



# Home Interior Using Augmented Reality

**Prof. Megha Trivedi<sup>1</sup>, Karan Chaure<sup>2</sup>, Saihita Ajgaonkar<sup>3</sup>, Akshay Chimkar<sup>4</sup>**

Professor, Computer Department, Vidyavardhini's College of Engineering and Technology, Vasai, India<sup>1</sup>

Student, Computer Department, Vidyavardhini's College of Engineering and Technology, Vasai, India<sup>2</sup>

Student, Computer Department, Vidyavardhini's College of Engineering and Technology, Vasai, India<sup>3</sup>

Student, Computer Department, Vidyavardhini's College of Engineering and Technology, Vasai, India<sup>4</sup>

**Abstract:** Now-a-days information and communication technology support the development of human interaction with physical, computer and virtual environment such as science, commercial, banking, education, etc. A field of computer science which deals with a combining of reality with computer related data can be called as Augmented Reality. In early days if we users wanted to buy a furniture/decorative objects without visiting the shops it was possible but it was not possible to check how the object actually looks in home structure. Now in our proposed system, it is possible for user to buy the furniture objects sitting in the home without visiting the shops. The main purpose of the "Furniture Layout Application Using Augmented Reality" is to develop an android application for trying different furniture in virtual way using a mobile which supports AR camera. The application will remove or rather eliminate the human efforts by physically visiting the furniture store which is too much time-consuming activity. Besides, this it might be easier to use this technique in Online shopping as an option for user to try out the furniture items in their room they are thinking to buy and allow user to visualize the room 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 to try multiple combination of object virtually without physical movement of furniture objects. These will help the buyer to determine how to setup furniture in home structure.

**Keywords :** Augmented-reality , Markless-Detection , Rendering, Firebase, 3D model.

## I. INTRODUCTION

Augmented reality[1] has been a hot topic in software development circles for a number of 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 you into a new world where the real and virtual worlds are tightly coupled. It is not just limited to desktop or mobile devices.

We can say that Augmented Reality is basically an interactive experience of the real-world environment where objects that reside in real world are enhanced by computer-generated information.

A simple augmented reality use case is: a user captures the image of a real-world object, 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.

## II. LITERATURE SURVEY

The research for augmented reality technology has brought up development of various applications in the field of computer science. In this literature review, it shows how the implementation of augmented reality in various fields using Android Studio.

**Santosh Sharma, Yash Kaikini, Parth Bhodia, Sonali Vaidya** has proposed technique named "Marker less Augmented Reality based Interior Designing system", which uses Markerless Augmented Reality as a basis for enhancing user experience and for a better perception of things. It has advantage of no need of markers in the surface



area and disadvantage is Object is aligned with camera so that it moves as we move a camera.

**Snehal Mangale, Nabil Phansopkar, Safwaan Mujawar, Neeraj Singh** has proposed technique named “Virtual Furniture Using Augmented Reality”[2] which is 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 predefined marker detection algorithm. Algorithm is based on image processing techniques using color and other properties as the input to detect the marker. User initially selects the furniture to be placed from the given database. The application superimposes furniture on the original image with the center coinciding with the markers center in both directions. Furniture objects are overlaid on to the two dimensional image frame acquire from webcam. This will appear as if it is actually placed in the real world. And finally the user can view how the area looks with the furniture present.

**Khushal Khairnar, Kamleshwar Khairnar, Sanket kumar Mane, Rahul Chaudhari** has proposed a technique named “Furniture Layout Application Based on Marker Detection and Using Augmented Reality” to develop an application where user have to place the marker in a room where he want to try out furniture items. The user’s webcam will be on and through the webcam he will capture the live feed of the room. Then application search the marker using fiducial marker detection algorithm. To identify the position of marker using direct linear transformation algorithm. Whichever furniture object the user want to try out he will select that object from the database. Then the application will superimpose 3D object. In three dimensional objects are overlaid on to the two dimensional image frame acquire from webcam. This will appear as it is actually placed in the real world. And finally the user can view the room and object from different angles.

### III. PROBLEM DEFINITION

As the customer purchases various types of furniture through online, but in online it shows only photo and cannot be determined size in room. Even though there are certain applications present which are based on 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 he 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.

This study proposes a new method for applying Augmented Reality [1] technology to furniture, where a user can view virtual furniture and communicate with 3D virtual furniture data using a dynamic and flexible user interface.

### IV. REQUIREMENT SPECIFICATION

- Software Requirements :

Language : JAVA

Operating system : Android 8.0 or more Tools :Android Studio, AR Core, Google Firebase, Blender.

- Hardware Requirements:

RAM Capacity : 4GB , Memory : 50GB , Network : Active Internet Connection, Graphics Card:1GB ,Accessories :

Official Google AR Camera support Smart Phone

#### Software Specifications :

- **Android Studio**

Android Studio is the official integrated development environment (IDE) for Google's Android operating system, built on JetBrains' IntelliJ IDEA software and designed specifically for Android development.

It is available for download on Windows, macOS and Linux based operating systems or as a subscription-based service in 2020.

It is a replacement for the Eclipse Android Development Tools (E-ADT) as the primary IDE for native Android application development.



- **Google ARCore**

ARCore provides SDKs for many of the most popular development environments. These SDKs provide native APIs for all of the essential AR features like motion tracking, environmental understanding, and light estimation. With these capabilities you can build entirely new AR experiences or enhance existing apps with AR features.

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. Six degrees of freedom allows the phone to understand and track its position relative to the world.

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

Light estimation allows the phone to estimate the environment's current lighting conditions. ARCore has been integrated into a multitude of devices

- **Google firebase:**

Firebase is a platform developed by Google for creating mobile and web applications. It was originally an independent company founded in 2011. In 2014, Google acquired the platform and it is now their flagship offering for app development.

The Firebase Realtime Database is a cloud-hosted NoSQL database that lets you store and sync data between your users in real-time. `plat_ios plat_android plat_web plat_cpp plat_unity`. NEW: Cloud Firestore enables you to store, sync and query app data at global scale. Using it for storing and retrieving 3F models.

- **Blender**

Blender is the free and open source 3D creation suite. It supports the entirety of the 3D pipeline—modeling, rigging, animation, simulation, rendering, compositing and motion tracking, video editing and 2D animation pipeline.

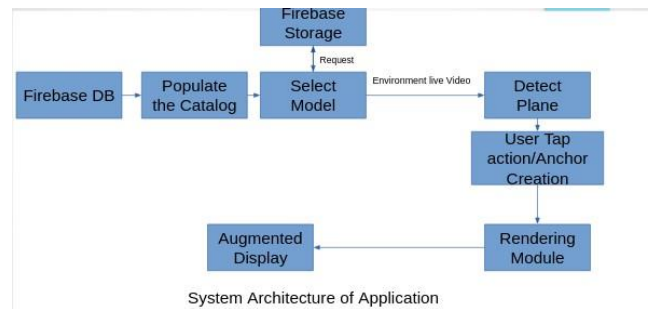
Several versions of Blender exist and the difference between them lies in the features that are included in each. The commercial version of Blender includes everything you need to create and render 3D scenes and animations. An advanced version of Blender also includes the Fluid Effects, Cloth, Hair and Fur features. A freely available version of Blender called the Personal Learning Edition is also available. The Personal Learning Edition is identical to Blender Complete, except that all renderings include a watermark, making it a great place to start if you want to learn Blender.

Along the bottom of the interface are the Time Slider, the Range Slider, and the animation controls, which are used to specify and move between the different frames of an animation sequence; also at the bottom are the Command Line, for entering textual commands, and the Helpline. Finally, the horizontal column of buttons to the left of the interface is known as the Toolbox and the Quick Layout buttons. These buttons are used to select and transform scene objects and to change the interface layout.

A key concept that you need to understand as you begin to work with the interface is that there are several ways to access the same command. For example, you can create a sphere using the Create, Polygon Primitives, Sphere menu command or by using the Polygon Sphere button in the Polygons shelf. This design is intentional, allowing beginners an intuitive method for accessing a command, and giving advanced users an access method that lets them work quicker as they learn the shortcuts.

## V. ARCHITECTURE

The system basically uses mobile phone built-in camera which supports Augmented reality to collect view as the real scene view observed by human eye and stacks the 3D furniture models on the screen displayed. First of all, we need to setup the scenes in Android Studio for User Interface of application like buttons, text areas, background image and virtual object selection. Later we build 3D furniture models by Blender and import the models into Android Studio. 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 smart phone has touch-screen interface function, we can place the furniture by sliding screen.



**Figure 1:** System Architecture of Application

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

## VI. MODULES

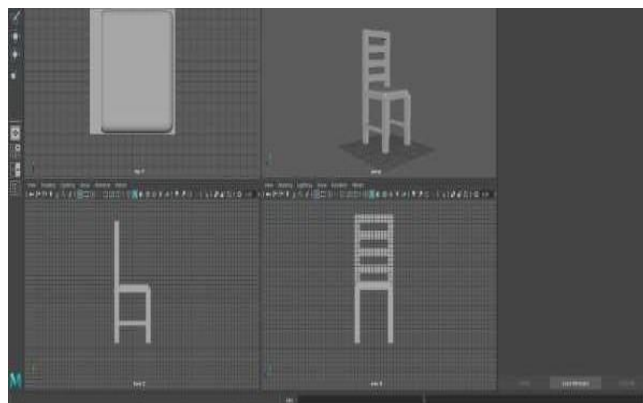
The application implementation consists of four modules.

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

### i. Creating Augmented Reality Objects

First, we should establish virtual models with the help of Blender[8] software to create 3D furniture models, the models mainly use Polygon and NURBS modeling methods, the animation mainly uses key frame and expression animation technology. After establishing models in Blender, four important information of the model will be stored in the file of each model, they are the model's vertex coordinate, texture coordinate, normal coordinate and the total number of polygons, these data are the main data when rendering model. Application will store them in memory and read them to render models when calling rendering function. The data quantity of the model is very huge, so we need a loading module of the model to make it loaded into program conveniently. Later we export the model data, the file exported by Blender is .obj file, which stores above information, next convert the information to file which is available in program by model loader and obtain the

model data by calling head file. After loading model data, we can render and display it in the scene through Android Studio[6].



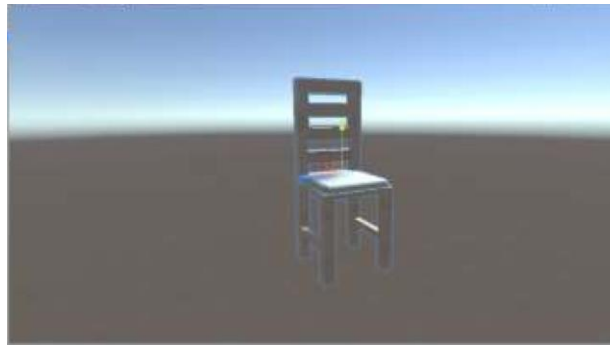
**Figure 2:** Developing Augmented Reality objects



As shown from the above figure 3.2 it shows how the 3D objects are developed for this application using the Blender. In the figure it shows the front view, side view, top view, 3D view of the object that is been created.

## ii. Developing Scenes for User Interface

In this module we create scenes for every slide of application using Android Studio. The main interface interacts by sliding browsing and selecting the key. The main interface contains furniture model, buttons that helps to move to next model, to scan the surface area of living room, description of model such as length, width, height and for buying the model in online store. The furniture column stores the key of all furniture, display one furniture at a time and which also supports sliding browsing. In order to implement these functions, we make the scene display to ratio of Android display and add the buttons to the scene that helps in moving to next scene. Later we import the 3D model developed using Blender[8] and functionalities like rotating the chair while displayed using JAVA code for that object and add functionalities to move to next scene.



**Figure 3:** Android Studio scene of the chair model

As shown in the above figure 3.3, it shows the Android Studio platform that is used to create scene for the chair model that is used as furniture which is imported from Blender. For every model of the furniture we will create an individual scenes and at final we combine all scenes.

## iii. Place the Virtual Object on the Surface Area

In this scenario, we use the help of Google AR core[7] package which will be imported in Android Studio and modify the package that will help us to scan the surface of living area where we need to place the virtual object in in the real world. Once the modifications to Google AR core has done, we will create scene such that after the surface area is scanned and when the user tap 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 desired in the real scene via user interface provided at this stage.

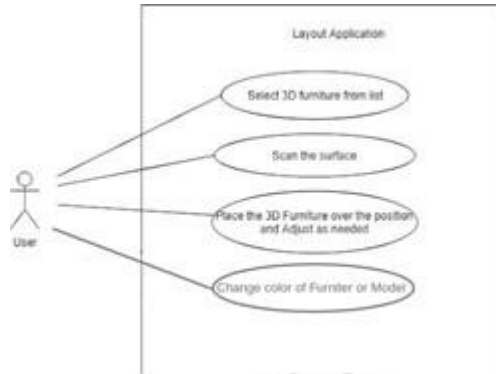
## iv. Verification of placed objects

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 object. In order 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 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 JAVA.



VII. UML DIAGRAMS :

Figure 4 : Use case Diagram



a) Use Case Diagram:

As shown from the above figure 3.4, 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 camera of device and place the model to verify whether it fulfill our needs. The actor here is the user and uses cases select 3D furniture, scan the surface, place the 3D furniture.

b) Sequence Diagram: As shown in the above figure 3.6, it describes the sequence diagram of the application, i.e. how the application is started and to the end of the resultant augmented display in a sequence of interactions. User, application, AR Camera, image position, 3D object. First user starts the application and holds the living area by scanning surface. As soon as the area is scanned the 3D model selected is placed over the area.

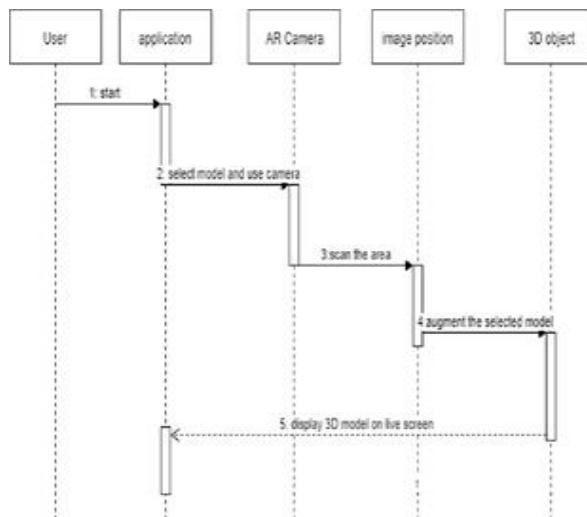


Fig 5. Sequence diagram

c) Activity Diagram:

As shown from the below figure 3.7, it describes the activity diagram of the application that consists of flow of the application. All the models will be populated from google Firebase server and will be viewed in Cardview fashion for selecting the model and downloading on main activity i.e. Main page. Next scan the surface, place 3D model and finally if satisfied then add more model objects to the scene.

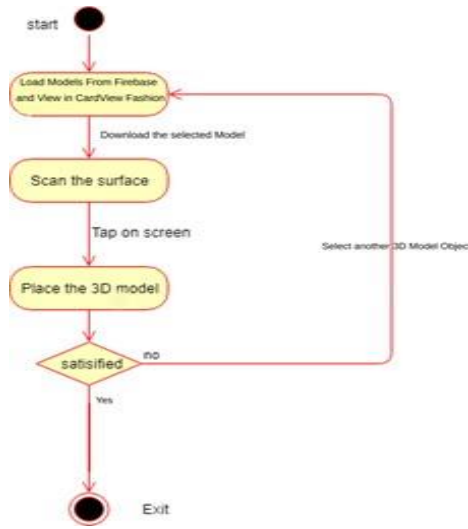


Figure 6: Activity Diagram

VIII. TESTING AND RESULTS

**Test Cases :** Testing is debugging program which is one of the critical aspects of the computer programming triggers. It is process of evaluating a system or its component(s) with the intent to find that whether it satisfies the specified requirements or not. It is executing a system in order to identify any gaps, errors or missing requirements in country to the actual desire or requirements.

Table 1. Code Testing

| ACTION   | RESULT  | REMARKS   |
|--|---|---|
| Tap to place the 3D object                                     | 3D object is not placed                             | Add Google AR package to 3D model and modify package. |
| Rotating the 3D object in clockwise or anticlockwise direction | 3D object doesn't rotate                            | Added transformation position class in the script     |
| Touch the screen to adjust the 3D object                       | Touch doesn't work when focused on the image target | Added Lean touch script to the 3D object              |



|  |   |                              |
|--|---|------------------------------|
| Changing the scene from one mode to another mode | UI button doesn't work as the function to go forward to another mode. | Added function to UI button. |
|--|---|------------------------------|

**Table 2.** Integration Testing

| ACTION                     | RESULT                    | REMARKS                                 |
|----------------------------|---------------------------|---|
| Building app               | Failed to build           | Add Android SDK in the builds           |
| Application failed to open | Google AR core is missing | Download Google AR core from play store |

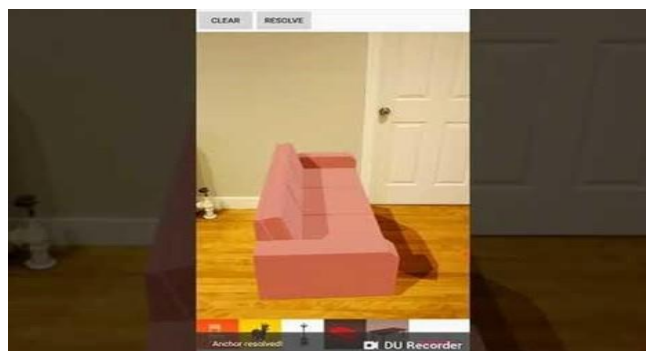
**Table 3.** Validation Testing

| ACTION  | RESULT  | REMARKS                        |
|---|---|--------------------------------|
| Open the application and target the 3D model. | 3D object is projected in real world environment using the real object. | Application runs successfully. |

**IX. OUTPUT SCREENS**

The output of the screen are displayed as follows:

**i. Main page**



**Fig 7.**Main page

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

**ii Scanning page**

After the object furniture 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 the Google AR core.





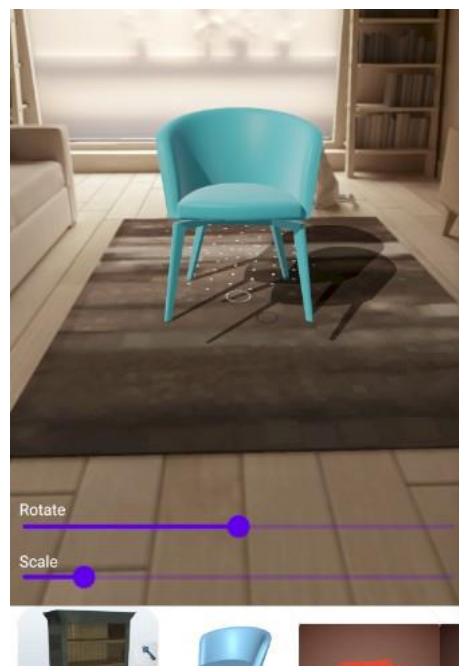
**Fig 8.** Scanning page

As shown in the fig 5.2 it shows how the living area is scanned to find the plane in order to place the selected object.

#### i) 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 UI buttons that helps in moving to Main page, Information page, Online store, rotating the object.

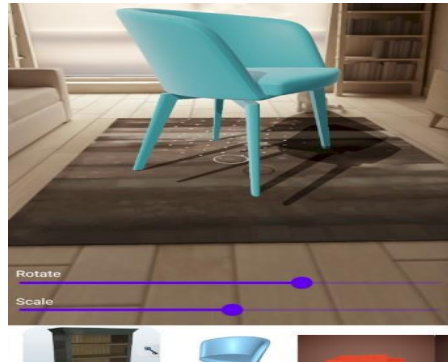
As shown in the above figure 5.3, it shows the furniture virtual 3D object that has been placed in the real world i.e, augmented display.



**Figure 9:** Furniture Object Placed

## ii) Rotate and adjust object

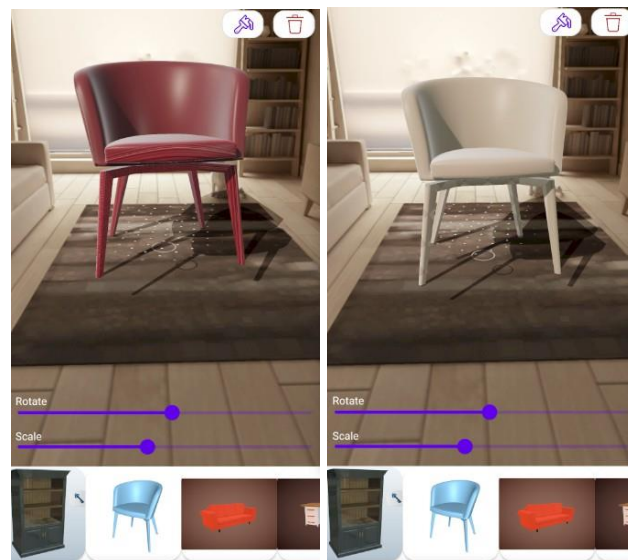
After the furniture object is placed we can adjust the object by making use of rotation UI button which helps in rotating the object by an angle of 30° per click.



**Figure 10:** Rotate and adjust object.

## v) Colour change option

Once the user thinks that furniture is not satisfactory to his needs he can change the colour options by clicking at top right corner (paint brush icon) of the application. The number of colors depends on how many colors the developer has added to a particular model.



**Figure 11:** Change color of object

## X. 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 real world. Augmented reality [5] 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. Due to this customer will come to know how their home structure would look after purchasing and placing the furniture object with multi-colour option. These helps the buyer in determining how to setup 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 customer will get benefit with these types of applications and gives a better understanding and decision making for purchasing a furniture in an efficient way. Augmented reality is new evolving technology in the field of computer science and will make us much more helpful than the traditional technologies [5].



## XI. 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, hair styles 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.

## XII. ACKNOWLEDGMENT

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The preferred spelling of the word “acknowledgment” in America is without an “e” after the “g”. Avoid the stilted expression “one of us (R. B. G.) thanks ...”. Instead, try “R. B. G. thanks...”. Put sponsor acknowledgments in the unnumbered footnote on the first page.

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