoy the experience of augmented reality. If you want to exit the game in the middle then you will lose the power of your player and message is shown to quit.

8.5. Class diagram

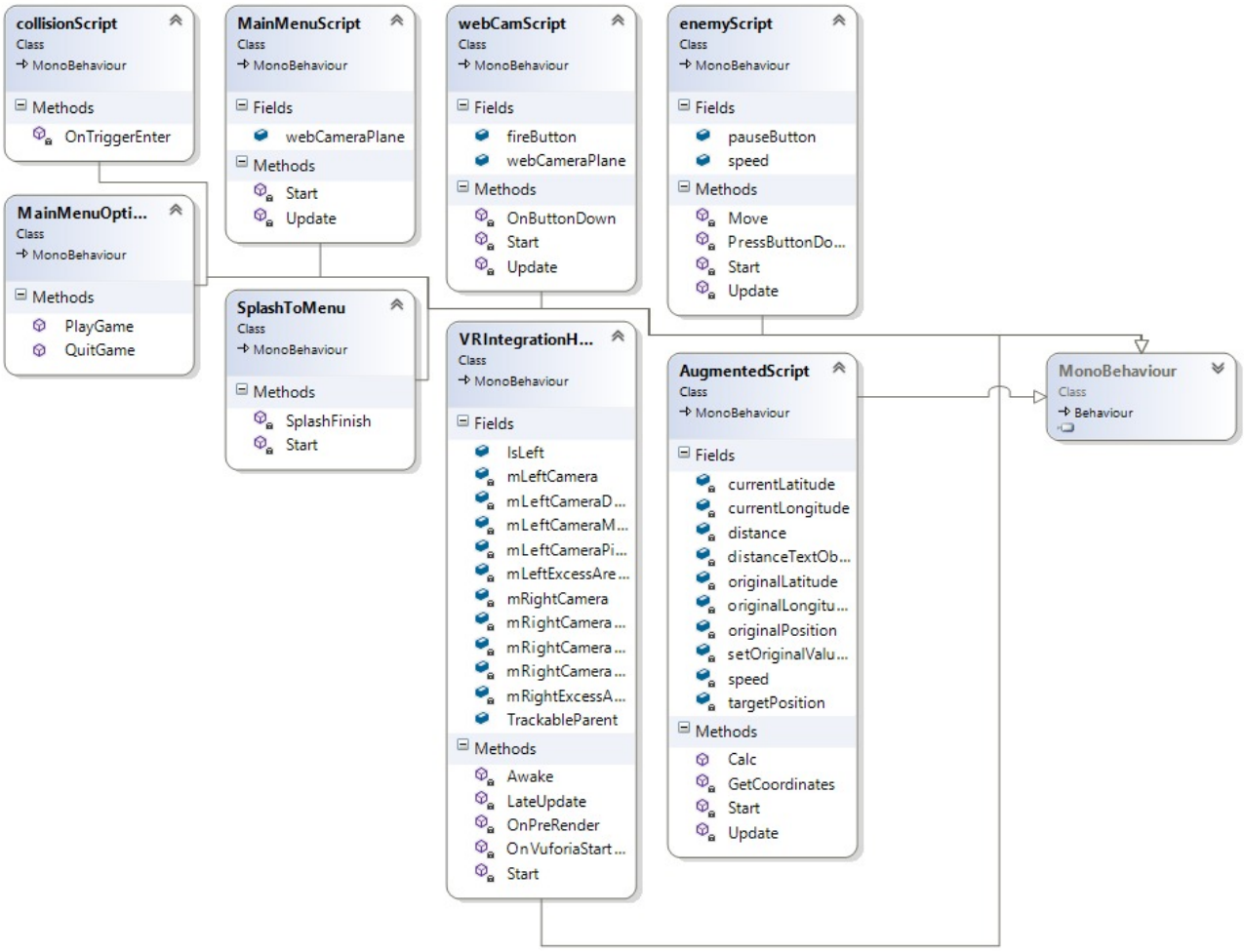
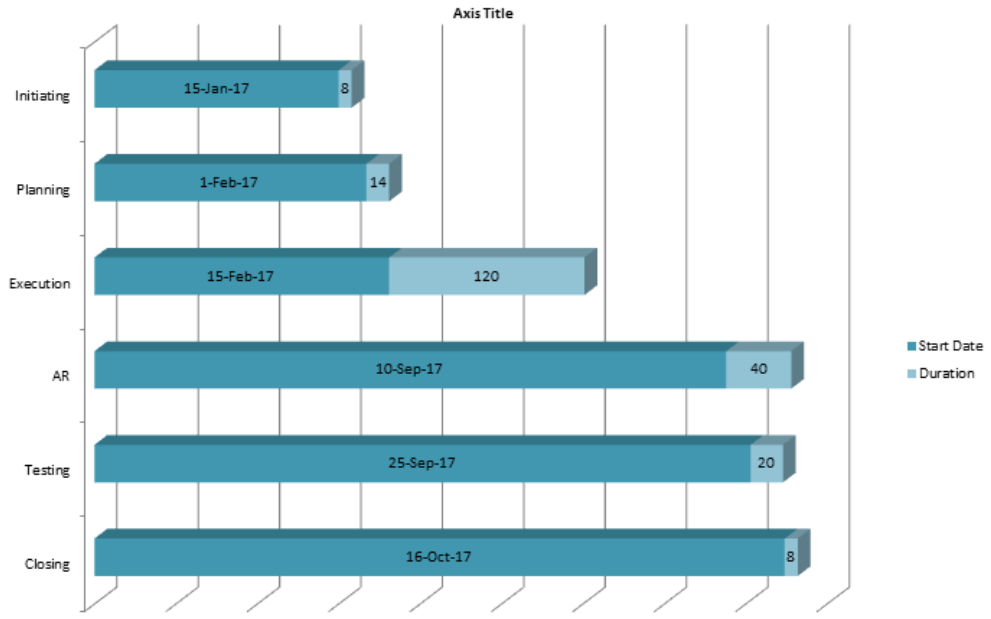


Figure: 5.3 class diagram

We choose this architecture because the player and the enemy each engage with the occasion. A primary menu script on states first is play sport and 2d is quit recreation. If the player goes at the play game country it'll put on web cam script. Internet cam country scripts are attached to the player which allows the script of augmented fact where player engage with real global.

9. Project Plan

	A	B	C	D
1	***Task Name***	***Duration***	***Start Date***	***Finish Date***
2				
3	**1 Initiating**	8 Days	1/15/2017	1/23/2017
4	Project Idea			
5	Research			
6	Feedback On Idea			
7	**2 Planning**	14 Days	2/1/2017	2/14/2017
8	Choose Platform for development			
9	Choose Coding Language			
10	Interface Design			
11	Character Design			
12	**3 Executing**	120 Days	2/15/2017	6/15/2017
13	Creat Player			
14	Create Enemy			
15	Design Cockpit			
16	Implement shooting			
17	Create Final Level			
18	**4 AR**		7/9/2017	
19	**5 Testing**	20 Days	9/25/2017	10/15/2017
20	White Box Testing			
21	Usability			
22	Integration Testig			
23	Unit Testing			
24	User Testing			
25	**6 Closing**	8 Days	16/10/207	10/22/2017
26	final Project Report			
27	Final Project Presentation			
28	Project Showcase			



10.Testing Approach

In this segment we're going to give an explanation for the specific check collection. The check technique consists of a series of different checks. The primary purpose of these checks is to ensure that a ways studios is an mistakes loose recreation

game trying out is a software program checking out process for control of video games. When code is created, different testing approaches test them and make them free off errors before handling to the user. Approaches turned into very critical and many different types of testing were completed so one can make sure that the software program acts as predicted in all situations in addition to making sure that the requirements have all been effectively.

10.1. Usability Testing

After development we take the review from friend's family members and we ask them give us the suggestions about game. They ask us menu and font and other mistake that occur in our game. Any other small problem that came in front on us was buttons, not converting coloration on hover and gamers did not recognize if whatever become taking place. We had set the color to exchange however then experience it didn't paintings on button UI's for a few cause. We changed it to textual content and delivered a button aspect.

10.2. White-Box Testing

We used white box testing to check our codes through our recreation using particular units of situations. We started out our recreation from the starting scene and performed it till the end to test the barriers. On a main menu, scenes are connected through buttons to play and stop the game. The purpose of the white-box testing is to make sure that every possible situation that might have been done.-

10.3. Integration testing

Integration testing of this project is done with gyro and vuforia with unity and by main menu to check the regularity of the project. After the testing we can further build our project to achieve the task.

10.4. Unit testing

Unit testing is a technique, in which software is divided into parts. Unit testing is important for our game development because by the help of this we make our game free from errors.

10.5. User testing

We ask from our family contributors and our friend about our game. We ask them they deliver me the comments about our recreation. All had a unique skill s and experience, some were properly game enthusiasts, a few had programming abilities and a few didn't even understand how to play with augmented reality recreation. We ask about the concept of this sport and additionally train them that the way to play the game. Basically humans says approximately recreation the outcomes are effective.

11.Conclusion

11.1. Advantages:

There are a lot of advantages of developing this project throughout. It gives a huge amount of benefits to us about to learn something new and help us in improving our skills in the field of game development. Now we have multiple of ideas beyond someone's thought to develop such a game that someone desires to play. Firstly we didn't know anything about gaming and there is no proper subject of gaming in our course. Now we know mostly things about gaming. Knowledge about Unity, Mono-develop, asserts, vuforia and AR technology.

Another advantage is, it increase our programming skills in C# and Java Script. Both these languages are the backbone of this project in Unity. By doing coding on daily basis, help us in improving our skills and acknowledge us a lot.

Playing game in AR, realize that we are actual playing this game with real time environment by camera. Now a day, AR is an emerging technology in gaming field. Most of the games are built in AR technology. AR is a new experience for us to learn, understand and explore it. By the Grace of God, now we can develop game for any platform as well as in AR Technology, a more sufficient and more desirable game according to user need.

The most interesting thing is that there are lots of tutorials related to AR game available on internet especially on You-tube. That's a huge benefit for us to learn and develop. By the help of you tube we develop the game and learn how unity works. As we have no previous experienced of game development, it disturbed allot, we spent many hours daily to learn from you-tube. By the help of tutorials we develop this game. Uses free asserts, create 3D environment according to our need. We really enjoyed the scenes that are created from our hand, it's a first time experienced for us.

11.2. Disadvantages:

Disadvantage is as we have no experience of game development before, it dishearten us. AR merged vuforia is large and complex game to build and to make it playable state. With the help of tutorials we develop it. Amount of hours we spent on you tube to learn and make it. As we all have no experience of game development, we wasted a lot of our precious time on you tube to learn and getting ourselves familiar with unity, vuforia and AR technology. We have basics C# and JavaScript skills but not enough for this development.

12.Further Development or Research

In future we can expand this game by adding new features.

- *New and more environments*
- *More levels with more action*
- *Option of multiplayers*
- *Option of difficult level*
- *New weapons feature*
- *New enemies like trend can add up*

We feel that we have not limited our options with the style of game we have chosen. The possibilities are endless and the story can be developed. We can re-use the environment in as many levels as we wish.

References

Data Gathering

[1].
https://www.researchgate.net/publication/271548605_Game_development_life_cycle_guidelines

Video Tutorial

https://www.youtube.com/MatthewHallberg

https://www,youtube.com/ChromeFXFilms

Assets

http://devassets.com

Unity Asset Store

Appendix A

Screen Shots

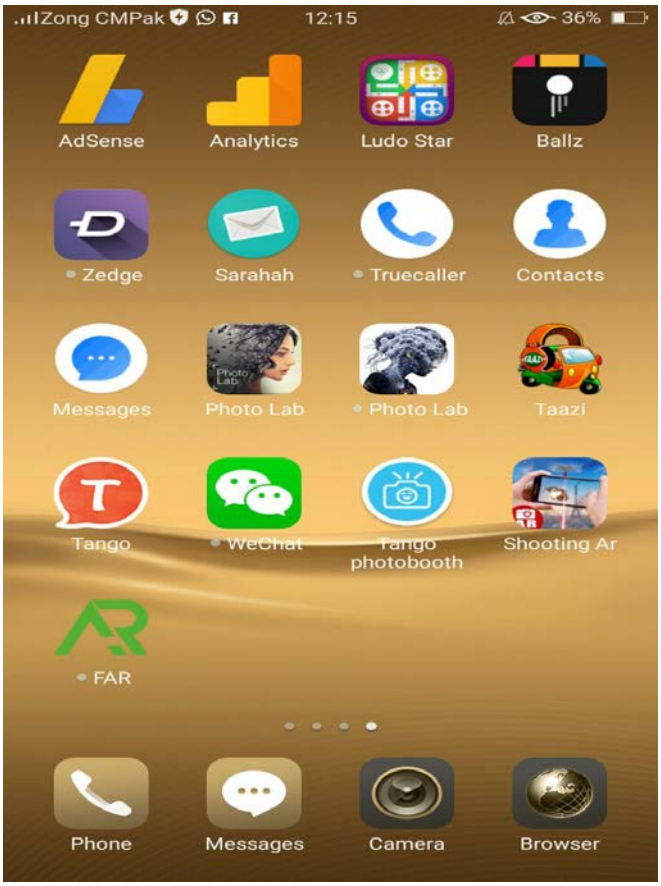


Figure A-0-1 Menu

Figure A-0-2 Land Scape Mode

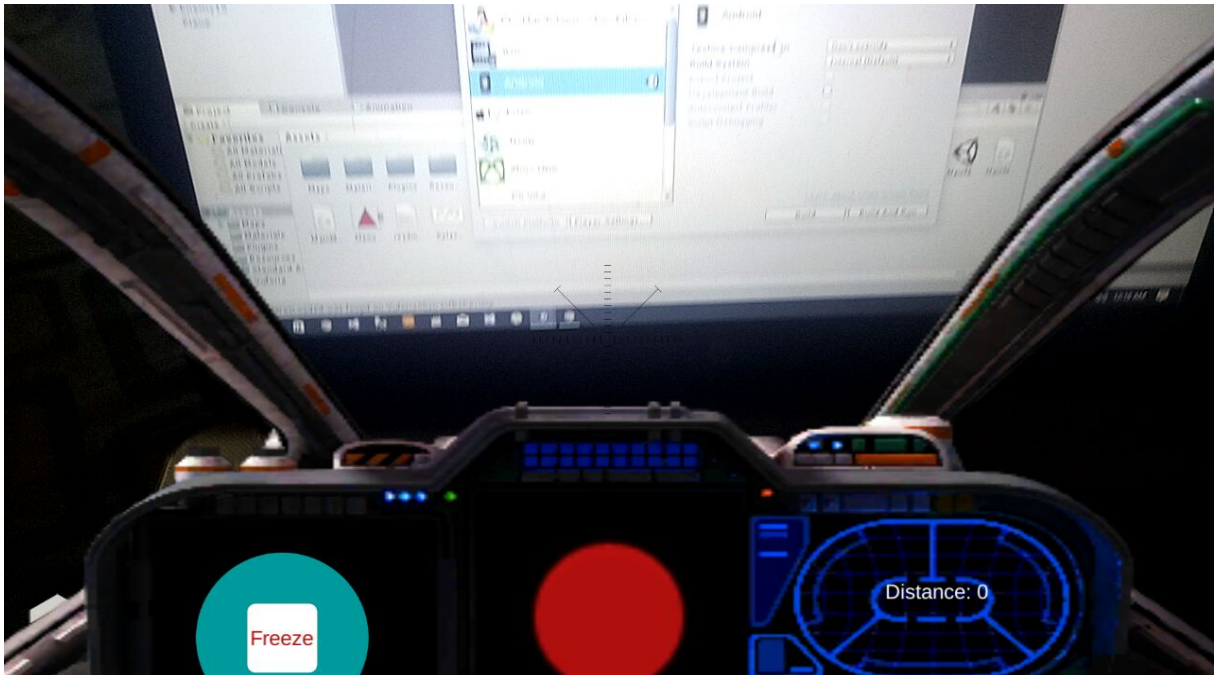


Figure A-3 Starting Game

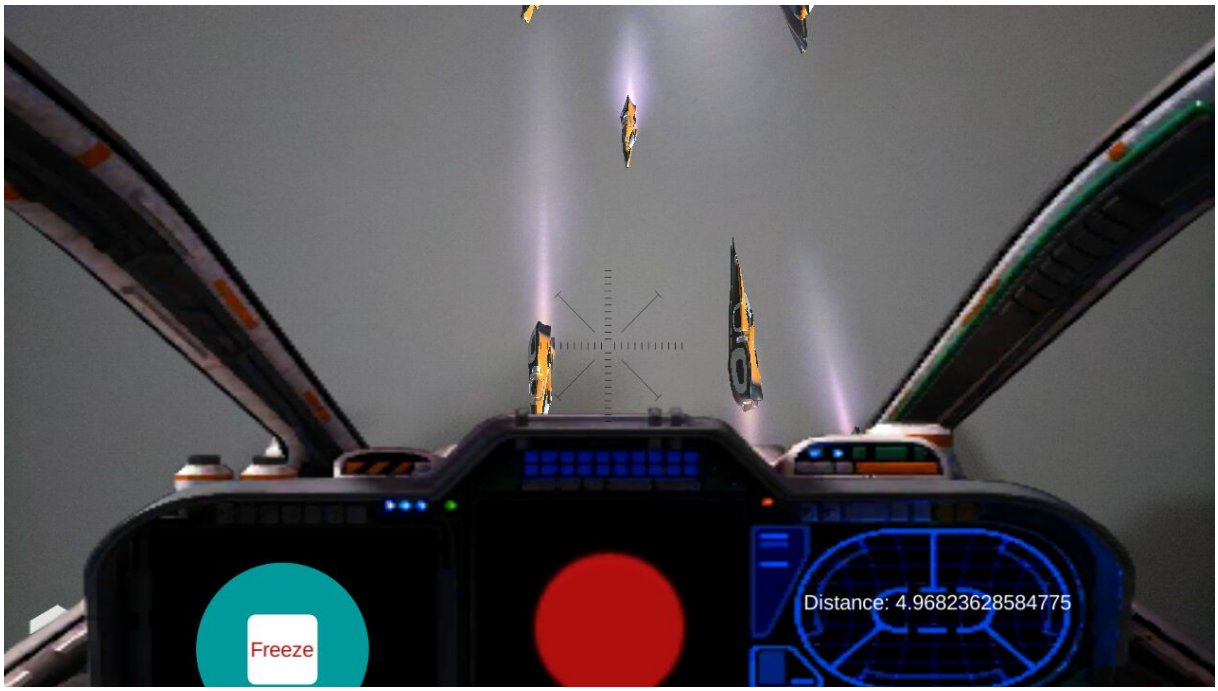


Figure A-4 Calculating distance

Figure A-5 Shooting

Figure A-6 Main Menu