A MAJOR PROJECT REPORT
ON

# UNITY 3D FURNITURE APP

SUBMITTED IN PARTIAL FULFILLMENT FOR THE AWARD OF DEGREE OF

**BACHELOR OF TECHNOLOGY**
**IN**
**ELECTRONICS AND COMMUNICATION ENGINEERING**

*Submitted By:*
KAPIL SHARMA (9917102148)
SANCHIT GUPTA (9917102167)
SATYAM GUPTA (9917102181)

*Under the guidance of:*
Mr. VARUNGOEL

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

JAYPEE INSTITUTE OF INFORMATION TECHNOLOGY, NOIDA (U.P.)

December 2020

# CERTIFICATE

This is to certify that the major project report entitled, "**UNITY 3D FURNITURE APP**" submitted by **"Sanchit Gupta", "Satyam Gupta"** and **"Kapil Sharma"** in partial fulfillment of the requirements for the award of Bachelor of Technology Degree in **Electronics and Communication Engineering** of the Jaypee Institute of Information Technology, Noida is an authentic work carried out by them under my supervision and guidance. The matter embodied in this report is original and has not been submitted for the award of any other degree.

**Signature of Supervisor:**

**Name of the Supervisor: Mr VARUN GOEL**

**ECE Department,**

**JIIT, Sec-128,**

**Noida-201304**

**Dated: 08/12/2020**

# DECLARATION

We hereby declare that this written submission represents our ideas in our own words and where others' ideas or words have been included, have been adequately cited and referenced the sources. We also declare that we have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in our submission.

Place: NOIDA

Date:08/12/2020

**Name:** Kapil Sharma
**Enrollment No. :**9917102148

**Name:** SanchitGupta
**Enrollment No. :**9917102167

**Name:** SatyamGupta
**Enrollment No. :**9917102181

# ABSTRACT

We can see recently these days that information and communication technology support the development of human interaction with physical, computer and virtual environment such as science, banking, education, etc. Augmented reality is a field of computer research which deals combination of reality with computer-related data. In early days if we consumer wanted to buy furniture objects without visiting the shops it was rather possible but it was not possible to check how the object looks in home structure. Now in our proposed system, the user can have the virtual experience of furniture objects sitting in the home without visiting the shops. The main purpose of our project "Unity 3D Furniture App" is to develop an android application for virtually trying different furniture using a mobile which supports AR camera. The application will eliminate human efforts by physically visiting the furniture store which is very time consuming and stressful work. Besides, this it might be easier to use this technique in Online shopping as an option for the user to try out the furniture items in their room they are thinking to buy and allow the user to visualize the room on how it will look after placing furniture in it. User can try out multiple combinations virtually, without physical movement of furniture items. Our motivation here is to increase the time efficiency and improve the accessibility of furniture try on by creating furniture augmented reality application. This system will help the customer to view the furniture object virtually in real environment before buying the object. Due to this system customer will come to know how his home structure would look after buying the furniture object. This system would let the user try multiple combinations of object virtually without physical movement of furniture objects. These will help the buyer to determine how to set up furniture in home structure.

# ACKNOWLEDGEMENT

This gives us immense satisfaction and pleasure that on the successful completion of the major project report and this would be incomplete without mentioning the names of the people who have helped us achieve it.

So we take this opportunity to thank our supervisor **Mr VARUN GOEL**, he has been a mentor and a guide along the entire journey of this term paper. We thank him for his immense support and guidance. Without him, the term paper could never have been a success.

We also thank Electronics & Communication Department, JIIT, Noida, for providing us with the right facilities and environment to complete our major project.

We also thank my friends and family members, for constantly motivating us and co-operating with us in the progress of the major project.

# TABLE OF CONTENTS

# LIST OF FIGURES

# CHAPTER- 1

# INTRODUCTION

Augmented Reality has been a hot topic in software development circles for several years, but it's getting renewed focus and attention with the release of products like Google Glass. Augmented reality is a technology that works on computer vision-based recognition algorithms to augment sound, video, graphics and other sensor-based inputs on real-world objects using the camera of your device. It is a good way to render real world information and present it in an interactive way so that virtual elements become part of the real world. Augmented reality displays superimpose information in your field of view and can take into a whole new world where the real and virtual worlds are tightly coupled. It is not just limited to desktop or mobile devices.

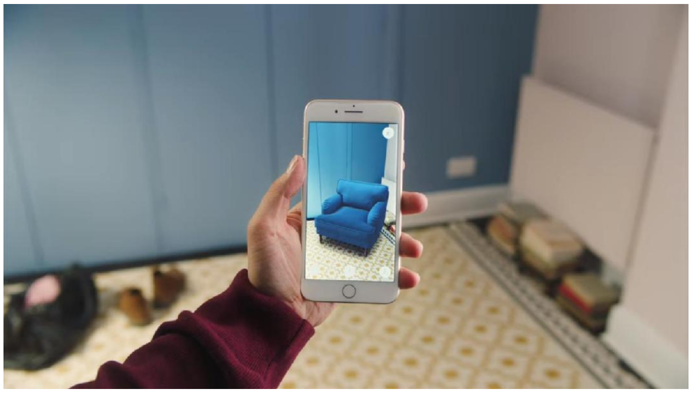

Fig 1: AR Furniture Demo

It provides a whole new experience for the user. A simple augmented reality works on a simple framework where a user captures the image of a real-world object by a device, and the underlying platform detects a marker, which triggers it to add a virtual object on top of the real-world image and displays on your camera screen.

## 1.1 Problem Definition

We know that the customer purchases various types of furniture online, but in online it shows the only photo and cannot be determined size in the room. Even though there are certain applications present which are based on the augmented reality they are not suitable for live processing and takes more time to process the area and some are fixed to a particular image plane. So, to overcome that anyone can use this application to check whether the furniture is adjustable or not which can be placed in the customer living area like home or office using augmented reality images. Our application is a step in this direction, allowing users to view a 3D rendered model a virtual resemblance of the physical furniture without any interruption of the markers which can be viewed and configured in real-time using our Augmented reality application.

## 1.2 Existing System

Traditional the user does not have any kind of 3D virtual experience but it relies mostly on some assisted manpower or 2D understanding of the images. However, this medium of approach restricted to the limit of explanations provided to the customer for the particular placement of furniture and makes him less efficient and confused to buy the furniture.

The main drawbacks in the use of existing systems:

- Images of the object don’t show real-world showcasing.
- Cannot determine the furniture will fit our needs.
- Various parameters of the object like width and height remain hidden.

## 1.3 Proposed System

With the need for augmented reality application, this can be easily achieved. Interior designing is a field where augmented reality has not been able to grow to its fullest. People today are well versed with the technology and are operating smartphones which support AR. Thus, the concept of creating a furniture layout-based application brings the designer step closer to being technologically advanced. A web-based application where user, have to place the marker in a room where they want to try out furniture items. The user’s webcam will be on and through the webcam, they will capture the live feed of the room. Application captures the image and passes through a predefined plane detection algorithm. The algorithm is based on image processing techniques using colour and other properties as the input to detect the plane. The user initially selects the furniture to be placed from the given database. Then the application superimposes the furniture on the detected plane centres and the object can be seen placed virtually. The proposed system uses Marker-less Augmented Reality as a basis for enhancing user experience and for a better perception of things. Markerless tracking is a method of positional tracking–the determination of position and orientation of an object within its environment. This is a very important feature in augmented reality (AR), making it possible to know the field-of-view and perspective of the user - allowing for the environment to react accordingly or the placement of augmented reality content following the real world.

## Steps to be followed

- The application starts with AR supported camera smartphones, this helps to scan the area that surrounds us.
- Selection of the object from the database is done to try on the objects.
- Analyzing the image frame and detecting the ground plane for virtual placement of the object.
- After the plane got detected the objects such as the sofa, the chair can be seen placed at the push of a button.
- Resizing and scaling of the imposed object can be done after the object is placed.

That’s how one can use the application to superimpose a variety of furniture objects in real-world virtually.

# CHAPTER 2

# SOFTWARE AND HARDWARE REQUIRED

**Hardware Required** :

- RAM Capacity: Minimum 4GB
- Graphics card: 1 Gb
- Accessories: Smartphone with AR support

**Software Required** :

- Android version: Android 8.0 or above
- Tool 1: Unity-3D
- Tool 2: Vuforia

## 2.1 Unity-3D

Unity-3D is a “game development ecosystem”, it includes an environment for the development of interactive 2D and 3D content including a rendering and physics engine, a scripting interface to program interactive content, a content exporter for many platforms (desktop, web, mobile) and a growing knowledge-sharing community. Unity-3D introduces new tools that help artists & designers tell better visual stories, new ways for teams to collaborate more productively, and more features than ever to help you succeed in the gaming industry and interactive games development.

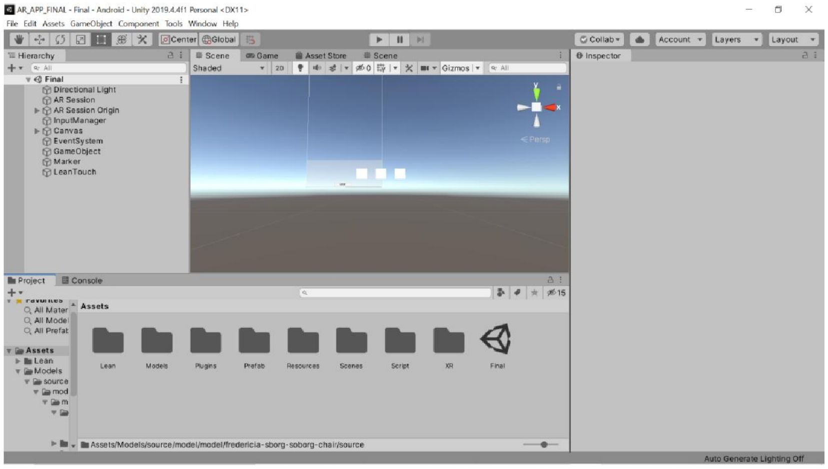

Fig 2.1: Unity 3D Interface

The main editor window is made up of tabbed windows which can be rearranged, grouped, detached and docked. This means the look of the editor can be different from one project to the next, or one developer to the next, depending on personal preference and what type of work we are doing. The default arrangement of windows gives you practical access to the most common windows. If ones are not yet familiar with the different windows in Unity, they can identify them by the name in the tab. The Project window in unity helps us to displays our library of assets that are available to use in our project. When we import assets into your project, they appear here.

## 2.2 Vuforia

Vuforia is an augmented reality software development kit which is made for mobile devices that enables the creation of augmented reality applications. It uses computer vision technology to recognize and track planar images and simple 3D objects, such as boxes, in real-time. This image registration capability helps developers to position and orient virtual objects as they want, such as 3D models and other media, concerning real-world images when they are viewed through the camera of a smartphone. The tracking of the position and orientation of the image in real- the time is done by the virtual object so that the viewer's perspective on the object corresponds with the perspective on the Image Target. It thus appears that the virtual object is a part of the real-world scene. The Vuforia SDK supports a variety of 2D and 3D target types including image Targets, 3D Multi-Target configurations, and a form of addressable Fiducial Marker, known as a VuMark. Additional features of the SDK include localized Occlusion Detection using ‘Virtual Buttons’, runtime image target selection, and the ability to create and reconfigure target sets programmatically at runtime.

# CHAPTER 3

# LITERATURE SURVEY

## 3.1 Architecture:-

The system uses mobile phone built-in camera which supports Augmented reality to collect view as the real scene view observed by the human eye and stacks the 3D furniture models on the screen displayed. First of all, we need to set up the scenes in Unity 3D for User Interface of application like buttons, text areas, background image and virtual object selection. Later we build 3D furniture models and import the models into Unity 3D. Through identifying and tracing the surface area, the camera obtains pointers using Google AR Core and establishes projection models, at last stacks the imported 3D virtual model in the Real-world view. Because Android smartphone has touch-screen interface function, we can place the furniture by sliding screen.

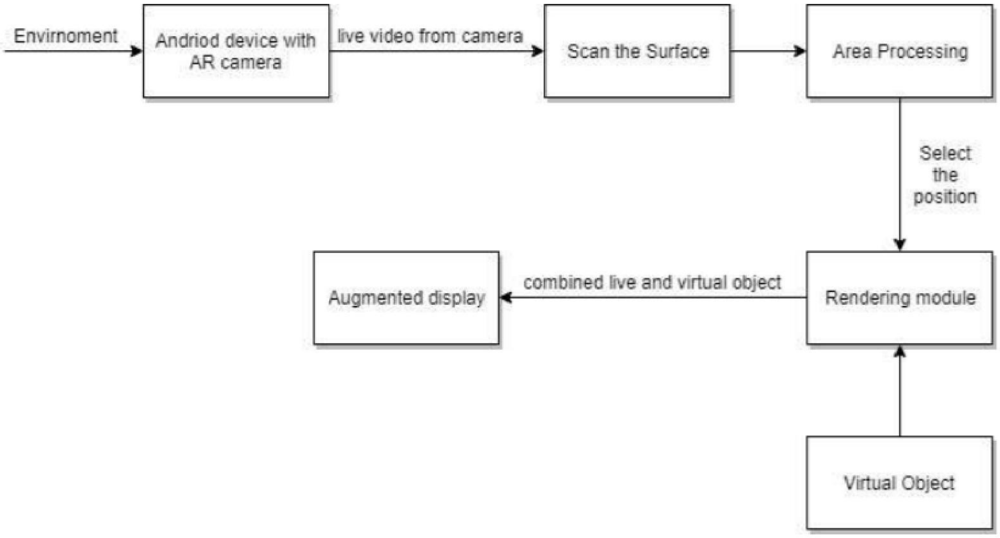

Fig 3.1: System Architecture of Application

As shown from the above figure 3.1, it describes the architecture of the application that takes the real view as input with the help of AR camera then process it with the virtual object to get the resultant output as an augmented display.

## 3.2 Modules:-

The application implementation consists of four modules:

- Importing Augmented Reality Objects.
- Developing Scenes for User Interface.
- Place the Object on the Surface Area.
- Verification of placed objects.

### 3.2.1 Importing Augmented Reality Objects

First, we established virtual models with the help of Sketchfab software to export 3D furniture models to our unity 3d. We could extract the particular object 3D model which we want in our app. Later we export the model data, the file exported stores above information, next convert the information to file which is available in the program and obtain the model data by calling the head file. After loading model data, we can render and display it in the scene through Unity 3D.

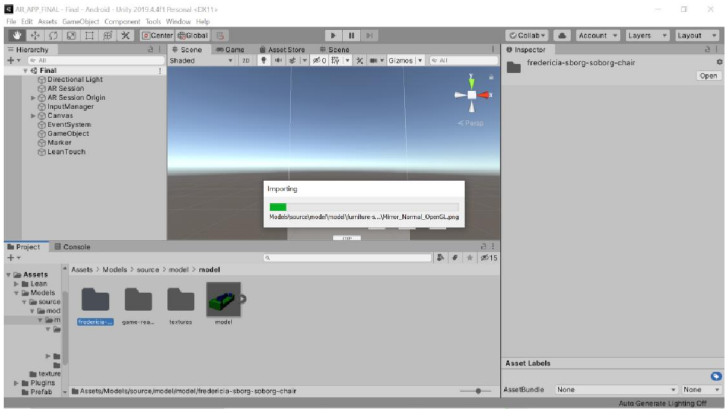
AR_APP_FINAL - Final - Android - Unity 2019.4.4f1 Personal <DX11>
File Edit Assets GameObject Component Tools Window Help
Center Global
Collab Account Layers Layout
Hierarchy
Final
Directional Light
AR Session
AR Session Origin
InputManager
Canvas
EventSystem
GameObject
Marker
LeanTouch
Scene Game Asset Store Scene
Shaded 2D Gizmos
Persp
Importing
Models\source\model\model\furniture-s...\Mirror_Normal_OpenGL.png
Inspector
fredericia-sborg-soborg-chair
Open
Project Console
Assets > Models > source > model > model
Assets
Lean
Models
source
mod
texture
Plugins
Prefab
frederick-...
game-rea...
textures
model
Assets/Models/source/model/model/fredericia-sborg-soborg-chair
Asset Labels
AssetBundle None None
Auto Generate Lighting Off

Fig 3.2.1: Importing 3D Models

### 3.2.2 Developing Scenes for User Interface

In this module, we create scenes for every slide of the application using Unity 3D. The main interface interacts by sliding browsing and selecting the key. The main interface contains furniture model, buttons that help to move to next model, to scan the surface area of living room, description of the model such as length, width, height and for buying the model in the online store. The furniture column stores the key of all furniture, display one furniture at a time and which also supports sliding browsing. To implement these functions, we make the scene display to the ratio of Android display and add the buttons to the scene that helps in moving to the next scene.

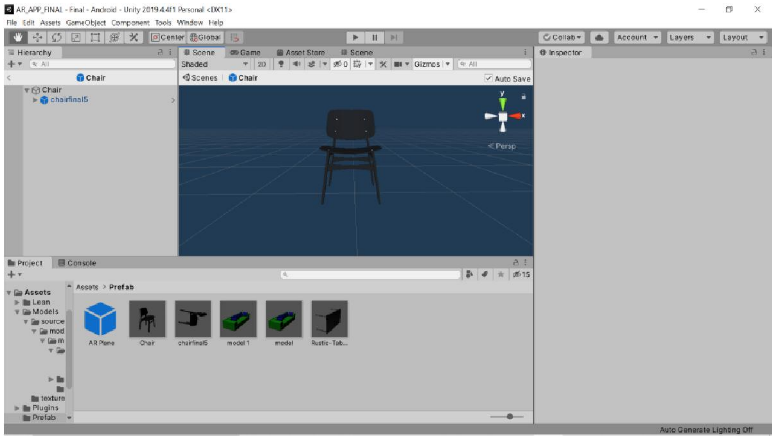

Fig 3.2.2: 3D Model Interface in Unity 3D

### 3.2.3 Place the Virtual Object on the Surface Area

In this scenario, we use the help of  AR core package which will be imported in Unity 3D and modify the package that will help us to scan the surface of living area where we need to place the virtual object in the real world. Once the modifications to Google AR core has done, we will create a scene such that after the surface area is scanned and when the user taps on the touch screen then the virtual 3D model will be rendered or integrated with the living area so that user can verify the object furniture model suits to our needs. The user can drag-and-drop virtual furniture model according to his desire in the real scene via a user interface provided at this stage.

### 3.2.4 Verification of placed objects

Once the user thinks that the object is well suited to his need, he can check the description by selecting the information button that helps in describing the width, height and length of the object. To view this description, we create another scene that helps in displaying all the required information. We add another button that helps in redirecting to the online store where the furniture is available to purchase. We add one more button that helps in rotating object by an angle of 30°. For this rotation and link redirection, we use two classes which are programmed with C#.

## 3.3 UML Diagrams

### 3.3.1 Use case Diagram

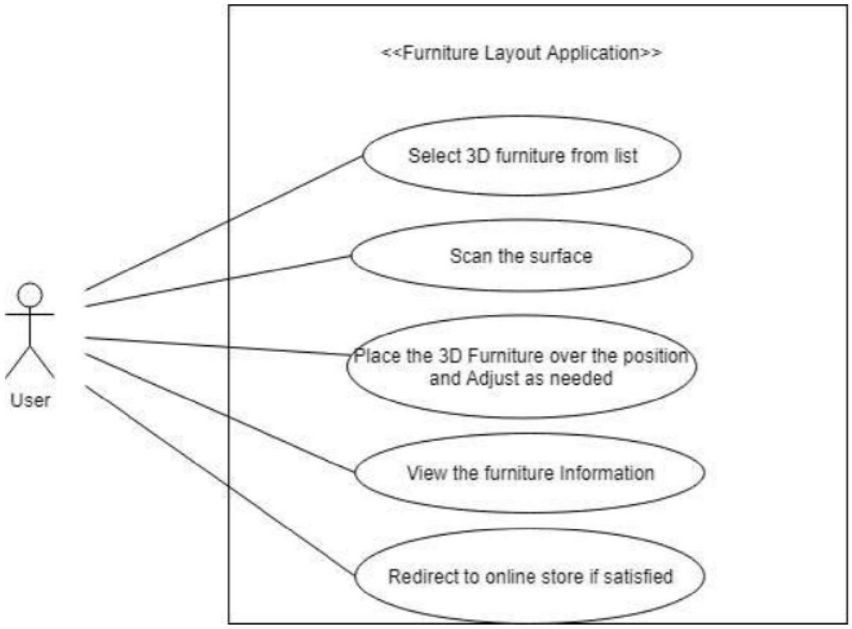
<<Furniture Layout Application>>
Select 3D furniture from list
Scan the surface
Place the 3D Furniture over the position and Adjust as needed
View the furniture Information
Redirect to online store if satisfied
User

Fig 3.3.1: Use case diagram

As shown from the above figure 3.3.1, it describes the use case diagram of the application where the user interacts with application using Android device that supports AR camera. Initial we select the model in which we are interested then scan the surroundings using the camera of the device and place the model to verify whether it fulfils our needs, if satisfied we can move to the online store. The actor here is the user and uses cases select 3D furniture, scan the surface, place the 3D furniture, view the information and redirect to an online store if satisfied.

### 3.3.2 Class Diagram

As shown from the below figure 3.3.2, it describes the class diagram of the application where the main classes include AR Camera, Model Target, Object, Lean touch, Canvas. AR Camera consists of the main configuration to be set to get the 3D model when the model target is given by the user. Canvas class consists of the buttons and texts that are used in the application interface. The object is the 3D model and consists of the information of scaling, transform. Learn touch class consists of how to rotate application i.e. portrait or landscape and all user interactions with the device using lean touch scripts.

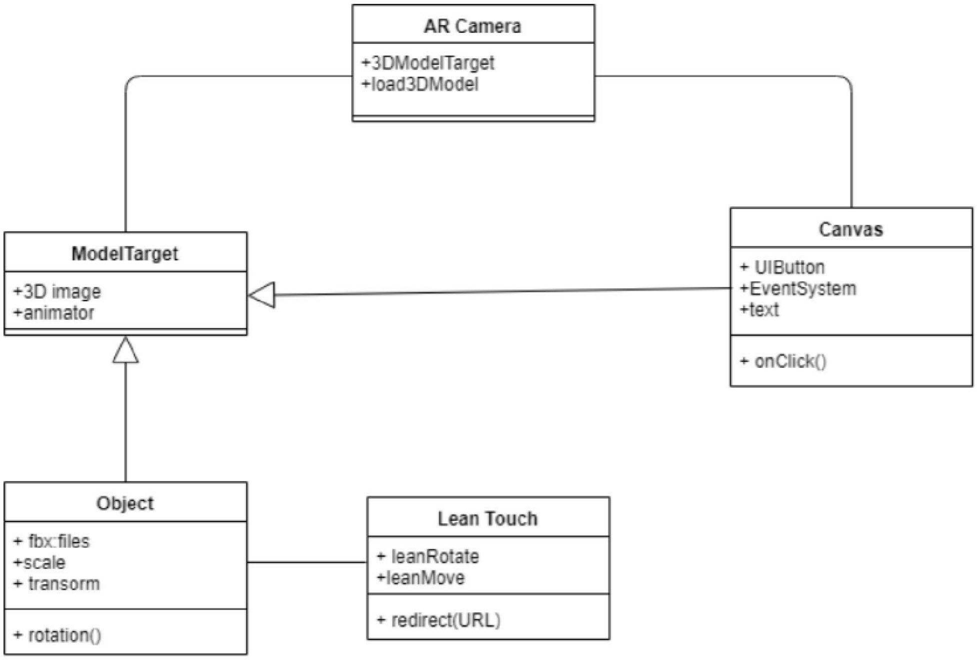

Fig 3.3.2: Class diagram

## 3.3.3 Flow Diagram

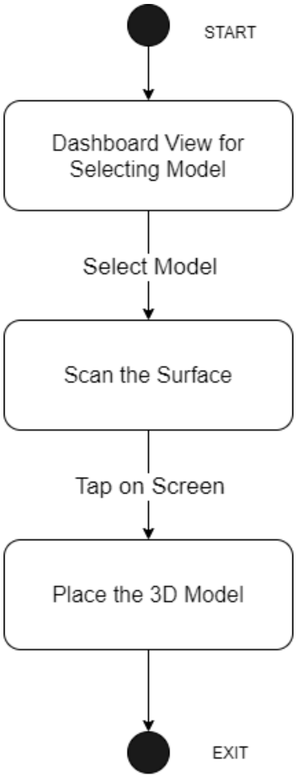

Fig 3.3.3: Flow Diagram

As shown from the above figure 3.3.3, it describes the Flow diagram of the application that consists of a flow of the application which has the actions Dashboard view for selecting the model i.e. home page. Next scan the surface, place 3D model and Resize and scale it according to the need.

## 3.4 Output Screens

### 3.4.1 Scanning Page

When the application is launched the scanning page appears where we can able to select the furniture model that is needed to buy and verify whether it suits our living area.

As shown in the below figure 3.4.1 it shows the scanning page that displays the chair object, if we need to choose another object we can move to another object by pressing arrow buttons.

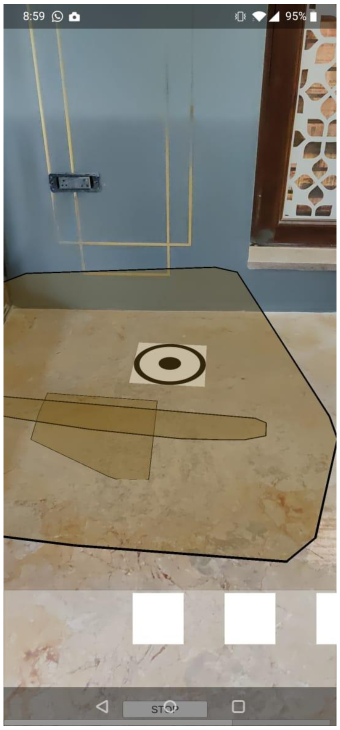

Fig 3.4.1: Scanning Plane Ground

After the furniture objected is selected by tapping on the object that we choose. Next, we move to the scanning scene where we need to scan the plane where the furniture object is to be placed. Scanning the surface will create the points on the floor using Google AR core.

As shown in the above figure 3.4.1it shows how the living area is scanned to find the plane to place the selected object.

### 3.4.2 Placing the object scene

Once the surface plan is scanned and obtained the points of the place we can tap on the screen to place the furniture object where ever we need over the plane. Along with the object placed, we get buttons that help in resizing and rotating.

As shown in the above figure 3.4.2, it shows the furniture virtual 3D object that has been placed in the real world i.e, augmented display.

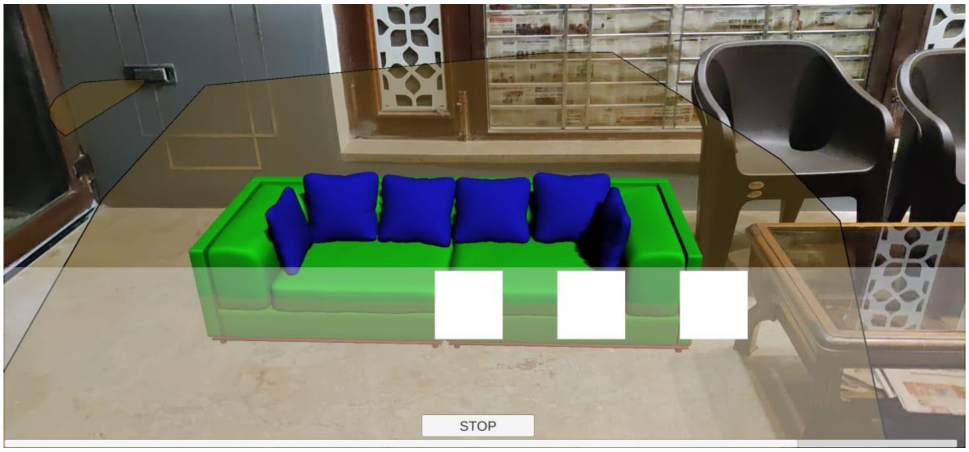

Fig 3.4.2: Virtual Placement of 3D Sofa

## 3.4.3 Rotate and adjust the object

After the furniture object is placed we can adjust the object by making use of rotation UI button which helps in rotating the object.

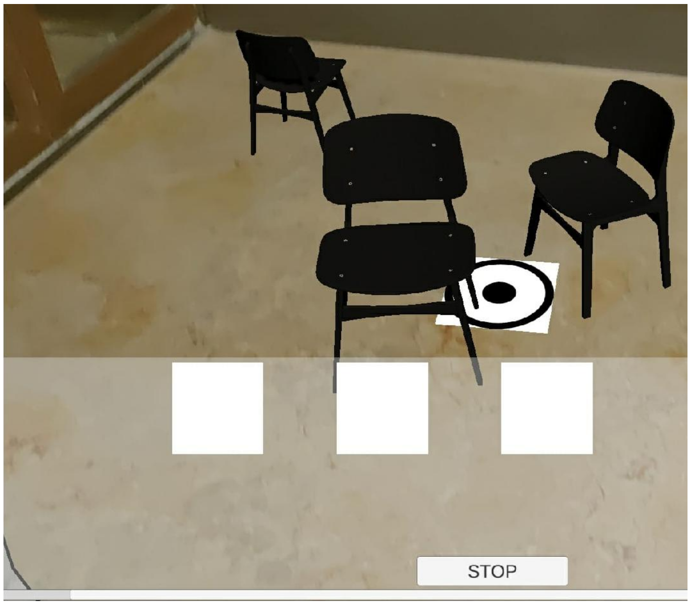

Fig 3.4.3: Rotation and Resizing of the model

As shown in the above figure 3.4.3, it shows the object rotated after it has been placed using the rotate button provided at the top left corner of the application.

# CHAPTER 4

# SUMMARY AND CONCLUSION

## 4.1 Conclusion

The main objective of this “Furniture Layout Application Using Augmented Reality” is to analyse the use of augmented reality to render the furniture model in the real world. Augmented reality technology that allows the customers to decide and interact the furniture with the real world, offering new possibilities for furniture online shopping. It helps the customer to view and understand the furniture for his requirements. These help the buyer in determining how to set up the furniture in their home structure. Augmented reality support for furniture help in creating many new opportunities for future research to anticipate new ideas in the field of online shopping as the customer will get benefit with these types of applications and gives a better understanding and decision making for efficiently purchasing furniture. Augmented reality is a new evolving technology in the field of computer science and will make us much more helpful than traditional technologies.

## 4.2 Future Scope

In future, our “Furniture Layout Application Using Augmented Reality” dataset and scope will be scalable. The user might not only be able to try out different furniture objects but they can also try out this application by trying on garments, goggles, watches, hairstyles etc. It can also be used for various applications in shopping malls, interior designing, Medical Science etc. New technology may come into existence in future that will help in developing 3D models automatically.

# REFERENCES

[1]. M. Mori, J. Orlosky, K. Kiyokawa and H. Takemura. (2016, Sep.). “A Transitional AR Furniture Arrangement System with Automatic View Recommendation”. IEEE Adjunct. [Online]. 21(3).pp.21-24. ISBN: 978-1-5090-3740-7. Available: https://ieeexplore.ieee.org/document/7836488

[2]. S. Mangale, N. Phansopkar, S. Mujawar and N. Singh. (2016, May). “Virtual Furniture Using Augmented Reality. IOSR Journal of Computer Engineering”. [Online]. eISSN: 2278-0661, p-ISSN: 2278-8727, pp.42-46. Available: http://www.iosrjournals.org/iosrjce/papers/Conf.16051/Volume-1/9.%2042-46.pdf?id=7557

[3]. E. Carvalho, G. Maçães, I. Varajão, N. Sousa and P. Brito. (2011, Nov.). “Use of Augmented Reality in the furniture industry”. Presented at Center for Computer Graphics. [Online]. Available: https://www.researchgate.net/publication/236863499_Use_of_Augmented_Reality_in_the_furnitureindustry

[4]. K. Khairnar, K. Khairnar, S. K. Mane, R. Chaudhari. (2015, Oct.). “Furniture Layout Application Based on Marker Detection”. International Research Journal of Engineering and Technology. [Online]. 02(07). p-ISSN: 2395-0072,e-ISSN: 2395- 0056. Available: https://www.irjet.net/archives/V2/i7/IRJET-V2I780.pdf

[5]. M. Billinghurst “Augmented reality in education” in New Horizons for Learning, 2nd ed., vol.3, New York: McGraw-Hill, 2010, pp. 123-135.

# Appendix

## Input manager:-

```
using System.Collections;
using System.Collections.Generic;
using UnityEngine;
using UnityEngine.EventSystems;
using UnityEngine.XR.ARFoundation;

public class InputManager : MonoBehaviour
{
    [SerializeField] private Camera arCam;
    [SerializeField] private ARRaycastManager _raycastManager;
    [SerializeField] private GameObject crosshair;

    private List<ARRaycastHit> _hits = new List<ARRaycastHit>();

    private Touch touch;
    private Pose pose;


    // Start is called before the first frame update
    void Start()
    {

    // Update is called once per frame
    void Update()
    {
        CrosshairCalculation();

        touch = Input.GetTouch(0);

        if (Input.touchCount < 0 || touch.phase != TouchPhase.Began)
            return;


        if (IsPointerOverUI(touch)) return;

        Instantiate(DataHandler.Instance.furniture, pose.position, pose.rotation);

    }

    bool IsPointerOverUI(Touch touch)
    {
        PointerEventData eventData = new PointerEventData(EventSystem.current);
        eventData.position = new Vector2(touch.position.x, touch.position.y);
        List<RaycastResult> results = new List<RaycastResult>();
        EventSystem.current.RaycastAll(eventData, results);
        return results.Count > 0;
    }

    void CrosshairCalculation()
    {
        Vector3 origin = arCam.ViewportToScreenPoint(new Vector3(0.5f, 0.5f, 0));
        Ray ray = arCam.ScreenPointToRay(origin);

        if (_raycastManager.Raycast(ray, _hits))
        {
            pose = _hits[0].pose;
            crosshair.transform.position = pose.position;
            crosshair.transform.eulerAngles = new Vector3(90,0,0);
        }
    }

}
  }
```

## Data Handler:-

```
using System.Collections;
using System.Collections.Generic;
using UnityEngine;

public class DataHandler : MonoBehaviour
{
    public GameObject furniture;
    private static DataHandler instance;
    public static DataHandler Instance
    {
        get
        {
            if(instance == null)
            {
            instance=FindObjectOfType<DataHandler>();
            }
            return instance;
        }
    }
}
```

## Button Manager:-

```
using System.Collections;
using System.Collections.Generic;
using UnityEngine;
using DG.Tweening;
using UnityEngine.UI;

public class ButtonManager : MonoBehaviour
{
   private Button btn;

   public GameObject furniture;



   // Start is called before the first frame update
   void Start()
   {
      btn = GetComponent<Button>();
      btn.onClick.AddListener(SelectObject);
   }

   // Update is called once per frame
   void Update()
   {
      if (UIManager.Instance.OnEntered(gameObject))
      {
         transform.DOScale(Vector3.one * 2, 0.2f);
         //transform.localScale = Vector3.one * 2;
      }
      else
      {
         transform.DOScale(Vector3.one, 0.2f);
         //transform.localScale = Vector3.one;
      }
   }

   void SelectObject()
   {
      DataHandler.Instance.furniture = furniture;
   }
}
```