A PROJECT REPORT

ON

"INTERIOR DESIGNING USING AUGMENTED REALITY"

Submitted to

UNIVERSITY OF MUMBAI

In Partial Fulfilment of the Requirement for the Award of

**BACHELOR'S DEGREE IN
COMPUTER ENGINEERING**

BY

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**UNDER THE GUIDANCE OF
PROF. KALPANA BODKE**

DEPARTMENT OF COMPUTER ENGINEERING
Anjuman-I-Islam's Kalsekar Technical Campus
SCHOOL OF ENGINEERING & TECHNOLOGY
Plot No. 2 3, Sector - 16, Near Thana Naka,
Khandagaon, New Panvel - 410206
2019-2020

AFFILIATED TO

UNIVERSITY OF MUMBAI

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CERTIFICATE

This is certify that the project entitled

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submitted by

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is a record of bonafide work carried out by them, in the partial fulfilment of the requirement for the award of Degree of Bachelor of Engineering (Computer Engineering) at *Anjuman-I-Islam's Kalsekar Technical Campus, Navi Mumbai* under the University of MUMBAI. This work is done during year 2018-2019, under our guidance.

Date: /   /

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I would like to take the opportunity to express my sincere thanks to my guide **Name of Guide**, Assistant Professor, Department of Computer Engineering, AIKTC, School of Engineering, Panvel for his invaluable support and guidance throughout my project research work. Without his kind guidance & support this was not possible.

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We would like to express deepest appreciation towards **DR. ABDUL RAZAK HONNUTAGI**, Director, AIKTC, Navi Mumbai, **Prof. TABREZ KHAN**, Head of Department of Computer Engineering and **Prof. KALPANA BODKE**, Project Coordinator whose invaluable guidance supported us in completing this project.

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CHAUDHARY SHOAIB SHAFIQUE SHAHEEN
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</div>

Project I Approval for Bachelor of Engineering

This project entitled *P̈roject Title¨* by *Students Name* is approved for the degree of *Bachelor of Engineering in Department of Computer Engineering.*
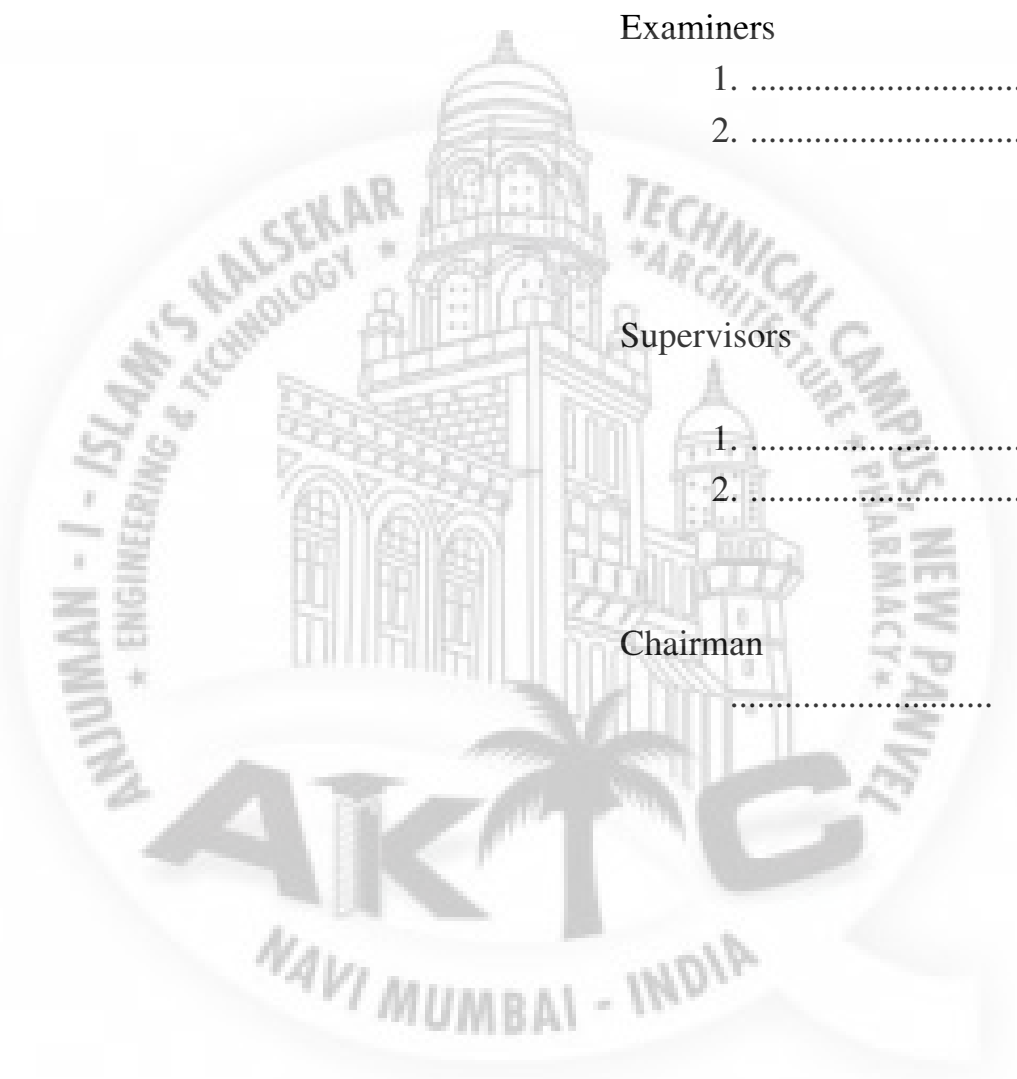
Examiners

1. ....
2. ....

Supervisors

1. ....
2. ....

Chairman

....

Declaration

I declare that this written submission represents my ideas in my own words and where others ideas or words have been included, I have adequately cited and referenced the original sources. I also declare that I have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in my submission. I understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

Student Name
Roll Number:

ABSTRACT

Augmented Reality is defined as the technique which superimposes virtual objects over the real-world environment and lets them interact with the real-world environment. The paper discussed the application which is based on Augmented reality. Nowadays, AR technology is acquiring almost every field of study. Interior Designing is one of them. This proposed project aims to enhance the method of interior design using Augmented Reality. We are implementing an application based on Augmented Reality which will help interior designers or Architects to design the home interior of their clients so easily and quickly. The demand for the well decorative and furnished house of our own choice is high due to the rise in population. Hence, many organizations are focusing on this field to enhance the traditional technique.

This paper presents the application which will virtually display the type of interior designing a customer wants and accordingly, able to apply it in the real project. Basically, user can place virtual objects on the real-world which will allow them to design their interior of the house using this simple mobile application. In this tough competition in the field of interior design, this application will provide a lot of features. We aimed to enhance the current interior designing process by reducing effort and time. Our application will also include multiple textures and designs so that there will be a large variety for the customers to choose from. Hence, the clients will be able to view the interior plan before the actual implementation and thus, can customize their designs instantly at that very time. The system will provide a user interface to augment the 3d object models in the room.
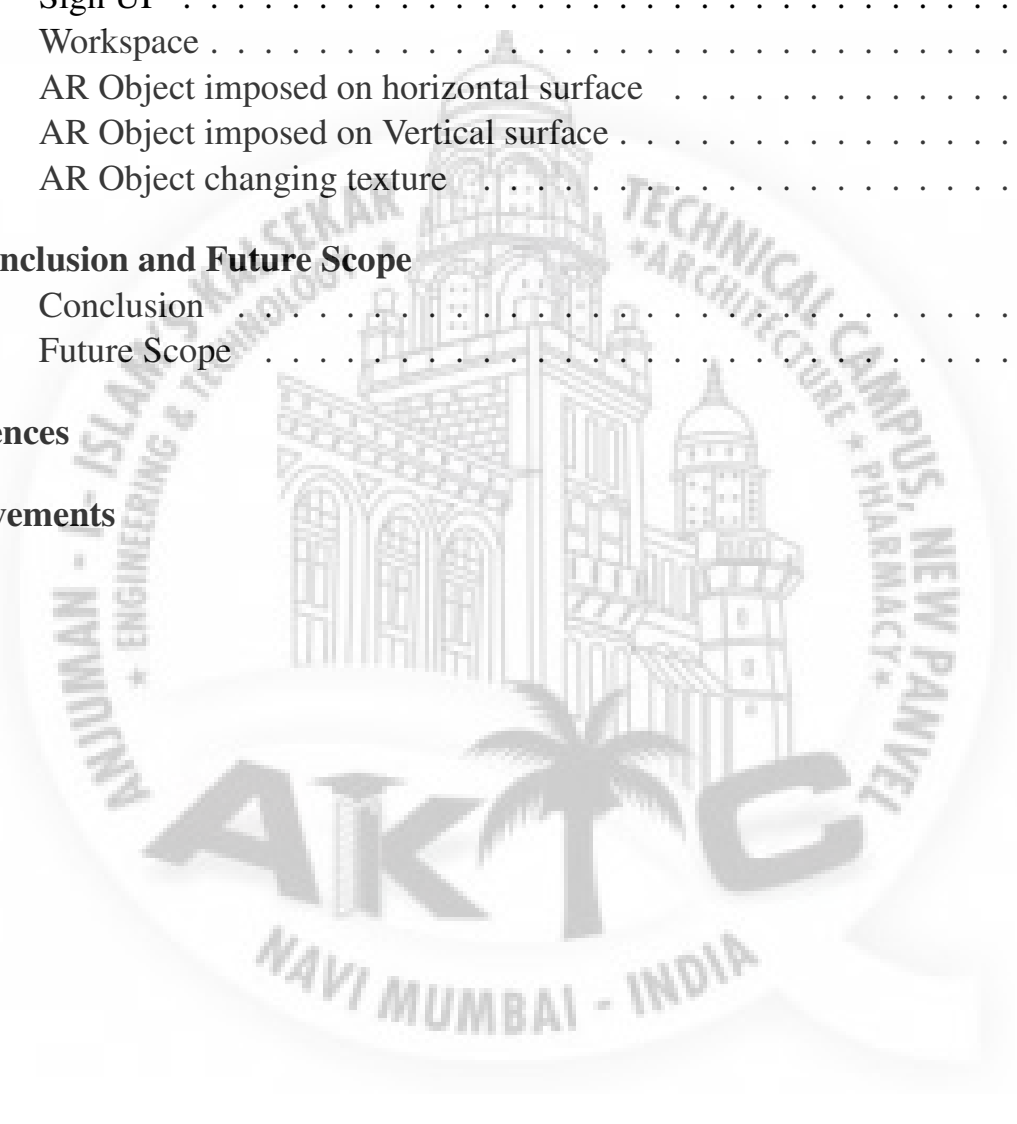
Keywords: Augmented Reality, virtual, interaction, android, marker-less, surface detection, interior design, architecture, 3D virtual model.

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Chapter 1

Introduction

Portraying how any object is going to seem in any part of the room is considerably troublesome for anyone. Hence, Augmented reality is inaugurated into the real world. Basically, this technology is placing a virtual object into the real world. This makes it easy for the customer to visualize an object in his room before even purchasing it. This application includes two types of Augmented Reality having a common medium. Implementing an application that will help an Architecture/interior designer to design the home interior and furniture for their customers through Augmented reality in an effective manner with no time and presenting the facility to the customer to customize their interior design virtually before actually composing it. This will be done by augmenting 3D models of furniture and decor in the virtual room through the camera. Our objective is to change the perspective of looking at things and to improve the vision. Through Augmented Reality, computer-generated object knows models, especially 3D models, are delivered to the real world. This can help the interior designer and customers to visualize the interior of a room in a more beneficial and helpful way. Another intention of creating this application is conserving lots of time of interior designing process which includes manual modeling of a room interior which approximately takes 2-3 weeks. We also endeavored to connect our clients and owner (designer) to present them with satisfying results.

Augmented Reality is very trending these days, and as the time will pass, it will become more common since smartphones and devices used for AR are becoming popular.AR allows us to see the mixed reality that exists. Like gardens and plants swaying, children playing and buildings built. Many of these examples are available on our smartphones, which are not that different. Augmented Reality is already so much in trend that, it is used in our day to day lives, like Snapchat, while we use filters. Another example is that we don't have to go out for shopping when it comes to clothes, since we can virtually wear clothes to see how they are going to look if we were them in reality. The most famous example of Augmented Reality is the game PokemonGo. this game was launched in 2016 and it became one of the most trending games. In this game, the players have to capture the pokemons from anywhere around the world and collect them.

1.1 Purpose

The main purpose of this project is to allow the clients and the designers to have an easy experience. It will meet their needs with the latest technology of Augmented Reality. It will be easy to handle and there will be no complications while using the application. The goal will be to lessen the time and effort giving a perfect result to the client. The client will be able to choose furniture and other decor as per his choice, depending on the colour and type. He can preview it before actually buying it, which makes it so much more convenient.

1.2 Project Scope

- Our Application can be used for many companies / industries, etc. which are related to architecture or interior designing.

- This App can also be helpful for designers to use the required amount and type of material as per the demand of the customer.

- It also helps in attracting customers to try and experiment new things for their home décor.

- A lot of time is saved for the designer as well as the customer.

- Our application can be used in architecture building planning, real estate, e-commerce, etc.

- Realtime Visualisation is possible.

1.3 Project Goals and Objectives

1.3.1 Goals

- Provide solution that will make the process of interior designing easy and convenient.

- Allowing the clients to handle the application too.

- To save the extra effort and time taken in the process.

- Lower the cost of actual process that includes a lot of work compared to doing it with mobile AR technology .

1.3.2 Objectives

- The objective of the project is to show how Augmented Reality can change the perspective of interior designing process.

- To study the applications of Augmented Reality.

- To understand the process of Augmented Reality step by step.

- To understand how to apply and use the technology in the applications.

1.4 Organization of Report

The report is organized as follows : The introduction is given in Chapter 1. It describes the fundamental terms used in this project. It describes the Goal, Objectives and scope of this project. The Chapter 2 describes the review of the relevant various techniques in the literature systems. It describes the pros and cons of each technique with how to overcome those cons using new technology.The project planning includes members and capabilities of this project ,roles and responsibilities of each member,Budget of Project and Project timeline is describe in Chapter 3. The Chapter 4 describes Functional and Nonfunctional Requirements of the project. Along with this it also explain features of system and constraints of system. The Chapter 5 includes Design Information with Class Diagram, Sequence Diagram , Component Diagram and System Architecture. Implementation of each module is explained in Chapter 6. Chapter 7 shows final Test Cases and Test Results. Chapter 8 includes Screenshot of outputs and Conclusion and Future Scope of the Project is described in Chapter 9.

Chapter 2

Literature Survey

2.1 Augmented Reality Application for Architects and interior designers: Interno A cost effective solution

The inner depth on how the augmented reality can be implemented to facilitate the architects and interior designers as well as, it discusses the algorithm used to achieve the functionalities.The application exhibits two types of Augmented reality, Marker less and marker based. The novelty of this project is that it does not require any sort of expensive gadgets. It can be used easily via smartphones and tablets. It is also operable on any operating system. This is a cost-effective solution that primarily reduces the overheads that the interior designers and architects confront on a daily basis. The software exhibits all the features that might be required by interior designers and architects respectively.

2.1.1 Advantages of Paper

a. Augment Multiple object at run-time.

b. Manipulate 3D object.

c. Change texture of model.

2.1.2 Disadvantages of Paper

a. Do not have 3D view of the object.

b. Don't connects customer with the client.

c. Can't save the scene for further use.

2.1.3 How to overcome the problems mentioned in Paper

a. Our application overcomes these problems by connecting designers and customers so that they can be able to have a communication.

b. It also allows the user to view from different angles as per the need of the user.

c. we can have the 3D view of the augmented object.

2.2   Interior Design with Augmented Reality

An application of Augmented Reality (AR) for interior design is created. Due to huge advancements in computer vision algorithms and cheap hardware, Augmented Reality is becoming mainstream. Furniture retail is a significant aspect of USA economy with over 100 billion dollars in sales. However, most of the sales come from physical stores. Buying furniture from brick and mortar shops is cumbersome and time consuming. AR is changing the furniture industry. Big players like IKEA, Wayfair, and Target are using this technology to boost sales by creating engaging Omni channel experience. In an AR environment, virtual furniture could be placed and manipulated in the physical world in real time which allows the user to have an interactive experience. Users would be able to visualize exactly how a table would look like in their kitchen. People can place an actual couch on the living room or visualize how a bookshelf would look in different color. The risk of product return and logistics is drastically reduced. As online stores replace brick and mortar shops, AR will play a vital role in the furniture sales. It provides new ways that an individual or enterprise could utilize AR to design interiors.

2.2.1   Advantages of Paper

a. we can have the 3D view of the augmented object.

b. 3D object can be manipulated.

c. we can add multiple object at Run-time.

2.2.2   Disadvantages of Paper

a. unable to change the texture of the 3D model.

b. Do not connect customer and designer.

c. Do not save the scene for further use.

2.2.3   How to overcome the problems mentioned in Paper

a. Our application allows to change different textures of the models at run-time.

2.3   A design support system for indoor design with originality suitable for interior style

A design support system is provided to make a room design with freshness and originality, impression suitable for user's requirement interior styles. The system supports to create the design plan through two steps: Creation process and Selection process. In the creation process, the system generates various design ideas by using several style furniture. In the selection process, the system selects the idea appropriate for their preference of interior styles by making a design style classifier using Naive Bayes. They describe the subjective evaluation to 24 research participants through the application built on the proposed system. They show the proposed system can create the design idea that a user is satisfied from the result of subjective evaluation concerning the planned idea by analysing 659 data collected from the participants.

2.3.1   Advantages of Paper

a. we can add multiple object at Run-time.

b. Texture of model can be change.

c. Have multiple design of the model.

2.3.2   Disadvantages of Paper

a. Do not have 3D view of the object.

b. 3D object cannot be manipulated. not connect customer and designer.

2.3.3   How to overcome the problems mentioned in Paper

a. Multiple models can be placed in the real world.

2.4   Technical Review

These are the following softwares that we have used for our applications:-

- **AR Core:-**
  ARCore is a software development kit developed by Google that allows for augmented reality applications to be built. ARCore uses three key technologies to integrate virtual content with the real world as seen through your phone's camera:
  1.Motion tracking allows the phone to understand and track its position relative

to the world.

2.Environmental understanding allows the phone to detect the size and location of flat horizontal surfaces like the ground or a coffee table.

3.Light estimation allows the phone to estimate the environment's current lighting conditions.

- **Unity:-**
  Unity is a cross-platform game engine developed by Unity Technologies. Unity gives users the ability to create games and experiences in both 2D and 3D, and the engine offers a primary scripting API in C, for both the Unity editor in the form of plugins, and games themselves, as well as drag and drop functionality. As of 2018, Unity had been used to create approximately half of the mobile games on the market and 60 percent of augmented reality and virtual reality content, including approximately 90 percent on emerging augmented reality platforms, such as Microsoft HoloLens, and 90 percent of Samsung Gear VR content. Unity technology is the basis for most virtual reality and augmented reality experiences, and Fortune said Unity "dominates the virtual reality business".

- **Blender:-**
  Blender is a free and open-source 3D computer graphics software toolset used for creating animated films, visual effects, art, 3D printed models, motion graphics, interactive 3D applications, and computer games. Blender's features include 3D modeling, UV unwrapping, texturing, raster graphics editing, rigging and skinning, fluid and smoke simulation, particle simulation, soft body simulation, sculpting, animating, match moving, rendering, motion graphics, video editing, and compositing.

- **Mongo DB:-**
  MongoDB is a cross-platform document-oriented database program. Classified as a NoSQL database program, MongoDB uses JSON-like documents with schema. MongoDB is developed by MongoDB Inc. and licensed under the Server Side Public License (SSPL).

2.4.1   Advantages of Technology

a. ARCore is Software Development Kit(SDK) for creating augmented reality apps. The best thing about ARCore is that it supports development for both Android (7.0 and higher) IOS platforms (11 or higher).

b. ARCore offers points, plane detection, pose, light estimation, anchors, image tracking, face tracking, object occlusion, and cloud anchors.

c. ARCore supports many existing devices eliminating the need for any specific hardware, e.g. a specialized camera or sensor.

d. The ARCore development toolkit is available for free.

2.4.2   Reasons to use this Technology

a. ARCore provides SDK for developing AR apps which will work on both popular devices i.e. Andriod(version 7.0 and later) and IOS(version 11 and later) .

b. ARCore offers a very good accuracy while detecting planes and edges.

c. With the capabilities of real-time position tracking and integration of virtual and real objects, ARCore is a great tool for AR in this types apps.
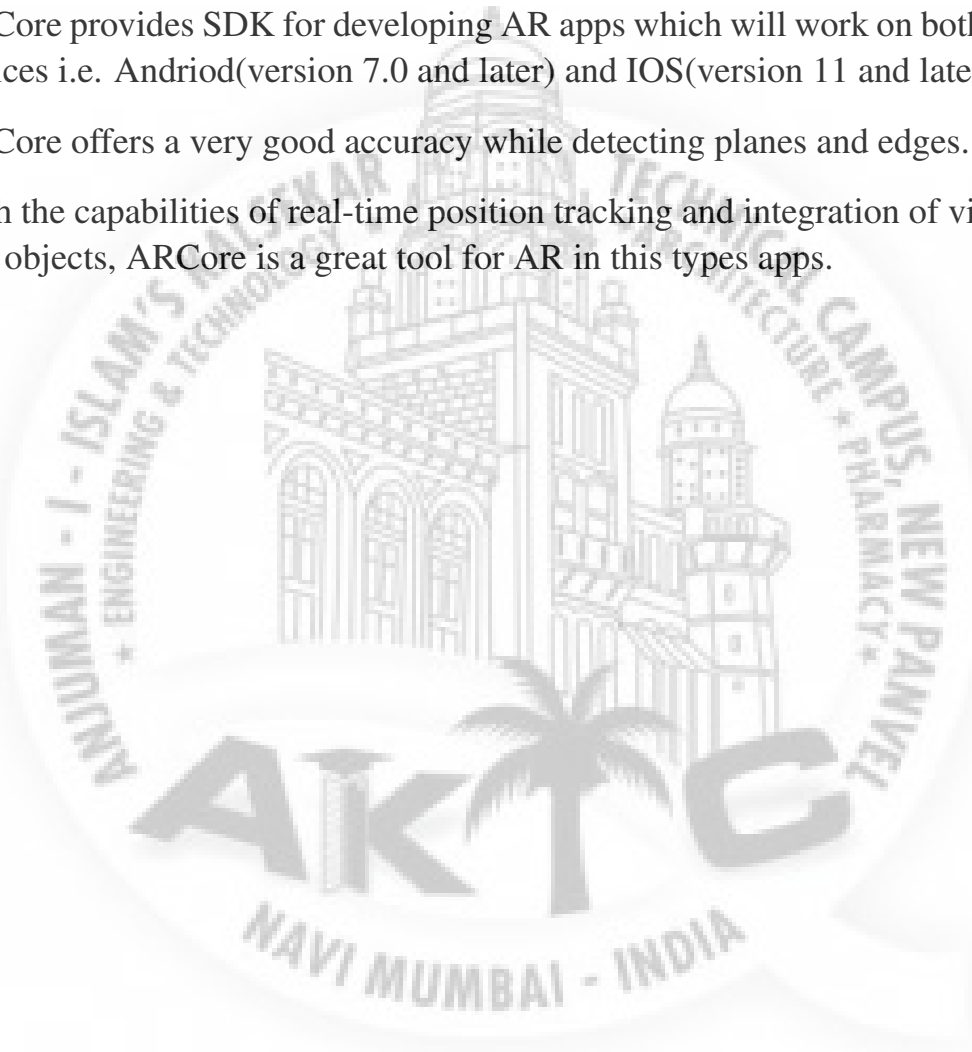
Chapter 3

Project Planning

3.1 Members and Capabilities

Table 3.1: Table of Capabilities

SR. No	Name of Member	Capabilities
1	Choudhary Shoaib	Unity Developer
2	Shaikh Mobin	Backend Developer
3	Qureshi Arshee	Designer

Work Breakdown Structure

3.2 Roles and Responsibilities

Table 3.2: Table of Responsibilities

SR. No	Name of Member	Role	Responsibilities
1	Choudhary Shoaib	Team Leader	AR and Ui Design
2	Shaikh Mobin	Team Member	Database Management
3	Qureshi Arshee	Team Member	3D Modelling and Documentation

3.3 Assumptions and Constraints

a. People who are using this app are blind/severely sight impaired or having low vision.

b. This application is useful for the company who decorate the home interior basically, the interior designer.

c. User of this application are moderately know about the interior designing.

d. The device have support of andriod version 7 or later/ IOS version 11 or later.

e. The device have a support for mobile AR technology.

3.4   Project Management Approach

a. Planning of project.

b. Defining the scope of the project.

c. Estimation of time and It's management.

d. Creating Gantt Charts and properly assigning tasks to members.

e. Reporting the progress of project with the guide.

3.5   Ground Rules for the Project

a. Properly planning and gathering relevant information is very important.

b. Developing a Blueprint of the project and work accordingly.

c. All the members should report to the guide whenever required

d. Setting up small goals every week.

e. Achieving the small goal within that span of time.

f. Keeping tracks of the progress towards project.

3.6   Project Budget

a. It is a cost-effective project.

b. Almost no expenses were spent during development.

3.7 Project Timeline
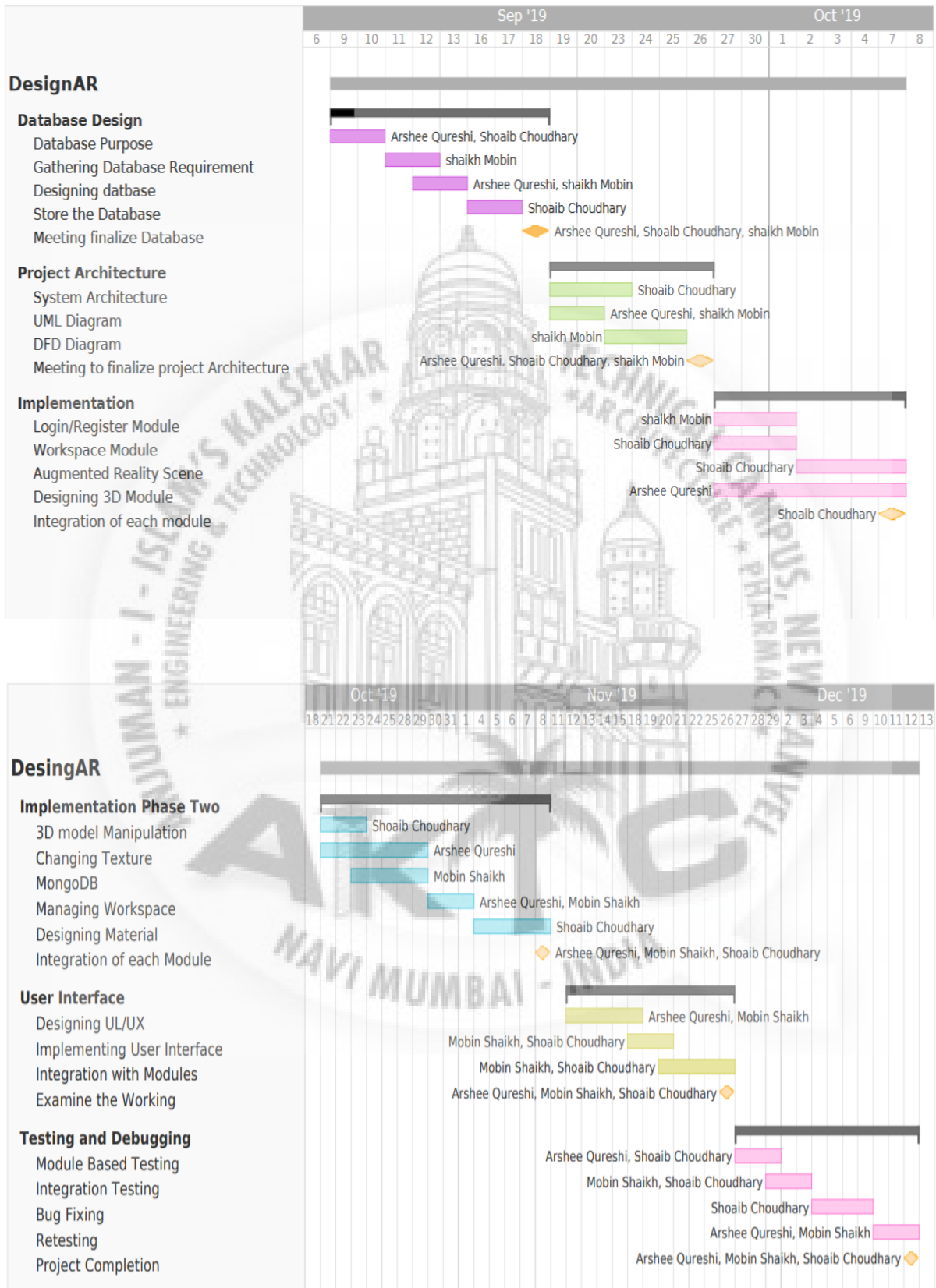
Chapter 4

Software Requirements Specification

4.1   Overall Description

4.1.1   Product Perspective

The product is an application based system implementing client-server model. This application provides service to the interior designers as well as the customers. This system is independent from any other third party systems. The main outcome is a platform where a customer's room can be designed as per his will. The walls and floors will be detected on the screen. The designer will have the details of all the customers who have hired them for designing. The customer can also login into the application to make his choice. The designer can have the details of as many customers as he wants. The designs can be modified as many times as a customer wants to.

4.1.2   Product Features

3D object tracking allows the users to place three-dimensional objects as AR markers on the screen anywhere.
Image recognition is used to identify objects, walls and floors.
Unity support is used for making powerful effects.
AR Core is used for motion tracking and environmental understanding.

4.1.3   User Classes and Characteristics

This project is specifically made for interior designing. The users of this system are customers as well as the designers. It will help them to make the process of interior designing easy.

4.1.4   Operating Environment

Software Requirements

- Android Nougat and above.

- Android API Level 27 and above.

- Android API Level 27 and above.

Hardware Requirements

- Minimum 2 GHz Processor.

- Minimum 3GB Ram.

- At Least 8 MP Camera.

4.1.5   Design and Implementation Constraints

This system suffers from lack of privacy problem. Lack of security may affect the overall augmented reality principle. Sometimes the furniture and colour may vary online and in real life.

4.2   System Features

3D object tracking allows the users to place three-dimensional objects as AR markers on the screen anywhere.
Image recognition is used to identify objects, walls and floors.
Unity support is used for making powerful effects.
AR Core is used for motion tracking and environmental understanding.

4.2.1   System Feature

3D object tracking provides the users the ability to place 3D objects on the screen.

Description and Priority

This is an important feature of the system. It enables the user to place three dimensional objects anywhere on the screen. Hence, the furniture can be placed anywhere in the room virtually which will help to visualize how it will look in real life.

Stimulus/Response Sequences

Stimulus:User taps on the object which he wants to move.
Response:Object is selected.
Stimulus:Drags the object to a particular place of his own choice.
Response:The object moves as per the user's will.
Stimulus:User places the object where he wants.
Response:The object is placed where the user was willing to place.

Functional Requirements

REQ-1:Should be given access to camera.
REQ-2:Access to database

4.2.2   System Feature

Image recognition provides the ability to the user for identifying objects, walls and floors.

Description and Priority

This is one of the main features of the system. It enables the user to detect floors and walls on the screen. Depending on that, the furniture will be superimposed at a valid part of the room.

Stimulus/Response Sequences

Stimulus:User taps on the object which he wants to move.
Response:Object is selected.
Stimulus:Drags the object to a particular place of his own choice.
Response:During this time the image recognition detects floor and walls area.
Stimulus:User places the object at a valid place depending on where the floor and walls are situated.
Response:The object is placed with respect to the walls and floor.

Functional Requirements

REQ-1:Should be given access to camera
REQ-2:Access to database

4.3   External Interface Requirements

4.3.1   User Interfaces

This is a little heavy android app because it consists 3D models. The GUI is very simple for this android application. There is a login or sign-up page. Then a workspace page will appear where the user's details will be stored. A scene will appear along with an object palette beside it. The user can choose any object has per his desires from the object palette. And then he can place the selected object onto the screen. There will also be a save button for saving the AR scene.

4.3.2 Hardware Interfaces

This application requires permission of some of the hardware commodities. One need to give camera access in-order to capture the picture.

4.3.3 Software Interfaces

The softwares that we have used for this application are Unity, which is a cross-platform game engine. Its engine offers a primary scripting API in C. Blender is also used for creating the 3D models of the objects. Mongo DB is also used. It uses JSON like documents with schema. AR Core is used for motion tracking, environmental understanding and light estimation.

4.3.4 Communications Interfaces

A login or sign-up page is used for the customers as well as the designers. There is no such large communication in the system.

4.4 Nonfunctional Requirements

4.4.1 Performance Requirements

Performance of overall system is very efficient and well optimize. From the time taken to capture and process it everything is well organized. While processing an image, it may take the same time for the other operations.

4.4.2 Safety Requirements

This system does not contain any critical data. Still it provide. The databases that are accessed are locally executed

4.4.3 Security Requirements

This system contains basic details of the customer which can create security issues. The requirement for the safety of the customer's private details would be that, only the designer who is in charge of working for the customer should have their details.

Chapter 5

System Design

5.1 System Requirements Definition

5.1.1 Functional requirements

The basic functions that the system must provide and focus on the needs and goals of the end users are :-

a. Create works pace - user must create work space for a particular client and assign a name to it.

b. User form - user must fill the form with client's detail.

c. Create AR space - After done with the details user must open the AR space by opening the camera.

d. Detect surface - As the AR space is created, user should start detecting surface by rotating the device 360 degree.

e. Choose object - Across the screen there will be a pallet to select the object to augment it.

f. Augment object - The chosen object will be augmented by tapping once on the AR space. Users can manipulate the object by pinching zoom in or out and they can place them anywhere in the AR space as per their wish.

g. Save scene - After user decorated the AR space by augmenting all the objects, they can save the scene by click on save button so it can be user further.

Use-case Diagram

A use case diagram at its simplest is a representation of a user's interaction with the system that shows the relationship between the user and the different use cases in which the user is involved.In our system User will interact with use cases like create work space, open AR scene, save scene.
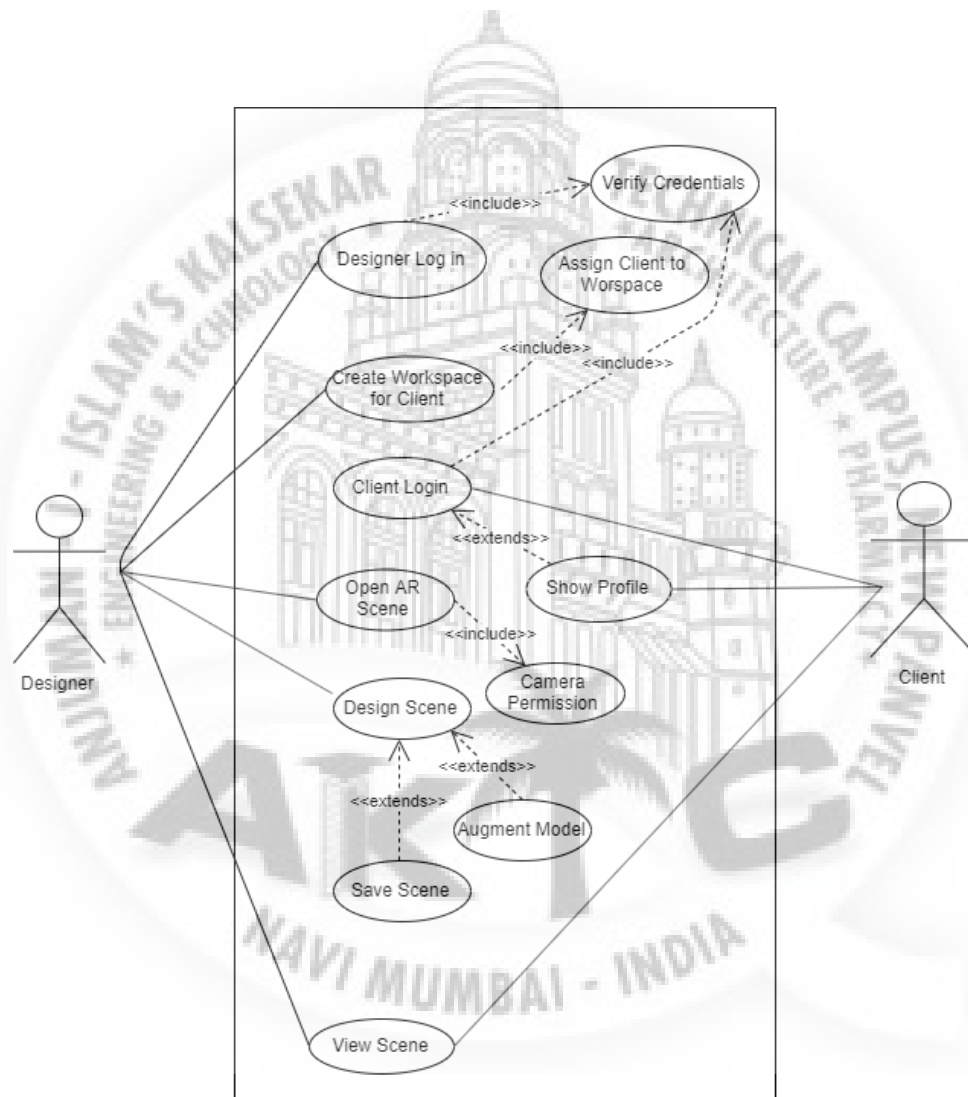

Figure 5.1: Use Case Diagram

Data-flow Diagram

A data-flow diagram is a way of representing a flow of a data of a process or a system. The DFD also provides information about the outputs and inputs of each entity and the process itself.Given below is Level 0 Level 1 and Level 2 DFD of system.
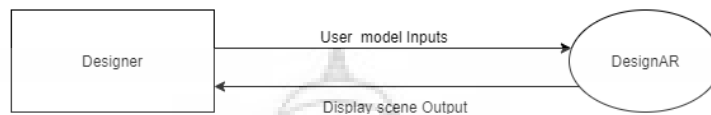
Level 0:

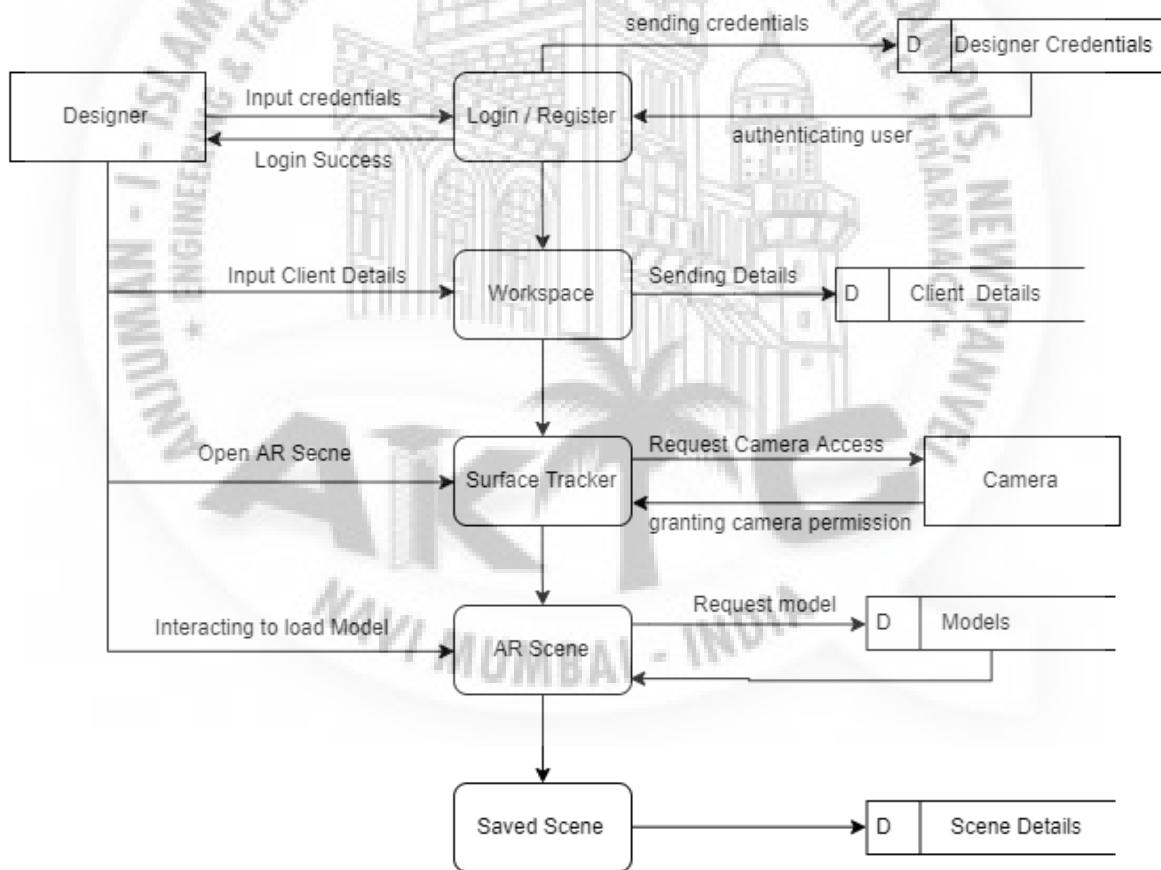**Figure 5.2:** DFD level 0

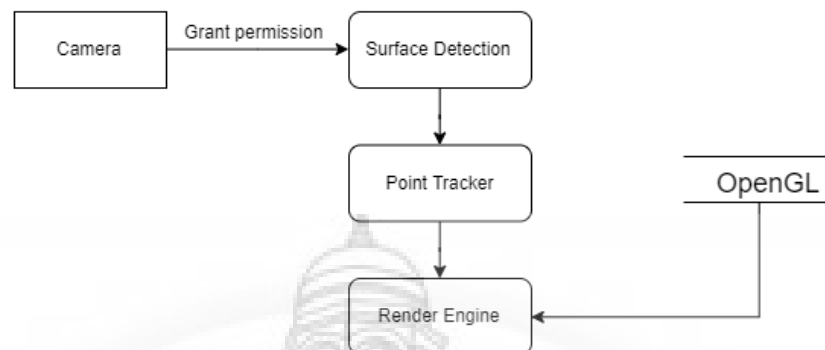Level 1:

Figure 5.3: DFD level 1

Level 2 :

AR Component:

Figure 5.4: DFD level 2 for AR Component

5.1.2 System requirements (non-functional requirements)

These are non-functional system properties such as availability, performance and safety etc. They define functions of a system, services and operational constraints in detail.

a. Time Efficiency - The execution of the system takes very less time.

b. Portability - The system needs to be installed in any andriod device which is so portable.

c. Performance - The system will work fine in every AR supported andriod devices.

d. Multi User System - This application can be used in different devices independently.

e. User Interactive - The application have a very simple User Interface though AR application is different than other.

f. Security - There are no vulnerability in its security.

5.2 System Architecture Design

A system architecture is the conceptual model that defines the structure, behavior,and more views of a system. An architecture description is a formal description and representation of a system, organized in a way that supports reasoning about the structures and behaviors of the system.
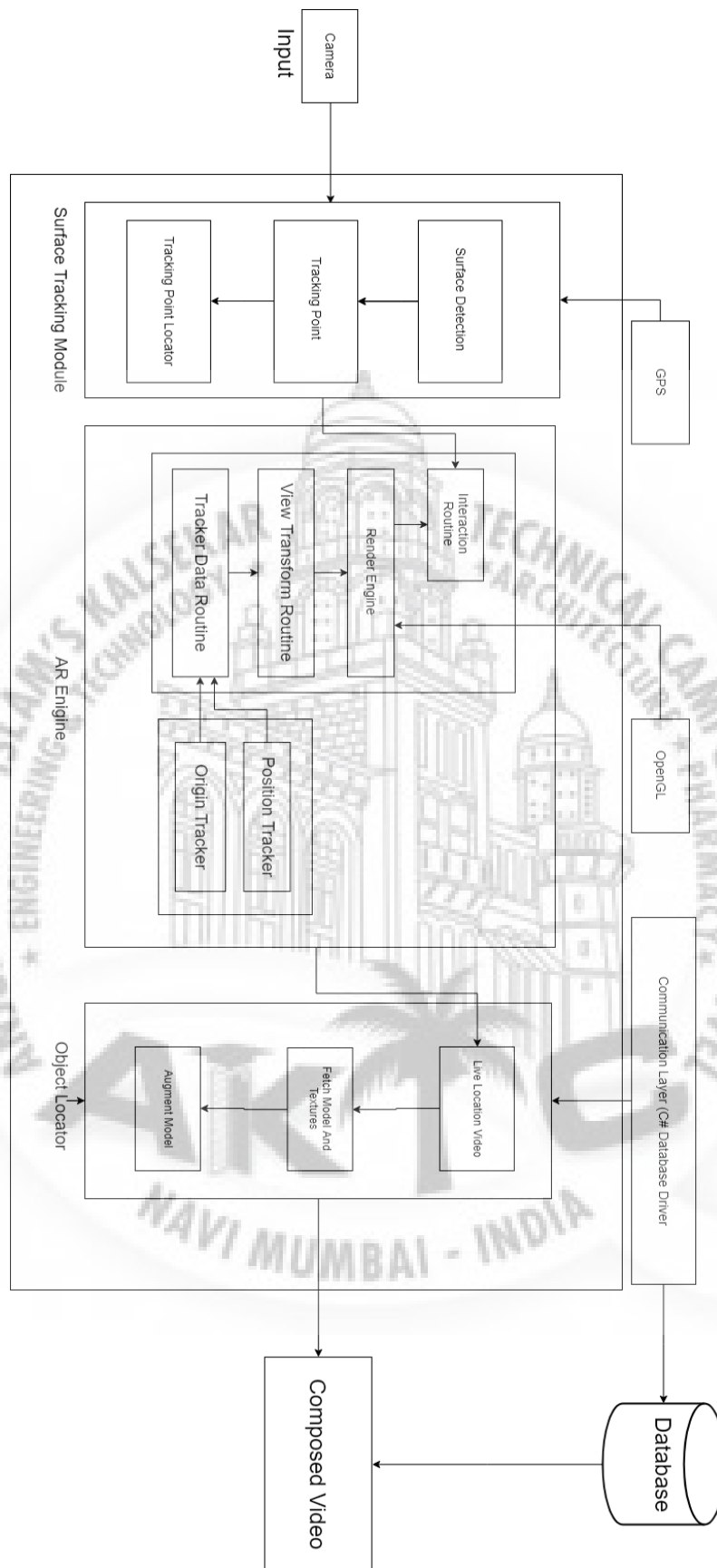
Figure 5.5: System Architecture

5.3 Sub-system Development

WRITE HERE overview of all modules

5.3.1 Surface Tracking Module

A technology that places a digital 3D content over real world's environment by detecting the surface or we can say that placing the digitally created 3D objects over the real-world surface without having any previous knowledge of the environment. Markerless AR recognizes the flat surfaces which are unknown to the application and show the virtual things over it.

Module 1 Flow Diagram or Modular Diagram

5.3.2 AR Engine

An augmented reality engine, or AR engine, provides developers with the framework for creating AR video experiences. An AR engine often contains an augmented reality SDK, which allows developers to design, build, and test their games. These tools enable developers to create and edit 3D characters that interact with the real world. With the help of these platforms, developers can assign behaviors to 3D objects and upload them for display in a camera view. AR engines perform similar functionality to engine software, but are unique in that they support AR operating systems and hardware either directly or through an API. AR engines create games for devices that support augmented reality, such as mobile phones. While some AR engines can also create augmented reality experiences, they should not be confused with virtual reality engines, which allow developers to create augmented reality video experiences that superimpose 3D objects into the real world.

Module 2 Flow Diagram or Modular Diagram

5.3.3 Object Locator Module

When the model is applied to every frame captured by the mobile device, it can suffer from jitter due to the ambiguity of the 3D bounding box estimated in each frame. To mitigate this, we adopt the detection+tracking framework recently released in our 2D object detection and tracking solution. This framework mitigates the need to run the network on every frame, allowing the use of heavier and therefore more accurate models, while keeping the pipeline real-time on mobile devices. It also retains object identity across frames and ensures that the prediction is temporally consistent, reducing the jitter.

Module 3 Flow Diagram or Modular Diagram

5.4   Systems Integration

System integration (SI) is an engineering process or phase concerned with joining different subsystems or components as one large system. It ensures that each integrated subsystem functions as required. SI is also used to add value to a system through new functionalities provided by connecting functions of different systems

5.4.1   Class Diagram

In software engineering, a class diagram in the Unified Modeling Language is a type of static structure diagram that describes the structure of a system by showing the system's classes, their attributes, operations, and the relationships among objects.In our system there are classes like work space, scene, model, client profile, designer profile.
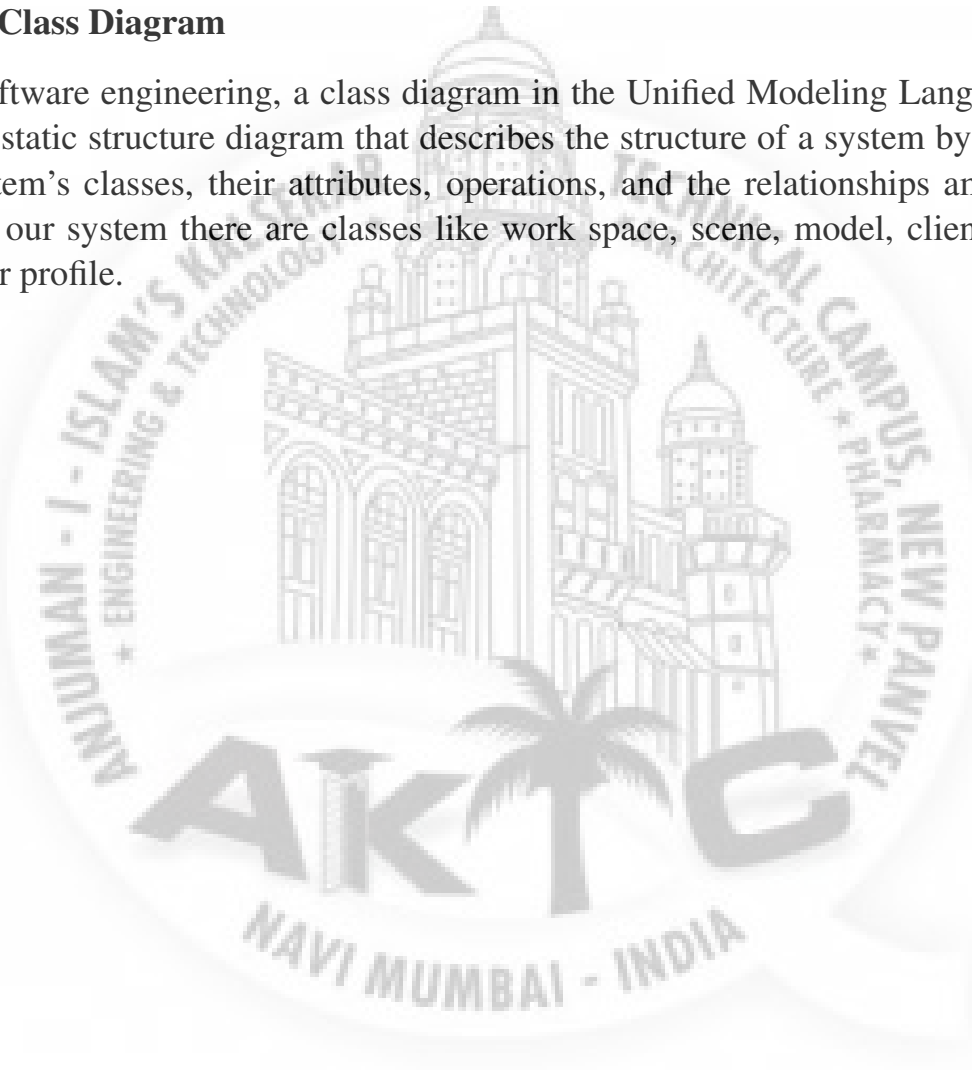
Figure 5.6: Class Diagram

5.4.2 Sequence Diagram

A sequence diagram shows object interactions arranged in time sequence. It depicts the objects and classes involved in the scenario and the sequence of messages exchanged between the objects needed to carry out the functionality of the scenario.
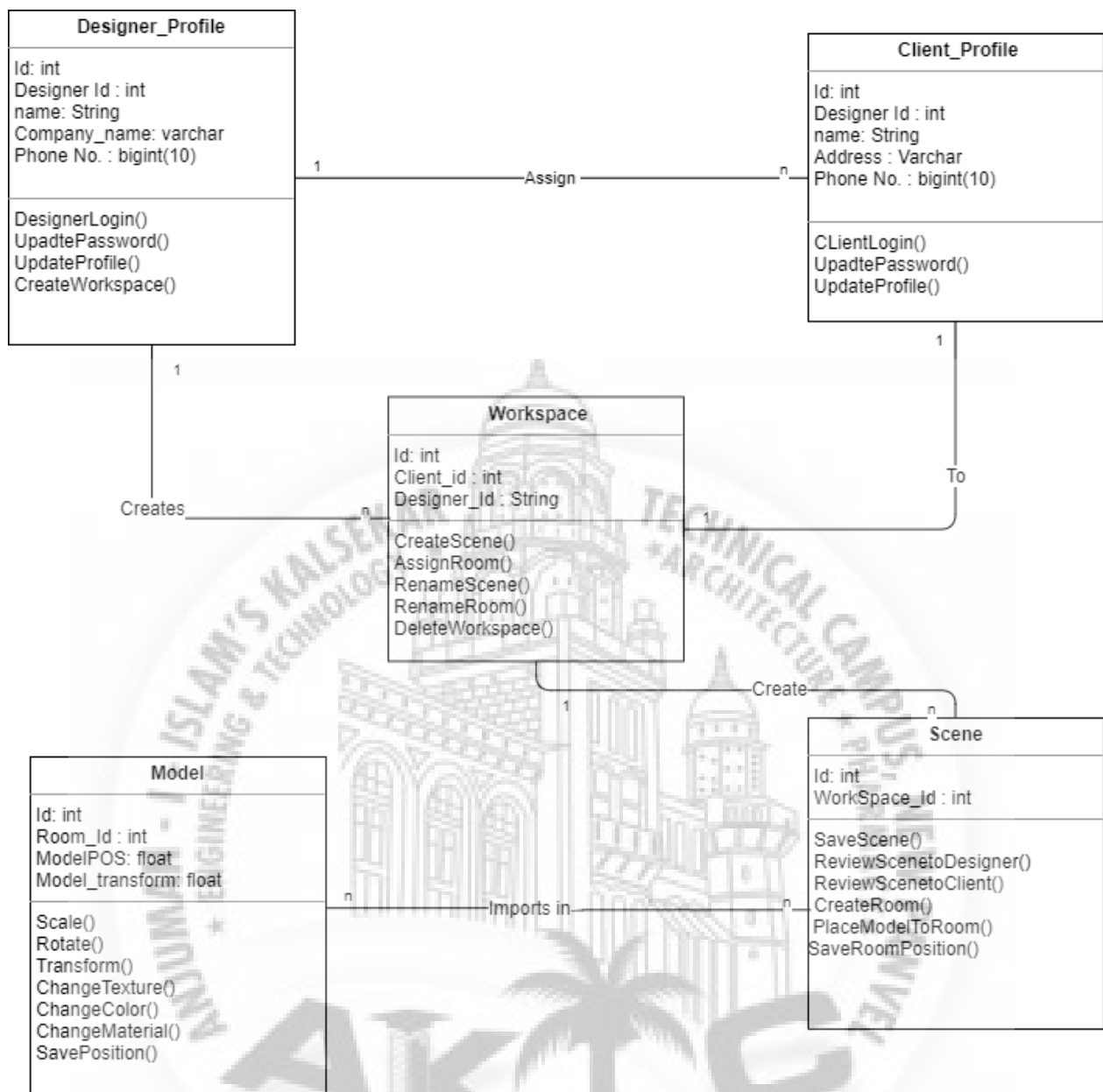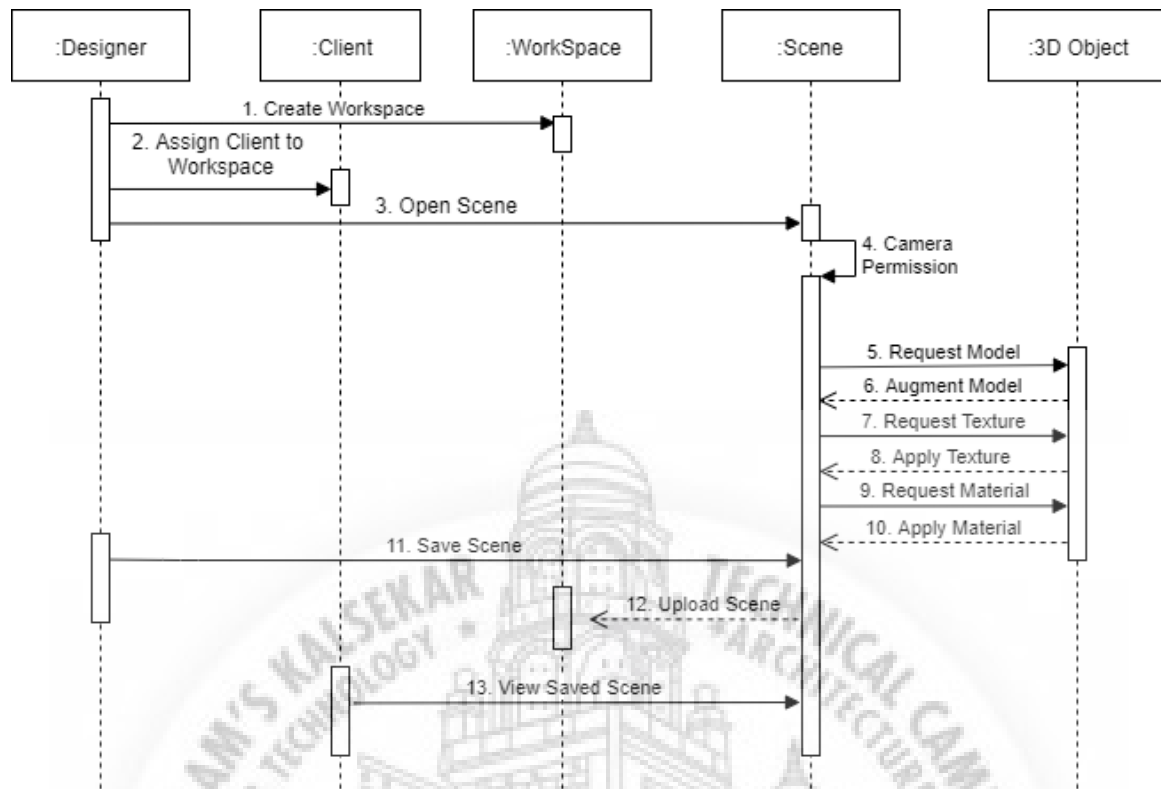
Figure 5.7: Sequence Diagram

Chapter 6

Implementation

6.1   Login Sign UP Module

This Module is implemented in Unity using Firebase as a database and authentication server for the user and designer to login.

```csharp
using System.Collections;
using System;
using System.Text.RegularExpressions;
using System.Collections.Generic;
using UnityEngine;
using Firebase.Auth;
using System.Threading.Tasks;
using UnityEngine.UI;
using UnityEngine.SceneManagement;
using TMPro;

public class SinginAUth : MonoBehaviour
{
    FirebaseAuth auth;
    public InputField emailInput;
    public InputField emailLogin;
    public InputField passwordInput;
    public InputField passwordLogin;
    public string emailAddress;
    public string password;
    public GameObject loginPanel;
    public GameObject createuserpanel;
    public bool done;


    public GameObject logingin;
    public GameObject loginfailedPanel;

    private void Start()
    {
        auth = FirebaseAuth.DefaultInstance;
        done = false;
    }

    public void emailAssign()
    {
        emailAddress = emailInput.text;
    }

      public void EmailLogin()
```

```
41      {
42          emailAddress = emailLogin.text;
43      }
44
45   public void PasswordAssign()
46   {
47       password = passwordInput.text;
48   }
49    public void PasswordLogin()
50    {
51       password = passwordLogin.text;
52    }
53
54
55   public void CreateUSerButton()
56   {
57       auth.CreateUserWithEmailAndPasswordAsync(emailAddress, password).
           ContinueWith(task =>
58      {
59           if (task.IsCanceled)
60           {
61
62                Debug.Log("SignInWithEmailAndPasswordAsync canceled.");
63                return;
64           }
65
66           if (task.IsFaulted)
67           {
68                Debug.Log("SignInWithEmailAndPasswordAsync error: " + task.
                    Exception);
69                return;
70           }
71           createuserpanel.SetActive(false);
72
73           print("Create User");
74      });
75      loginPanel.SetActive(true);
76   }
77
78
79
80
81   public void SingingButton()
82   {
83       logingin.SetActive(true);
84
85       auth.SignInWithEmailAndPasswordAsync(emailAddress, password).
           ContinueWith(task =>
86      {
87           if (task.IsCanceled)
88           {
89                Debug.Log("SignInWithEmailAndPasswordAsync canceled.");
90                return;
91           }
92
93           if (task.IsFaulted)
94           {
95                Debug.Log("SignInWithEmailAndPasswordAsync error: " + task.
                    Exception);
96                return;
97           }
```

```
98          SceneManager.LoadScene(1);
99      });
100
101  }
102
103 }
```

6.2 Work-space Management

This Module is for creating and managing the work-spaces for user by the Designers.

```csharp
using System.Collections;
using System.Collections.Generic;
using UnityEngine;
using UnityEngine.SceneManagement;
using UnityEngine.UI;

public class workspaces : MonoBehaviour
{
    [SerializeField] string nameFromEditText;
    [SerializeField] InputField EditTextField;
    [SerializeField] Dropdown dropdown;
    List<string> WorkspaceNameList;

    private void Start()
    {
        WorkspaceNameList = new List<string>();
    }

    public void NameText()
    {
        nameFromEditText = EditTextField.text;
        print(nameFromEditText);
    }


    public void CreateWorkspace()
    {
        WorkspaceNameList.Add(nameFromEditText);
         dropdown.ClearOptions();
        dropdown.AddOptions(WorkspaceNameList);
    }

    public void loadNewWorkspace()
    {
        SceneManager.LoadScene(2);
    }

    public void Loadhome()
    {
        SceneManager.LoadScene(0);
    }
}
```

6.3   AR Module

This is the core module of this system.It is the Augmented reality Module built using Unity and AR Core Engine.In this Module the 3D object is Augmented into the real world by using Algorithms like surface detection,.

```
1  namespace GoogleARCore.Examples.HelloAR
2  {
3      using System.Collections.Generic;
4      using GoogleARCore;
5      using GoogleARCore.Examples.Common;
6      using UnityEngine;
7      using UnityEngine.EventSystems;
8      using UnityEngine.UI;
9
10 #if UNITY_EDITOR
11     // Set up touch input propagation while using Instant Preview in the editor.
12     using Input = InstantPreviewInput;
13 #endif
14
15     /// <summary>
16     /// Controls the HelloAR example.
17     /// </summary>
18     public class HelloARController : MonoBehaviour
19     {
20         /// <summary>
21         /// The first-person camera being used to render the passthrough camera
                image (i.e. AR
22         /// background).
23         /// </summary>
24         public List<GameObject> ModelsList;
25
26         public Camera FirstPersonCamera;
27         GameObject andyObject;
28         public bool placed;
29
30         public static int modelSelected;
31
32         /// <summary>
33         /// A prefab for tracking and visualizing detected planes.
34         /// </summary>
35         public GameObject DetectedPlanePrefab;
36
37         /// <summary>
38         /// A model to place when a raycast from a user touch hits a vertical
                plane.
39         /// </summary>
40         public GameObject AndyVerticalPlanePrefab;
41
42         /// <summary>
43         /// A model to place when a raycast from a user touch hits a horizontal
                plane.
44         /// </summary>
45         public GameObject[] AndyHorizontalPlanePrefab;
46
47         public GameObject AndyHorizontalPlane;
48
49         /// <summary>
50         /// A model to place when a raycast from a user touch hits a feature
                point.
```

```csharp
51          /// </summary>
52          public GameObject AndyPointPrefab;
53
54          /// <summary>
55          /// The rotation in degrees need to apply to model when the Andy model
                is placed.
56          /// </summary>
57          private  float k_ModelRotation = 0.0f;
58
59          /// <summary>
60          /// True if the app is in the process of quitting due to an ARCore
                connection error,
61          /// otherwise false.
62          /// </summary>
63          private bool m_IsQuitting = false;
64
65          /// <summary>
66          /// The Unity Awake() method.
67          /// </summary>
68          ///
69
70
71          public void Awake()
72          {
73              AndyHorizontalPlane = AndyHorizontalPlanePrefab[0];
74              // Enable ARCore to target 60fps camera capture frame rate on
                    supported devices.
75              // Note, Application.targetFrameRate is ignored when QualitySettings
                    .vSyncCount != 0.
76              Application.targetFrameRate = 60;
77              modelSelected = 0;
78              placed = false;
79          }
80
81          /// <summary>
82          /// The Unity Update() method.
83          /// </summary>
84          public void Update()
85          {
86
87              // If the player has not touched the screen, we are done with this
                    update.
88              Touch touch;
89              touch = Input.GetTouch(0);
90      //          if (Input.touchCount < 1 || (touch = Input.GetTouch(0)).phase !=
            TouchPhase.Began)
91      //      {
92      //      return;
93      //      }
94
95              // Should not handle input if the player is pointing on UI.
96              //          if (EventSystem.current.IsPointerOverGameObject(touch.
                    fingerId))
97              //      {
98              //              return;
99              //      }
100
101             // Raycast against the location the player touched to search for
                    planes.
102             TrackableHit hit;
103             TrackableHitFlags raycastFilter = TrackableHitFlags.
```

```
104              PlaneWithinPolygon |
               TrackableHitFlags.FeaturePointWithSurfaceNormal;
105
106        if (Frame.Raycast(touch.position.x, touch.position.y, raycastFilter,
             out hit) && !placed && !IsPointerOverUIObject())
107        {
108            // Use hit pose and camera pose to check if hittest is from the
109            // back of the plane, if it is, no need to create the anchor.
110            if ((hit.Trackable is DetectedPlane) &&
111                Vector3.Dot(FirstPersonCamera.transform.position - hit.Pose.
                   position,
112                  hit.Pose.rotation * Vector3.up) < 0)
113            {
114                Debug.Log("Hit at back of the current DetectedPlane");
115            }
116            else
117            {
118                // Choose the Andy model for the Trackable that got hit.
119                GameObject prefab;
120                if (hit.Trackable is FeaturePoint)
121                {
122                    prefab = AndyPointPrefab;
123
124                }
125                else if (hit.Trackable is DetectedPlane)
126                {
127                    DetectedPlane detectedPlane = hit.Trackable as
                       DetectedPlane;
128                    if (detectedPlane.PlaneType == DetectedPlaneType.
                     Vertical)
129                    {
130                        prefab = AndyVerticalPlanePrefab;
131                    }
132                    else
133                    {
134                        prefab = AndyHorizontalPlane;
135                    }
136                }
137                else
138                {
139                    prefab = AndyHorizontalPlane;
140                }
141
142                // Instantiate Andy model at the hit pose.
143                andyObject = Instantiate(prefab, hit.Pose.position, hit.Pose
                   .rotation);
144                ModelsList.Add(andyObject);
145                // Compensate for the hitPose rotation facing away from the
                   raycast (i.e.
146                // camera).
147                andyObject.transform.Rotate(0, k_ModelRotation, 0, Space.
                   Self);
148
149                // Create an anchor to allow ARCore to track the hitpoint as
                   understanding of
150                // the physical world evolves.
151                var anchor = hit.Trackable.CreateAnchor(hit.Pose);
152
153                // Make Andy model a child of the anchor.
154                andyObject.transform.parent = anchor.transform;
155
```

```
156                      placed = true;
157                  }
158              }
159
160
161              if (Frame.Raycast(touch.position.x, touch.position.y,
                      raycastFilter, out hit) && placed && !IsPointerOverUIObject
                      ())
162              {
163
164                      // Create an anchor to allow ARCore to track the
                          hitpoint as understanding of
165                      // the physical world evolves.
166                      var anchor = hit.Trackable.CreateAnchor(hit.Pose);
167
168                      // Make Andy model a child of the anchor.
169                      andyObject.transform.position = anchor.transform.
                          position;
170
171                  }
172
173              andyObject.transform.Rotate(0, k_ModelRotation, 0, Space.Self);
174      }
175
176      public void placeObject()
177      {
178          placed = false;
179      }
180
181      public void RotateObj()
182      {
183          k_ModelRotation = 1;
184      }
185
186      public void ChangeCHair(int index)
187      {
188          modelSelected = index;
189          AndyHorizontalPlane = AndyHorizontalPlanePrefab[index];
190          TextureController.materialSet = index;
191      }
192
193
194
195
196      /// <summary>
197      /// Check and update the application lifecycle.
198      /// </summary>
199
200
201      /// <summary>
202      /// Actually quit the application.
203      /// </summary>
204      private void _DoQuit()
205      {
206          Application.Quit();
207      }
208
209      /// <summary>
210      /// Show an Android toast message.
211      /// </summary>
212      /// <param name="message">Message string to show in the toast.</param>
```

```csharp
213         private void _ShowAndroidToastMessage(string message)
214         {
215             AndroidJavaClass unityPlayer = new AndroidJavaClass("com.unity3d.
                     player.UnityPlayer");
216             AndroidJavaObject unityActivity =
217                 unityPlayer.GetStatic<AndroidJavaObject>("currentActivity");
218
219             if (unityActivity != null)
220             {
221                 AndroidJavaClass toastClass = new AndroidJavaClass("android.
                         widget.Toast");
222                 unityActivity.Call("runOnUiThread", new AndroidJavaRunnable(()
                         =>
223                 {
224                     AndroidJavaObject toastObject =
225                         toastClass.CallStatic<AndroidJavaObject>(
226                             "makeText", unityActivity, message, 0);
227                     toastObject.Call("show");
228                 }));
229             }
230         }
231
232         private bool IsPointerOverUIObject()
233         {
234             PointerEventData eventDataCurrentPosition = new PointerEventData(
                     EventSystem.current);
235             eventDataCurrentPosition.position = new Vector2(Input.mousePosition.
                     x, Input.mousePosition.y);
236             List<RaycastResult> results = new List<RaycastResult>();
237             EventSystem.current.RaycastAll(eventDataCurrentPosition, results);
238             return results.Count > 0;
239         }
240     }
241
242 }
```

6.4   Database Connectivity

In this Module the system is connected with database

```
1   using System.Collections;
2   using System.Collections.Generic;
3   using UnityEngine;
4   using UnityEngine.Networking;
5   using MongoDB.Driver;
6   using MongoDB.Bson;
7   using UnityEditor;
8
9   public class mongoCOnnect : MonoBehaviour
10  {
11      private MongoClient client;
12      private IMongoDatabase db;
13
14
15      void Start()
16      {
17          var client = new MongoClient("mongodb+srv://charlie:
                DesignARpass@cluster0-goxgd.mongodb.net/test?retryWrites=true&w=
                majority");
18
19          var database = client.GetDatabase("DesignAR");
20          var coll = database.GetCollection<BsonDocument>("models");
21          var filters = Builders<BsonDocument>.Filter.Empty;
22          var result = coll.Find(filters).ToList();
23          foreach (var doc in result)
24          {
25              Debug.Log(doc.ToJson());
26          }
27      }
28
29      IEnumerator UploadFileCo(string uploadURL)
30      {
31
32          WWW localFile = new WWW("file:///1.wav");
33          yield return localFile;
34          WWWForm postForm = new WWWForm();
35          postForm.AddBinaryData("file", localFile.bytes, "1.wav");
36          WWW upload = new WWW(uploadURL, postForm);
37          yield return upload;
38          if (upload.error == null)
39          {
40              Debug.Log(upload.text);
41              Debug.Log("upload error null");
42          }
43          else
44          {
45              Debug.Log("Error during upload: " + upload.error);
46          }
47      }
48
49      void UploadFile(string uploadURL)
50      {
51          StartCoroutine(UploadFileCo(uploadURL));
52      }
53
54  }
```

Chapter 7

Screenshots of Project

7.1 Login
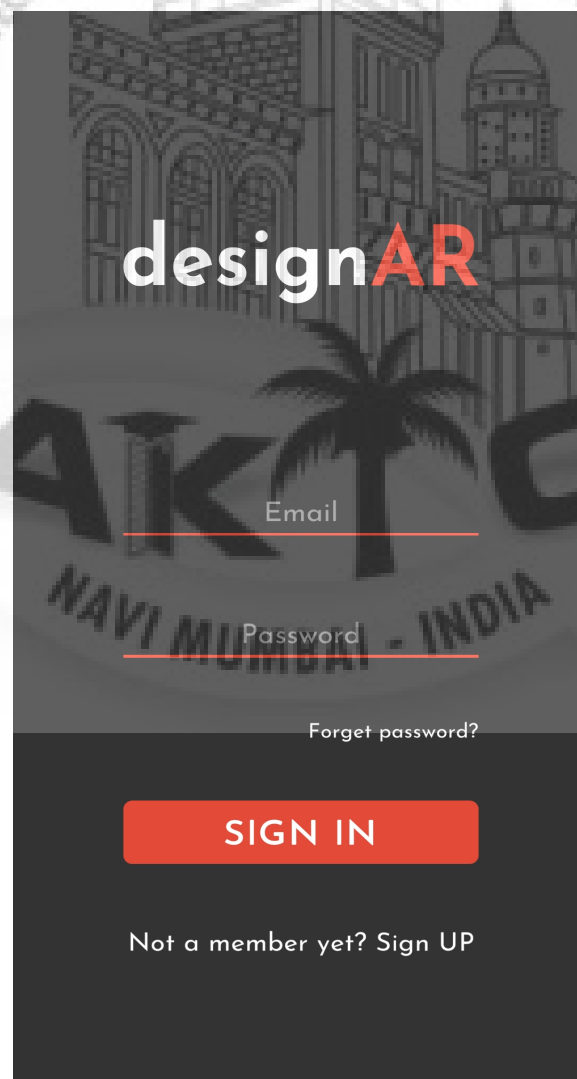
7.2 Sign UP
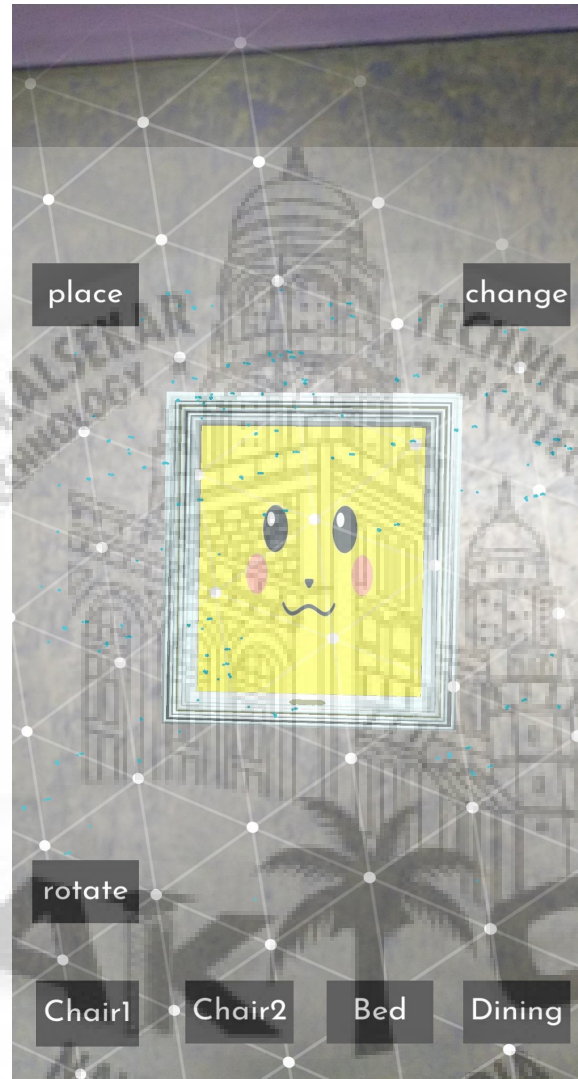
7.3   Workspace
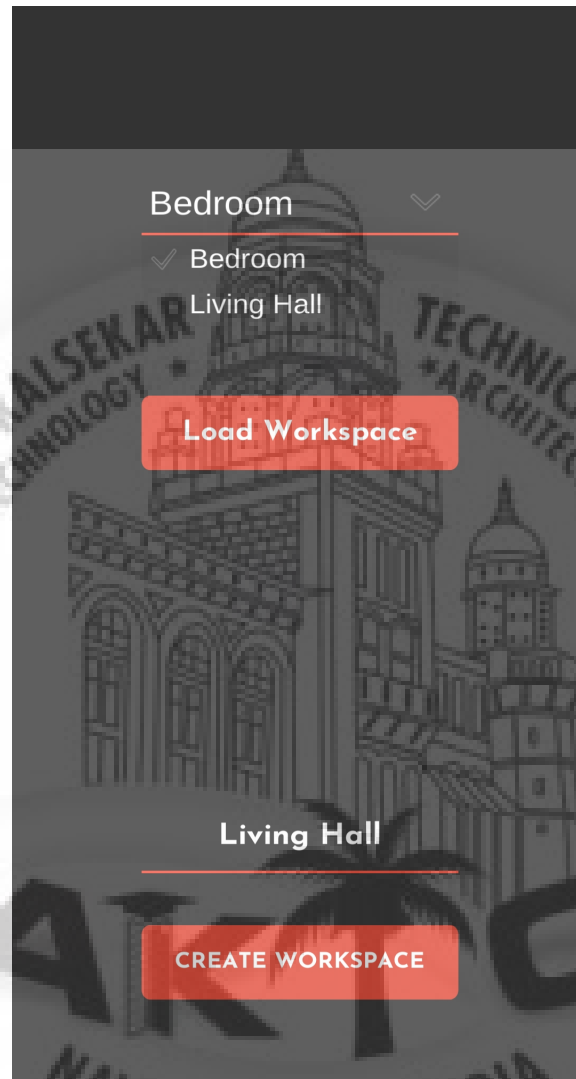
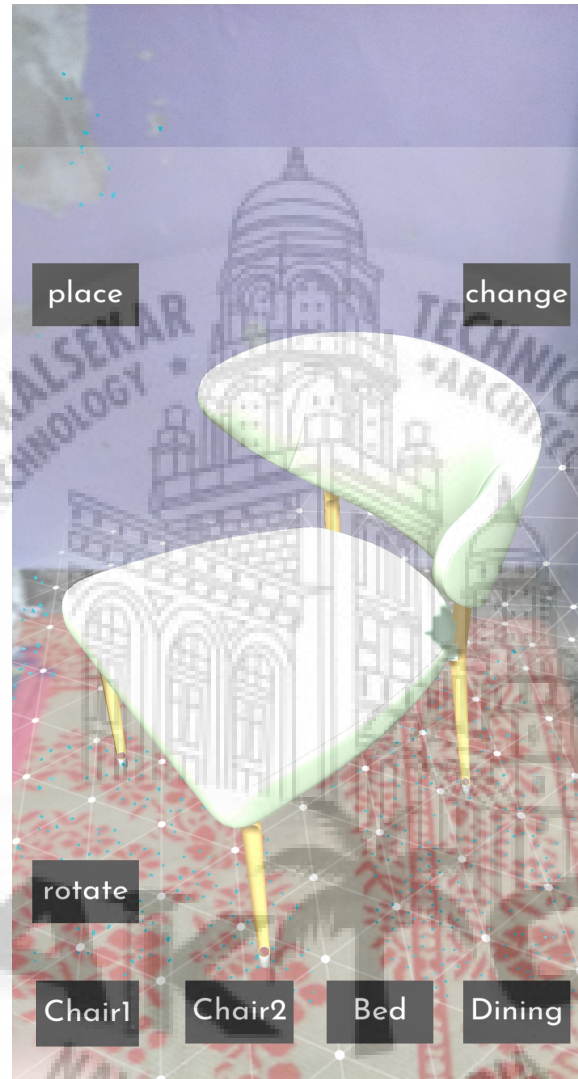## 7.4   AR Object imposed on horizontal surface

7.5 AR Object imposed on Vertical surface

7.6   AR Object changing texture

Chapter 8

Conclusion and Future Scope

8.1 Conclusion

Interior Designing using Augmented Reality, is an application made specifically for interior designers and architects to tackle the complexities of usual interior designing methods. The typical interior designing process is usually done offline. It is a very time consuming process and also complex, as the designers have limited resources to describe in detail, the final result of the interior design to the customer. Though there are several applications built similar to ours, but every application has its own pros and cons. After having a thorough reading of the other applications' research papers, and based on the requirements of the customers, our application strives to overcome the drawbacks of the other applications.

8.2 Future Scope

- Add more variety of items for the customers to choose from.

- Add more textures and colours so that there can be more options.

- The users will get automatic suggestions depending on their choice of furniture and the room space.

- The customer and the designer will be able to chat in the application itself.

References

[1] *Augmented Reality Application for Architects and interior designers: Interno A cost effectivesolution*; Author:-SidraNasir1,MohammadNomanZahid1,TalhaAhmedKhan2, 3*, Kushsairy Kadir4, Sheroz Khan5 1Faculty Of Science and Technology, Ilma University Formerly IBT, Karachi, Pakistan.

[2] *A design support system for indoor design with originality suitable for interior style*; Author :- Akihiro Ogino Computer Science and Engineering Kyoto Sangyo University Kyoto, Japan.

[3] *Interior Design with Augmented Reality* ; Author :- Ananda Poudel and Omar Al-Azzam DepartmentofComputerScienceandInformationTechnology-SaintCloudStateUniversity

[4] *Augmented Reality for nDimensional Building Information Modelling Contextualization, Customization and Curation* ; Author:-ZI SIANG SEE Centre for Research-Creation in Digital Media Sunway University Bandar Sunway, Selangor, Malaysia

[5] Unity-Manual:Unity User Manual(2019.2):- `https://docs.unity3d.com/Manual/index.html`

[6] C Sharp Guide — Microsoft Docs :- `https://docs.microsoft.com/en-us/dotnet/csharp/`

[7] Blender 2.80 Reference Manual :- `https://docs.blender.org/`

Achievements

1. Publications

    (a) *NAME OF PAPER*; NAME OF AUTHORS,journal Name, month and year of published(`http://EXAMPLE.com`)

2. Conferences

    (a) *NAME OF PAPER*; NAME OF AUTHORS, Name of conference , month and year of attend(Venue :)

3. Project Competitions

    (a) *Interior Designing Using Augmented Reality*; Choudhary Shoaib, Shaikh Mobin, Qureshi Arshee, 6th National Level Project Exhibition cum Poster Presentation, 13th March 2020(Venue : Universal College of Engineering, Vasai)