NITTE MEENAKSHI INSTITUTE OF TECHNOLOGY

(AN AUTONOMOUS INSTITUTION, AFFILIATED TO VISVESVARAYA TECHNOLOGICAL UNIVERSITY,

BELGAUM, APPROVED BY AICTE & GOVT.OF KARNATAKA

KNOWLEDGE ★ CHARACTER ★ UNITY

PHASE-I REPORT

on

AR APPLICATION FOR ARCHITECTS AND INTERIOR DESIGNERS

Submitted in partial fulfilment of the requirement for the award of Degree of

Bachelor of Engineering

in

Computer Science and Engineering

Submitted by:

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(Accredited by NBA Tier-1)

2020-2021

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CERTIFICATE

This is to certify that the Phase 1 Report on **AR application for Architects and Interior designers** is an authentic work carried out by SAI SIDDHANTH. A (**1NT17CS158**), RITHESH SHANMUGHAN **(1NT17CS151),** RAHUL KHATRI **(1NT17CS142)** and

UTSAV MONDAL **(1NT17CS217)** bonafide students of **Nitte Meenakshi Institute of Technology**, Bangalore in partial fulfilment for the award of the degree of *Bachelor of Engineering* in COMPUTER SCIENCE AND ENGINEERING of Visvesvaraya Technological University, Belagavi during the academic year *2018-2019.* It is certified that all corrections and suggestions indicated during the internal assessment has been incorporated in the report.

Internal Guide	**Signature of the HOD**	**Signature of Principal**
NAME	Dr. Thippeswamy M. N.	Dr. H. C. Nagaraj
Designation, Dept. CSE, NMIT	Professor, Head, Dept. CSE,	Principal, NMIT,
Bangalore	NMIT Bangalore	Bangalore

Signature of Examiners

1.

2.

ACKNOWLEDGEMENT

The satisfaction and euphoria that accompany the successful completion of any task would be incomplete without the mention of the people who made it possible, whose constant guidance and encouragement crowned our effort with success. I express my sincere gratitude to our Principal **Dr. H. C. Nagaraj**, Nitte Meenakshi Institute of Technology for providing facilities.

We wish to thank our HoD**, Dr. Thippeswamy M. N.** for the excellent environment created to further educational growth in our college. We also thank him for the invaluable guidance provided which has helped in the creation of a better project.

I hereby like to thank our *Nirmala J.S, Assistant Professor*, Department of Computer Science & Engineering on **his/her** periodic inspection, time to time evaluation of the project and help to bring the project to the present form.

Thanks to our Departmental Project coordinators. We also thank all our friends, teaching and non-teaching staff at NMIT, Bangalore, for all the direct and indirect help provided in the completion of the project.

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DECLARATION

We are hereby declare that

(i)   The project work is our original work
(ii)   This Project work has not been submitted for the award of any degree or examination at any other university/College/Institute.
(iii)   This Project Work does not contain other persons' data, pictures, graphs or other information, unless specifically acknowledged as being sourced from other persons.
(iv)   This Project Work does not contain other persons' writing, unless specifically acknowledged as being sourced from other researchers. Where other written sources have been quoted, then:
        a) their words have been re-written but the general information attributed to them has been referenced;
        b) where their exact words have been used, their writing has been placed inside quotation marks, and referenced.
(v)   This Project Work does not contain text, graphics or tables copied and pasted from the Internet, unless specifically acknowledged, and the source being detailed in the thesis and in the References sections.

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<u>ABSTRACT</u>

The project is a user friendly application that aids the architectures and interior designers to provide their clients a preview of their fully completed product even before construction. And giving them a better understanding of the finished product.

The application provides both default and custom feature that can used to create rooms , furniture and other objects and these objects can be easily resized ,repositioned and reoriented using gestures. The custom objects can be created by analysing few images of the object from different views using a device camera and this same object can be rendered into the virtual built environment or in real world.

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Chapter 1 : INTRODUCTION

1.1 Background

Termed as mixed reality, it discusses multiple fields that covers Virtual Reality (VR), Augmented Reality (AR), tele- presence, and other related technology. This technology has been used in various fields like in medicine, repairing, manufacturing, tele-robotic, robotics, maintenance, engineering design, education and military application. This study will bridge all users of relevant businesses to the user intensive design of augmented reality.

1.2 Brief History

The idea to use AR for architecture, engineering and construction dates back to early 1996 and it has actually matured from a pure research field to certain practical industrial applications, until now it has not been implemented as a real product in architecture or design. In contrast, architecture and design communities apparently have knowledge of operations/tasks that AR could potentially enhance and also the motivation to bring in this new technology for improving the current practices.

This paper holds a different perspective of how Mixed and Augmented Reality has been and could be applied in the area of architecture and design.

The design & implementation of Augmented Reality system for industrial problem in architecture and design field, researchers and system developers face three major relevant challenges: extraction of preparation of reality model, industrial domain knowledge and technological limitations.The following discuss the details of each challenge and the suggested solutions.

1.3 Applications

This paper provides you with inner depth on how augmented reality can be implemented to help the architects and interior designers well, it discusses the algorithm used to achieve the functionalities. The novelty of this project is that it does'nt require any sort of expensive gadgets. It can be used easily via smartphones, tablets, etc. It is also operable on any of the operating systems.

1.4 Research Motivation & Problem Statement

To Envision how a certain object will look in a room before it is decorated is a difficult challenge. Augmented reality is a new technology that includes placing of some of the virtual objects on the real environment. As an outcome, the end-user can see the real environment augmented with this physical object where you will be able to interact with them.

1.4.1 <u>Research Motivation</u>

Use of Augmented Reality in interior designing is not only helpful for the architects but also for the clients, there are many particular turning points for this mutual benefit:

- Better Visualization – AR in interior design help the client visualize the project before it is developed. Using AR for interior designing gives the ability to the user to design the space any way they want.
- Design editing abilities -User will also get an ability to edit the designs and make changes even if the design is at the final stage.
- Better guidance– AR in interior design will let a user guide the designer in the best possible manner. Every detail can be communicated interactively using AR.
- Find and try products remotely – The clients can try various products for their new project such as the furniture without paying a penny.
- Interactive idea presentation – Using AR it would be much easier for designers to present their innovative ideas to clients.
- Profitability – An effective AR visualization for the clients will help in accelerating the purchase and designing process along with increasing the probability of closing successfully.

1.4.2 <u>PROBLEM STATEMENT</u>

Nowadays with excessive work load and busy life, many professionals face problems that result in the loss of their clients or the certain overheads that spoil the process of satisfying the client.

AR/VR helps to remove some of the fear and anxiety that a client might have about committing to a design plan that they are unsure of and achieve 98% closure rate

The proposed software shall be utilised by interior designers and architects. This proposed research will most likely act as an effective tool which will decrease the gap between industrial company and customer in addition to other applicable businesses.

The print media (panaflex, images, print outs) influence is not enough to satisfy designers and architects to visualize their unique ideas and complicated stuff in their desired way in the real world environment.

1.5 RESEARCH OBJECTIVE

1.5.1 Primary Objectives

- The objective of this project is to design and develop an augmented reality app as an effective tool which can decrease the gap between industrial company and customer in addition to other applicable business communities.
- To help in visualizing architect plans and interior designs. A virtual model of real environment can be designed before its physical implementation, it will allow interior designers/architects to implement their idea in the given workspace virtually and then view it in real environment.
- To allow architects to view their 3D visualizations on their 2D drawings.

1.5.2 Main Contributions

This is a cost effective solution that reduces the overhead that interior designers or architects confront on a daily basis. This software displays all the features that might be required by interior designers and architects respectively.

CHAPTER 2 : LITERATURE SURVEY

2.1 Introduction

Augmented reality remarkably facilitates, to resolve real lifestyles issues. Issues are in particular, primarily based on elements i.e., money and time. The hassle encountered turned into the overhead of architectural/interior designing and its growing demand these days. Hardware implementations are required in Head-mounted displays and monitors and are in particular designed for expert users.

2.2 Related Works

The use of computer vision in the field of Architectural construction is not new. Augmented reality had its applications in this field from the 1990s but the work related to our project started in 2012([2] Virtual reality simulated environment. Integration with VR Platform and Architecture Design Technology. Enhance the VR Interactive Performance in Architecture Simulation.) and further in the year 2014 ([3] Use of Virtual 3D furniture. Using the in-depth camera in real time as an input. Estimation and optimisation of the available space in a room. The friendly User Interface) and then in year 2018 ([6] Uses AR for previewing. User interactivity. Uses AR trackers. Virtualising the real world in 2D.

Our project will be using an gesture recognition and 3D virtualisation of the real world objects and the interface will provide customisation of 3D models.

2.3 Study of Tools/Technology

Android applications for AR is key to resolve these issues considering the fact that it is an android app, supported by means of android devices such as smartphones that's easily available to end users. The provision of numerous tools for the implementation of AR as an android app, research on applications of AR within discipline of architecture and its advantages in precision of decision making. Thus, saving money & time Therefore it can be regarded as a reliable cost effective solution.

2.4 Summary

It is troublesome for an architect to envision how any object will appear in a room or in an open area with lot of aspects left to end-user's imagination. The scale, color, and the way it integrates with the existing surroundings. Augmented reality, technology that places computer graphics on the real environment has several applications within the discipline of architecture and engineering and has been used to address some issues of the real environment. Earlier it was referred to as mediated reality wherein a view of reality is changed by means of a computer; the technology has changed one's notion about reality. Head-mounted display (HMD), contact lenses, eyeglasses, monitors are some of the gadgets wherein augmented reality has been integrated. Many advanced gadgets typically assist professional users. Common people or the non-professional people also can make the most out of the augmented reality functions for solving their real existence issues.

CHAPTER 3: SYSTEM REQUIREMENTS SPECIFICATIONS

3.1 General Description

An IOS or Android application supporting device capable of providing basic

features to   support Augmented or Mixed Reality [GPS, accelerometer and gyroscope].

3.1.1 Product Perspective

For Clients :

- Better visualization

- Design Editing abilities.

- Improved guidance

- Customize products remotely

For Designers:

- Interactive idea presentation

- increased profitability

- Improved collaboration

- Profitability

- competitive edge

3.2 System Requirements
3.2.1 Hardware

1. AR/MR Lens

2. Android/IOS [dependent on AR core & kit] supporting device

3.2.2 Software

Any x86 or x86_64 based AVD:

Requires Android 8.1 (API 27) or later.

The rear camera is emulates a virtual scene. The front camera is

not supported.

3.2.2.1 Functional Requirements

- End Users (Architects and Interior Designers) will have to enter the basic measurements of the room and should be able provide images for the custom objects to create its 3 dimensional model.
- They must follow the gesture guide to resize, reposition, reorient the objects.

3.2.2.2 Non-functional Requirements

- Templates for different room, basic objects and furniture.
- MAINTAINALIBILITY:- This application can be used for the duration of 5 years without any additional enhancement in the hardware and the software. For enhanced experience an AR/MR lens could be used.
- REALIBILITY and ACCURACY:- The product is expected to provide 95% accurate results.

3.2.2.3 User Requirements

A. Module for Architecture

Marker based augmented reality is used to enable the functionality developed for architects. A marker's required to see the rendered 3D object. An image or a representation that can be perceived by an image tracking module using methods consisting of pattern recognition, image processing and computer vision techniques can be defines as a marker. It defines the correct size and position of the camera once detected. In the process of marker detection, after deciphering its identity and approved as a marker. Using this feedback, the application calculates the position of the 2D image. The tracking module comprises of two main phases. First, application detects the marker and evaluates coordinates of the marker. Hence, implements it on the available space. Then, the tool will provide an automatic arrangement of the building according to the 2D image. Use SI/MKS or CGS as primary unit. Finally, a proposed display plan of building will be rendered into a real scene. It is the heart of one part of an application. This module will start when the AR camera's launched. After the calibration of the camera and it gives feedback to the AR camera in real time. The camera evaluates every image in the scene and detects the markers. The marker coordinates are tracked and marker's position are calculated

and sent to the AR camera. The coordinates are sent to the Image rendering module where an object is rendered on it.

B. Module for Interior Designing

Marker-less AR is another part in which location and mapping is simultaneously done that allows you to place your AR experience pretty much wherever you want. This technique is the heart of another part of an application, specifically designed for interior designing. In this Module, Camera calibrates and the co-ordinates of the area is calculated. An object appears when an end-user selects an object. When the end-user desires to change the objects pose and size. Their fingers gesture on the selected object is analyzed if the gestures are identified then the camera is calibrated and when the pose change is approved then it is displayed in real time. This application allows the users to interact with multiple virtual object in real-time. The user can also delete the object on its selection if it is not needed and later can capture its image for safe keeping.

C. Camera Tracking Module

If Calibration about the stationary details of a scene then the system has to deal with dynamic scene changes too. Therefore, it estimates the scene for instance, certain features especially in interior design module. As for the Module dedicated to Architects on detection of tracking point on the 2D image it calibrates itself.

3.3 Summary

The application should convert 2D maps into 3D by scanning (specifically for architects) and end users can maintain their schedules and set the reminder, share their work among the community (blog) and will also have accessibility of understanding other designers work which will provide them with new motivation. The users can maintain their profile. And can also upload their own customized models too. Only authorized users can access this application (as we have provided sign up and sign in functionality). The user can interact with virtual 3D models of the furniture using an Augmented Reality in real time, and altering the color of walls and furniture, style, or covering of furniture in a real environment. Therefore, this permits complex and innovative designs to be explored and envisioned, making AR technology for interior designer and Architects accessible to both pros and amateurs.
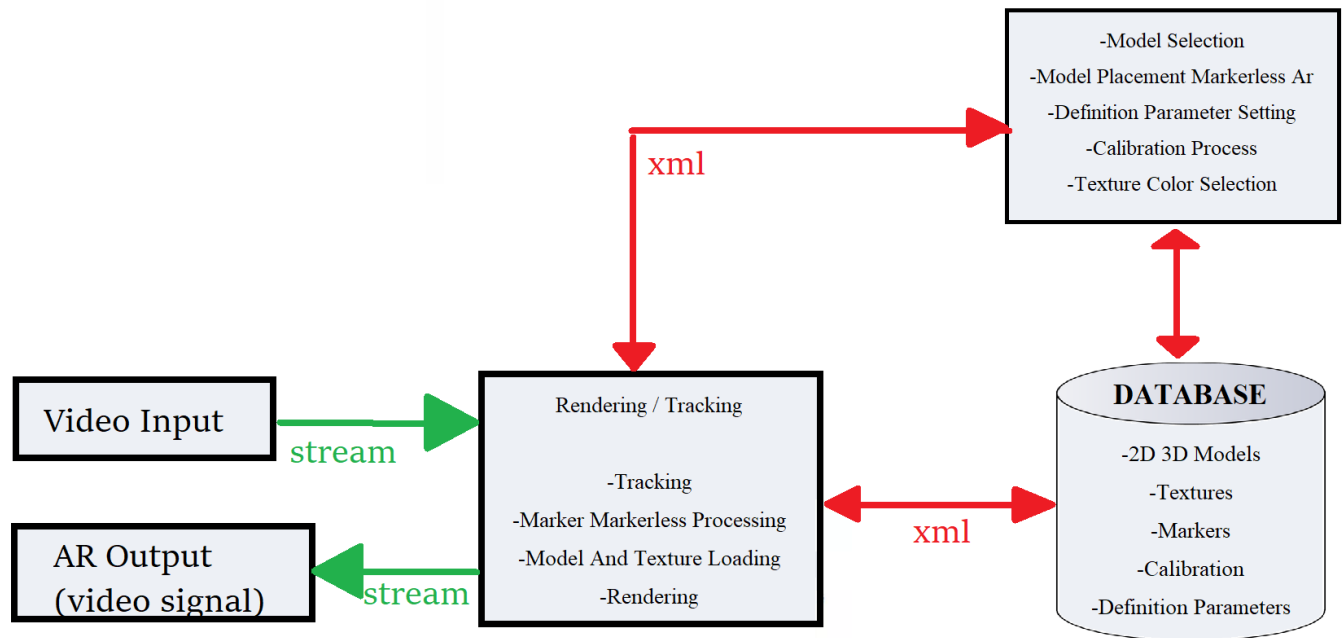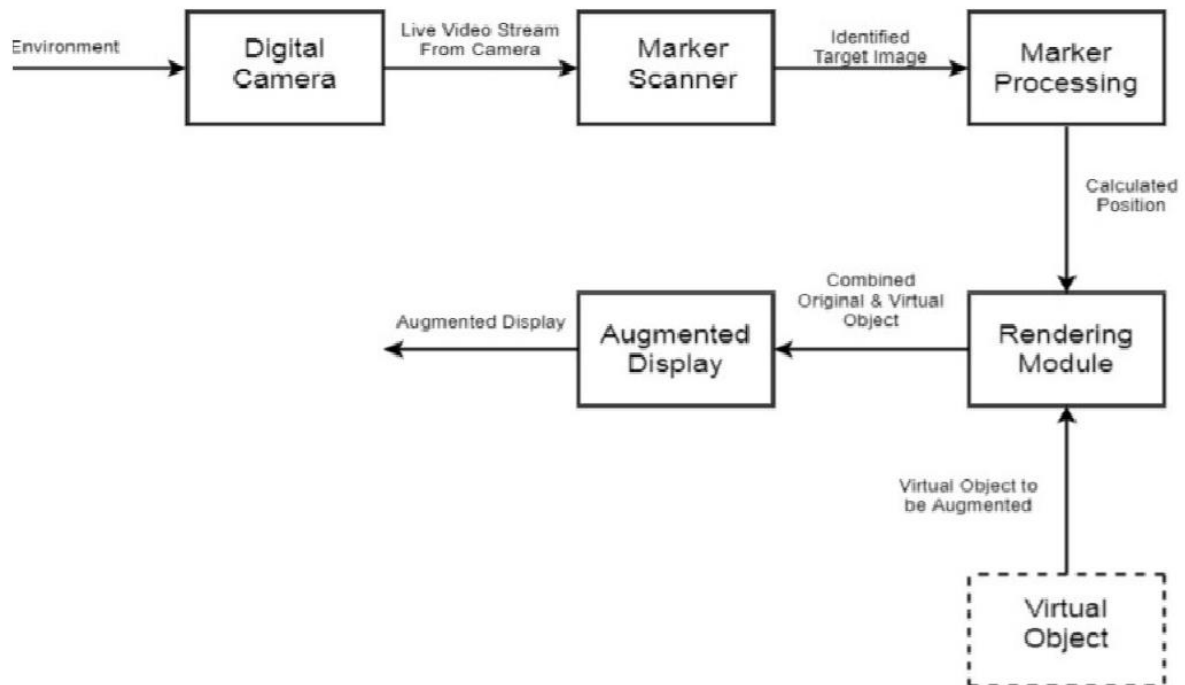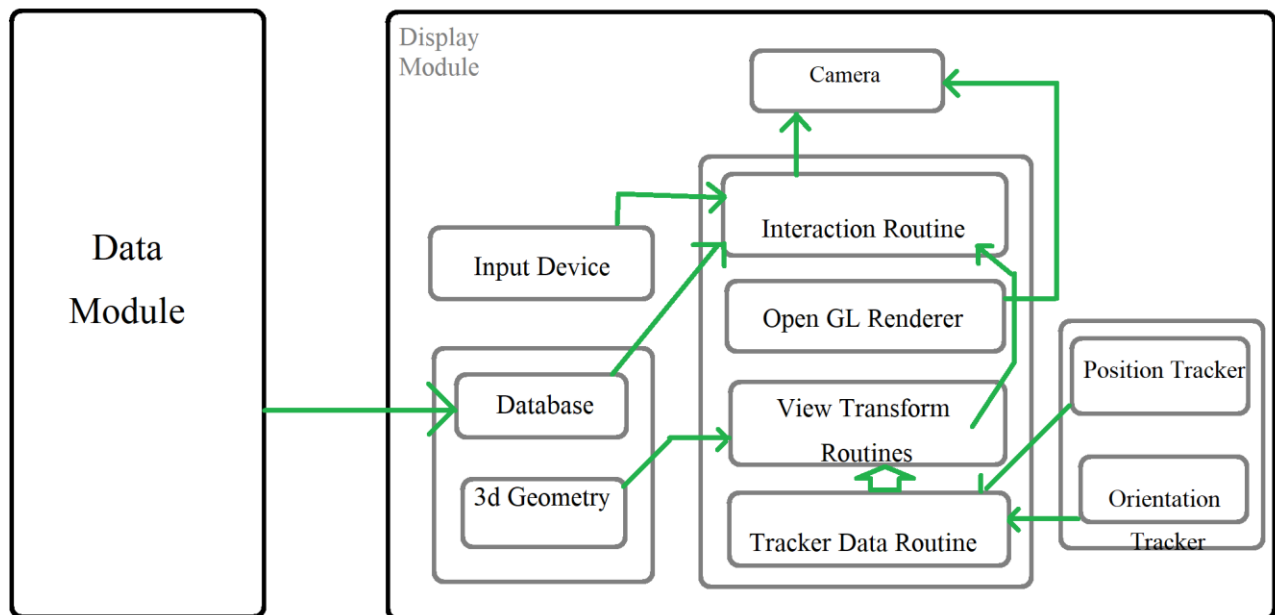
CHAPTER 4 – DESIGN

4.1 Architectural Design
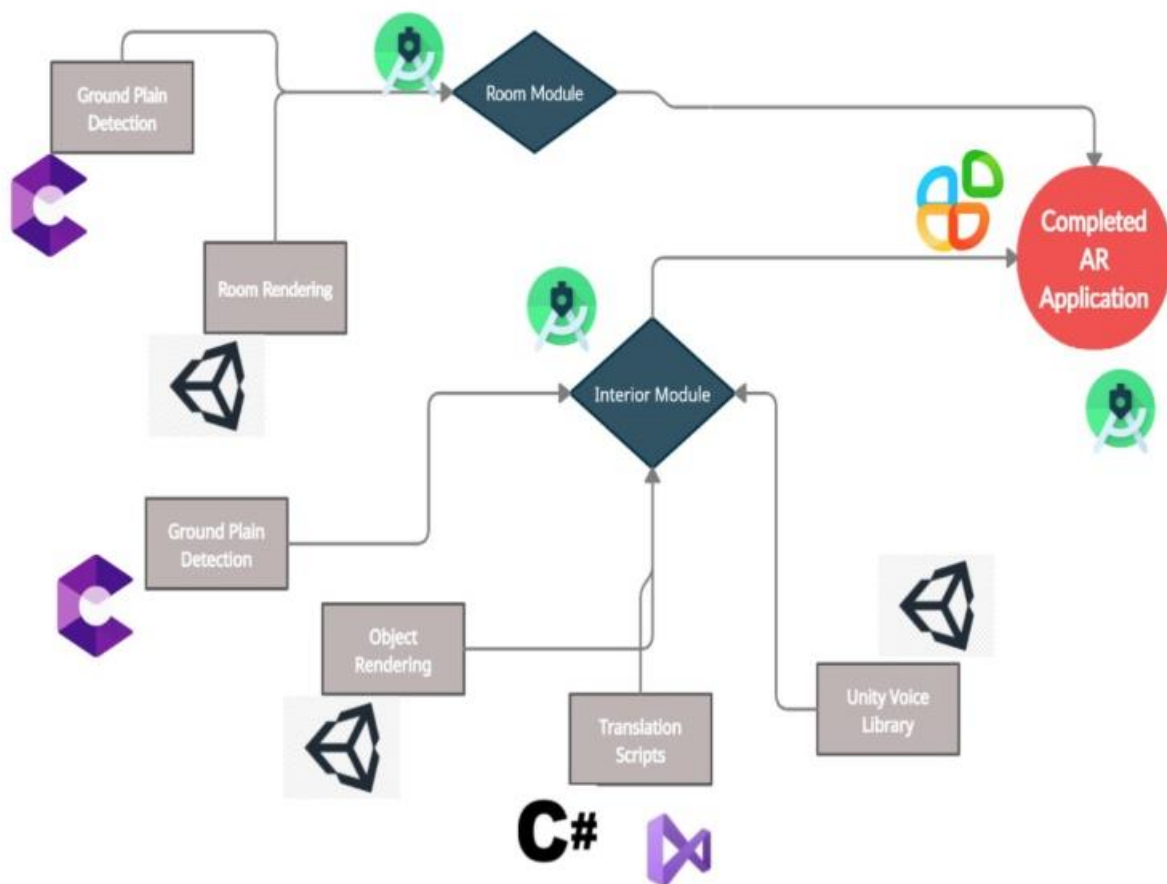
4.2 Class Hierarchy Diagram

4.3 Sequence Diagram

4.4 Activity Diagram

CHAPTER – 5 : IMPLEMENTATION

5.1 Description of the Process

The process of image tracking for rendering the captured image

- Launch the camera on the device to scan the digital image of the real time environment
- Accept the feedback from the camera
- Detect the ground plane of environment
- If plane detection is identified, then decode the plane
- Calculate the coordinates of the marker
- rendering of the room
- rendering of the 3D object
- display the rendered 3D object

CHAPTER – 6 : TESTCASES

Serial number	Module	Expected results	Status
1	Ground Plane Detection (ARCore & Vuforia)	AR camera should be capable of detecting plain surfaces	Successfully Implemented
2	Rendering (Unity3D)	Should be capable of rendering room game environment	Successfully Implemented
3	Screen Control (LeanTouch Scripts)	Repositioning, Re-orienting, Re-scaling of game object during runtime	Successfully Implemented
4	Voice Command(Unity 3D Library)	Screen maneuver with gestures	Successfully Implemented
5	Android Compatibilty (Android Studio)	Running whole application on an android platform	Successfully Implemented

CHAPTER – 7 : Results
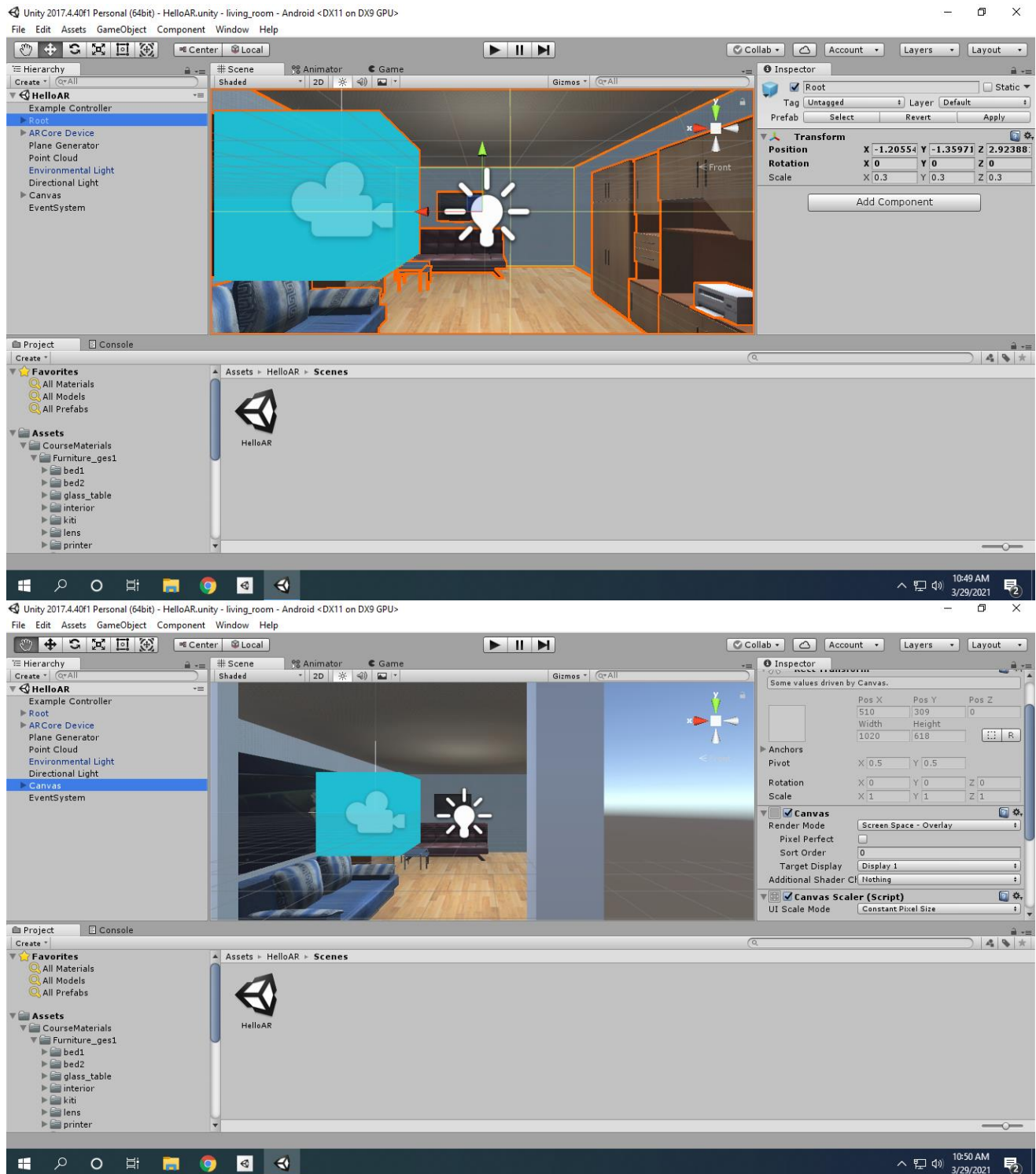
CHAPTER – 8 : IMPACT OF PROJECT TOWARDS SOCIETY/ ENVIRONMENT

1. Visualization

AR is a powerful visualization tool. It allows you to bring an object or concept into a reality that is otherwise imagined, inaccessible or difficult to grasp, and can even help to make the invisible visible.

helps students learn and work in ways not otherwise possible. With access to the minutest details not limited by the availability of physical tools.

2. Annotation

Annotation with AR helps guide you through the completion of a task, navigate a new environment or even provide real-time descriptions of what's happening around you.

Architects can directly annotate what you are looking at to guide you through a process. Previously used in the workplace for field service repairs and training, remote assist scenarios can be extended to emergencies in remote locations where an expert, such as a professional, may not be readily available.

3. Environment Friendly

AR provides for a very contrasting eco-friendly option when it comes to the domain of Interior designing and architecture. Physical tools and labor concerning Papers, Pens, pencils, charts and other environmentally affective apparatuses can be avoided providing for lesser wastage as well as a greener option in said domain.

CHAPTER – 9 : CONCLUSION

This application is relatively new, this application allows the user to add multiple object to the screen in real-time. The user can manipulate the object like, move, rotate, resize and change the color or texture of the object on selection. Thus, allowing the interior designer and architects to implement their design and evaluate them in real- environment.

CHAPTER – 10 : REFERENCES

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4. AR interior designer: Automatic furniture arrangement using spatial and functional relationships Jeff K. T. Ta