
**Institute Of Mathematics and Computer Science**

# BS. (CS) THESIS

# AUGMENTED REALITY BASED ROOM DECORATION APP

THESIS SUBMITTED TOWARDS THE PARTIAL FULFILMENT OF THE REQUIREMENT OF THE UNIVERSITY OF SINDH FOR THE AWARD OF BACHELORS OF SCIENCE IN COMPUTER SCIENCE DEGREE.

**January, 2022**


**Institute Of Mathematics and Computer Science**

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# AUGMENTED REALITY BASED ROOM DECORATION APP

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**January, 2022**


## Institute Of Mathematics and Computer Science

# CERTIFICATE

This is to certify that the project entitled **"Augmented Reality Based Room Decoration Mobile Application"** has been carried out by **Ghulam Yasin, Syed Abdurrehman, Waqas Aziz and Yasir Nawaz**, during the academic year 2021 as a partial requirement for the degree of Bachelors of Science in Computer Science (BS.CS).

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# DECLARATION

This thesis is our original work and has not been ever submitted, in whole or in part, for a degree at this or any other university. It does not contain, to the best of our knowledge and belief, any material published or written by any other person except as acknowledged in the text.

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# DEDICATION

We dedicate our dissertation work to our family, many of our mentors, and for the betterment of humanity.

# ACKNOWLEDGEMENTS

We are grateful with the core of our heart to ALMIGHTY ALLAH who made it possible to complete this thesis / project successfully.

Our deepest gratitude goes to our mothers for their unflagging love and support throughout our life. We have no suitable words that can fully describe their everlasting love to us. Similarly, we are grateful to our other family members who always encouraged us in getting this valuable task completed.

We specially thank our supervisor, **Dr. Syeda Hira Fatima Naqvi**, for his/her supervision and support that motivated us throughout the duration of the project with invaluable suggestions time and again.

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# ABSTRACT

Information technology currently supports the development of human interaction with virtual environment. This development will continue in developing in the form of Human Computer Interaction (HCI). Augmented Reality is a field of computer research, which deals with the combination of reality with computer-generated data. The main purpose of this project is to develop a windows application for trying different furniture items in a virtual way. This application will eliminate the need of physically visiting the furniture store, which is very time consuming activity. This research is using photo-realistic 3D models to rendering used in computer graphics. Rendering of the basis for color and shading in order to make it appear solid and 3D. These 3D furniture models are superimposed on to the live feed of real space taken from the camera. After imposing the model it will appear as, it is actually placed into the real world. Using this application one can choose from the different set of furniture and try it on their space.

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# CHAPTER 1

# INTRODUCTION

## 1.1 Motivation

The principle reason for this task is to build up an application for attempting distinctive furniture things in furniture stores without utilizing the typical methods, which is a very tedious movement. We will build up a framework with enlarged reality that lets client to attempt on virtual furniture in client's genuine home structure before buying. From this client will probably pick furniture questions significantly less demanding. This it may be less demanding to utilize this system in Online shopping as a possibility for client to experiment with the furnishings things in their room they are thinking to purchase and enable client to picture the room how it will care for putting furniture in it. It won't be important to go out on the town to shop and long hunting down the vast client need, or utilize a measure tape to see if or not the furnishings would fit in client's room or not. Client can endeavor numerous mix of furniture questions essentially without physically moving the furnishings things. Our inspiration here is to build the time effectiveness and moreover improve the availability of furniture attempt on by making this format in increased reality. Rendering of the reason for shading and shading so as to influence it to seem strong and 3D. These 3D furniture models are superimposed on to the live feed of genuine space taken from the camera. After forcing the model it will show up as, it is really put into this present reality. Utilizing this application one can browse the distinctive arrangement of furniture and attempt it on their space. It will assist the clients with visualizing the room or space where they need to put the furnishings things. And furthermore,

get the careful look of the room or space in the wake of putting furniture in it. Clients can experiment with various blends for all intents and purposes, without physical development of furniture things. The inspiration here is to build the time productivity and improve the openness of furniture attempt on by making furniture design utilizing increased reality application.

## 1.2 Problem Statement

Wang, Gu, David, Gong & Kim (2007) state unfortunately AR is still not carry out as a real output in the field of architectural design although it actually matured from a pure research field into certain practical industrial applications. This showed that Augmented Reality has had a relatively slow transition into the architecture design sector. For the reason of that, these cause several problems.

Nowadays, people usually will go to the shop for samples to decorate house and room. But majority of the people are busy with work. People are no time to go to various stores to buy furniture for their home, shop or office. It is also difficult to let alone taking it out and trying it at home. If found out that the furniture is not suitable to the house, then the furniture needs to return to the furniture shop. Even if have time to go to the furniture shop, after visit to the shop, people may found out that there is none of the furniture that fulfils requirement. Hence there should have a way to let people use their mobile to view a 3D interior design in anyway and anytime before it populate with the real items.

Next, that is difficult to fulfil the customer,,s contentment of decorate the room without imaginary picture to refer will make them confuse. And that is so hard to choose the sofa that suitable to the house at the furniture shop.

Normally, people will ask the opinion or suggestion from the staff of the furniture shop when can‟t decide which furniture is suits the house. Hence, the staff of the furniture shop will recommend some of the furniture that may suitable. For the reason that there are limited spaces, so not all the furniture is display in the furniture shop. Thus, staff of the furniture shop may use words to express on the design of the furniture that are not display in the shop. It,,s hard by explain in words, customer normally do not get a good picture of the design of the furniture because discuss without a visual design. It,,s really wasting time and energy.

Other than that, there are a lot of people throw off the furniture catalog. There are few reasons that people act like that. Many catalogs that obtain from the public are 3 not attractive enough. Although some catalog have nice and colourful design, but the picture printed on the catalog is stark and lifeless, that is difficult to attract user‟s attention. Other than that, many catalog contain a lot of description, users not willing to waste their time on reading a catalog that contain a lot of unnecessary information. It is bored to look on this type of furniture catalog.

On the other hands, in the industrial design field, some of the designers have used sketches with pen on paper to explore and evaluate early concepts (Tek, 2009). This is usually drawn in 2D or 3D hand sketch. In this case, if the interior design furniture is present in hand sketch, designer often encounter situations in which client can‟t view a better graphics of visualization. For example, client can‟t view the design of the table, chair, cabinet and etc more effectively.

Hence, below are the problem statements that can be stress in order to implement in this project:

i. People have no time to go to various stores to buy the furniture and furnishing.
ii. Difficult to fulfill the customer's contentment of decorate their room without imaginary picture to refer.
iii. There are a lot of people who will throw off the catalog.
iv. People can't view a better graphics of visualization

## 1.3 Objective

The following are the main objectives:

i. To create an interior design application using augmented reality technology.
ii. To provide users a new interactive technology to be practiced in interior design.
iii. To develop an augmented reality mobile application in 3D interior design that provides more convenience to the user.
iv. To produce realistic virtual furniture model in interior design similar to the real furniture.

## 1.4 Scope of the thesis

i. User - Everybody that has mobile gadget to use the augmented reality application to design their room or house with virtual 3D objects.
ii. Furnishing companies - Implement augmented reality application with virtual 3D representation furniture and furnishings for their customer.
iii. Content application - The application is an interactive AR application. The model focus is the furniture of the living room. So, the 3D models that develop will be the furniture of

the living room. In order to use this application, user needs to have camera on their device. After that, user just needs to install the application, turn on the application and point the camera to the living room. User can take a picture of the design space and set the image as tracking pattern. Then, user can choose the furniture from the list and the sofa's image will be overlaid on the room. Reactivating the camera can then reset the whole process. Last, a screenshot can be saved for further refer.

iv. Interaction technique - Three types of gestures have been provided in this application such as drag, pinch and rotation gesture. User can drag, rotate, enlarge and minimize the furniture model in order to fit in their house. At the same time, user can view different dimension of the 3D virtual object such as the front view, side view and back view of the model by rotate the model with fingers.

# CHAPTER 2

# LITERATURE REVIEW/BACKGROUND

The first mentions of AR date back to the 1950s when the cinematographic pioneer Morton Heilig thought of how to draw the movie audience into onscreen activity by addressing more senses apart from sight and hearing in an effective manner (Carmigniani, Furht, Anisetti, Ceravolo, Damiani & Ivkovic, 2011). In 1962, Heilig built a prototype of his vision called Sensorama simulator that was ahead of its time, but eventually ended up without a crucial investment (Turi, 2014). Nevertheless, the biggest milestone for AR occurred in the beginning of the 1990s when scientists Tom Caudell and David Mizell from the aeronautical company Boeing coined the term "augmented reality" and presented the advantages of usage (Carmigniani et al., 2011).

Over the years, researchers, scientists and developers found more areas that could benefit from the augmentation. The first applications focused on military, industrial and mostly medical purposes, but AR systems for commercial use, journalism, sports, marketing or entertainment began to appear more and more often throughout the last years (van Krevelen & Poelman, 2010). Besides the field and context of use, the AR applications also differ based on the specific entities they augment. AR is capable of enhancing the physical reality by overlaying virtual elements on: people, products or surrounding space (Carmigniani et al., 2011). So far, AR used on smart devices equipped with operating system, camera and location-based sensor or on large interactive screens, either privately or publicly in retail business, are among the most common ones (Javornik, 2014).

AR applications on smart devices allow a consumer to see a virtual product placed in the familiar environment, such as augmenting virtual furniture in the actual physical room, or an enhanced view of a self in the form of virtual mirrors or virtual try-ons, which are enabling the users to try virtual make-up, glasses or clothing. While digital try-ons already existed in the form that websites allowed to upload an own picture, the AR virtual mirrors deliver more interactive real-time experience (Javornik, 2016). In terms of public AR applications, Javornik et al. (2017) investigated "magic mirrors" which augmented the actual image of visitors with make-up of historical figures in a museum and a dressing room of an opera house. This study revealed that AR is more engaging if the user can control the experience, but for public spaces the automatized augmentation is contributing to create attention. Moreover, the usefulness of the AR application was differing depending on the kind of users. While make-up artists valued the potential to experiment with 8 looks, actors saw it as useful to get into the role and visitors of the museum as means to playfully learn about culture and history (Javornik et al., 2017). Moreover, major newspaper houses such as the New York Times or the Wall Street Journal experiment with embedding the AR content like videos or animated infographics to increase the interactivity of traditional storytelling (Pavlik & Bridges, 2013).

Aiming to achieve customer engagement or to positively affect customers' purchase intention, many of big brands from various industries such as Converse, Coca-Cola, Disney, Epson, IKEA, LEGO, Lacoste, L'Oréal and MINI are currently experimenting with AR either as part of their advertising or as a virtual trial of their own products (Banks, 2016; Csutoras, 2016; Duran, 2016). Apart from these more or less successful examples of using the emerging technology for commercial purposes, it has been empirically confirmed in year 2016 that consumers are ready to

engage with AR, although they might have not been aware either of the technology or the term itself (Seitz, 2016). Pokémon GO became a global hit with millions of users downloading the mobile app to hunt virtual creatures in the real world (Parkin, 2016). The instant success story was also helpful in terms of awareness of AR among both consumers and a broader investment community (Seitz, 2016). Another story confirming users' fascination by AR and willingness to engage with it, is the social network Snapchat. The application with 300 million active users per month, which is mostly popular among the youthful generation under 24 years old (Aslam, 2017), is mainly known because of the feature called "lenses" (Kar, 2016). It allows people to overlay their faces with amusing graphics and filters. According to Kar (2016), "Snapchatters" spend 20 seconds a day on average playing around with augmented lenses. Moreover, Snapchat has started to monetize this function, and offers companies to take advantage and upload their branded masks (Kar, 2016). In the future, the technological company promises that it could visualize images - and consequently advertisements - onto variety of real-world objects and not only on human faces (Dalton, 2017).

Furthermore, leaders of IT sector aim their focus to wearable computing which might move the relevance and importance of AR even further (Munro, 2013). Wearable devices such as glasses, goggles or contact lenses allow a much closer association with the user (Starner, 2004). The sensors inside such gadgets allow them to see what the user sees, hear what the user hears, and sense the user's physical state. If this information is combined, an intelligent interface may be able to analyse what the user is doing and try to predict the resources he will need next or in the near future (Starner, 2004). Wearable computing is on the horizon, and will enable immersive and more intuitive experiences. Examples of the first pioneering devices capable to fulfil addressed possibilities are Google

Glass or Microsoft HoloLens (Munro, 2013). These IT firms were sceptical 9 to the enclosed world of virtual reality and rather focused their research and development in augmented direction (Parkin, 2016). However, Google Glass project was suspended in 2015 after only two years of existence when only a chosen few could buy the gadget for $1,500. Even though the Time magazine honoured Google Glass as one of the best inventions of the year 2012 (McCracken, 2013), the smart glasses however did not find many fans due to its high price, unprepared ecosystem of third party applications and visual creepiness affecting the nature of humanity (Montgomery, 2015).

Yet, such utilization of the AR wearables has been rare in marketing, due to the limited access to aforementioned devices (Javornik, 2016). In addition to the lower accessibility, sociologists question the society's readiness for these products in terms of the challenges that they will bring to public life, personal privacy, and consumers' relationship with the companies and authorities that will have access to more accurate personal data than ever before (Statt, 2014).

# CHAPTER 3

# METHODOLOGY

## Tools

## 3.1 Software

To meet the objectives, the android operating system is selected. Android is a mobile operating system based on a modified version of the Linux kernel and other open source software, designed primarily for touchscreen mobile devices such as smartphones and tablets. Android provides a rich application framework that allows us to build innovative apps, in this project android is preferred as most of the mobile operating system industry (73%) is android based.

### 3.1.1 Flutter

Flutter is Google's portable UI software development kit (SDK) for crafting natively compiled mobile, web, and desktop applications initially this project was called sky. It offers a complete environment with a framework, widgets, and tools. Flutter is also open-source and free, meaning you can use it in a straightforward way. In Flutter, Everything is a widget nested inside another widget. It comes with beautiful, customizable widgets and we can control the behavior of each widget and also styling becomes easy.

Flutter is preferred as it is one of the best tools for creating cross platform mobile applications, consisting of a rich repository of UI components and built-in APIs, providing low memory consumption and high performance.

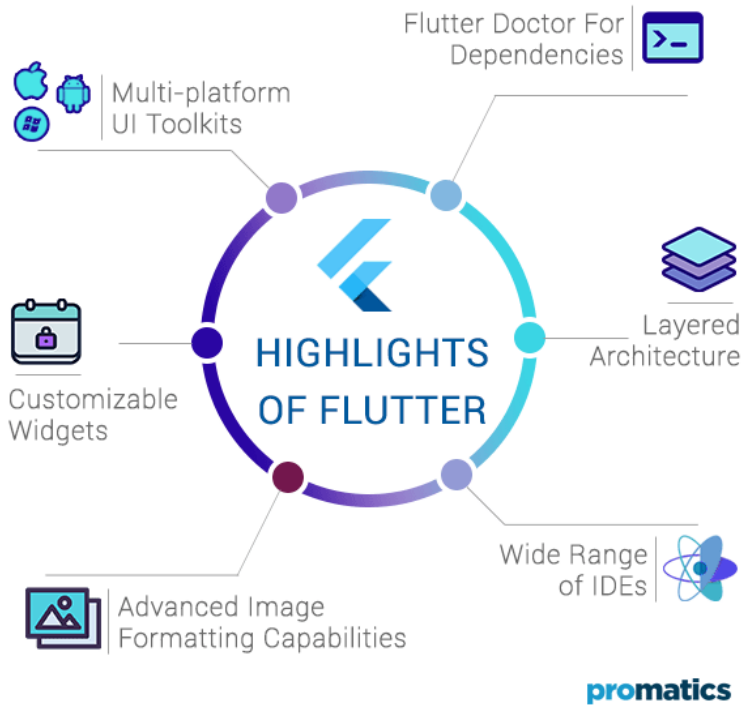


*Figure 1 – Flutter Description*

## 3.1.2 Packages and Plugins

Flutter plugins are thin Dart wrappers on top of native (Java, Kotlin, ObjC, Swift) mobile APIs and services. For instance, if you wanted to access a sensor on the phone, the only way is to write a plugin.The API of the plugin is written in Dart. The implementation of the plugin is written in

either Java/Kotlin (for Android support), in ObjC/Swift (for iOS support), or both (for cross-platform support).

Packages are written entirely in Dart, the main difference between the two is that with a pure Dart package you don't need to write any native code and testing is a breeze.

### 3.1.3 Augmented Reality

Augmented reality (AR) is the interactive experience of real-world nature in which real-life objects are developed by computer-generated cognitive information, sometimes in a variety of senses, including visual, auditory, haptic, somatosensory and odor. AR can be defined as a system that combines three basic elements: a combination of real and virtual world, real-time interaction, and accurate 3D registration of real and virtual reality, Augmented reality refers to a technology which 'augments' the user's visual (and in some case auditory) perception of their environment. Typically, digital information is superimposed over a natural existing environment. Information is tailored to the user's physical position as well as the context of the task, thereby helping the user to solve the problem and complete the tasks, in the 21'st century tech giants have started adopting this revolutionary technology which lightens the barrier between physical and digital worlds. Industries like manufacturing, utilities, telecommunications, retail, healthcare, and logistics also are increasingly adopting AR for a variety of uses, including assembly, maintenance and repair, education and training, retail showcasing. Improving healthcare outcomes with better diagnostic tools. Creating immersive experiences for sports fans or concertgoers. Building virtual or augmented tours of real estate properties or hotels. Helping people find

their way through shopping malls and airports using AR on their phones are some instances of when AR came to be really useful.


*Figure 2 – Augmented Reality*

Augmented reality technology was invented in 1968, with Ivan Sutherland's development of the first head-mounted display system. However, the term 'augmented reality' wasn't coined until 1990 by Boeing researcher Tim Caudell. The technology has come a long way with a growing list of use cases for AR.

Augmented reality was first used for navigation in NASA's X-38 spacecraft. AR is often

*Figure 3 – History of AR*

confused with its relative branch VR (Virtual Reality) although both are based on mimicking reality, in AR the virtual reality is created within the actual reality whereas in VR the reality is mimicked completely into a virtual universe.

The application, **DesignAR** uses the principles of Augmented reality technology, the application is based on an online furniture shop which uses the technique to virtually place the furniture in the reality(real world) by using the ARCore plugin provided in flutter to solve a real world problem saving time and resources meanwhile providing a fun interface and an easy access to online shopping and getting familiar with a modern technology like Augmented Reality.

### 3.1.4 ARCore

ARCore is the plugin used in **DesignAR**, it is Google's platform for building augmented reality experiences. Using different APIs, ARCore enables your phone to sense its environment, understand the world and interact with information. Some of the APIs are available across Android and iOS to enable shared AR experiences.

ARCore uses three key technologies to integrate virtual content with the real world as seen through the camera of a smartphone or tablet:

- 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.


*Figure 4 – ARCore*

These three technologies weave together to give your phone an understanding of the world around you and how your phone relates to it. It can then speak to the app you're using, telling it how to best create an immersive augmented reality experience for you. That could be as simple as a sign that says what kind of restaurant you're looking at or a complex character walking around the world.

### 3.1.5 Firebase

Firebase is a development platform known originally for its real-time database that's still at its core a multi-node,key-value database optimized for synchronizing data, often between user machines or smartphones and centralized storage in the cloud.


*Figure 5 – Firebase Introduction*

It's designed to make life easier for developers by handling much of the pushing and pulling of data. That relieves app developers of the programming burdens associated with managing versions or locations. They can write the new bits to Firebase and the data will be consistent throughout the system.

Firebase is valued largely because it can constantly propagate and synchronize changes between local copies of information stored on users' machines with versions kept in the cloud. Firebase eliminates many of the challenges of mixing authentication, synchronization, and segregation by juggling multiple versions and ensuring the right bits are the same throughout the system. Its modern form allows it to split workloads between multiple machines by either splitting the datasets, creating copies of their bits, or both. Firebase extends the algorithms used for datacenter consistency to the entire network by treating the data stored on users' phones or desktops as local versions of the big database. In essence, your phone or your laptop is now part of the cloud. It is an ideal tool for helping developers get started quickly because it handles much of the work of replicating data and pushing event notifications. It abstracts away the challenges of storing data simultaneously in a user's phone and a central database. The main data model is limited to **NoSQL**,

although some developers have created FireSQL, a tool that adds SQL-like syntax.

## 3.1.5.(a) Cloud Firestore

Cloud Firestore is a NoSQL document database that lets you easily store, sync, and query data for your mobile and web apps - at global scale. Firestore is part of Firebase's app development platform.

## 3.1.5.(b) Cloud Storage

Firebase Cloud Storage is built with mobile connectivity in mind. Automatically pause and resume transfers as your app loses and regains connectivity.

## 3.1.5.(c) Authentication

Firebase security applies Google's internal expertise to easily build app sign-ins. It provides backend services, easy-to-use SDKs, and ready-made UI libraries to authenticate users to your app. It provides an end-to-end identity solution, supporting email and password accounts, phone auth, and Google, Twitter, Facebook, and GitHub login, and more.

## 3.1.6 Application Programming Interface (API)

Application Programming Interface acts as a software intermediary that allows two applications to talk to each other. It enables data transmission between one software product and another. In DesignAR a **API** is used on the server to fetch images for the furniture application.

# Technique

In this section we will work on how we engineered the DesignAR application, what methodologies and techniques were used alongside to give the pictorial representation of the actual application. The main goal for the project was to implement Augmented Reality principles into an application as to counter a major household/ interior designing problem, the project aims to help the users to virtually place household furniture, trying and testing it without actually buying the real product from a store which then later might result in a waste of resources and time.

## 3.2 SplashScreen

Splash screen is the first graphical notification you receive when you visit any app. It can even appear as an introductory screen of an application. It also signifies that you have to wait for a few seconds before landing on the actual screen of the application. DesignAR starts up with a similar splash screen and a loading circular Indicator, splash screens benefit in two aspects, primarily providing a good user interface and user experience alongside fetching JSON data from the server asynchronously for a better performance of the application.


*Figure 6 – DesignAR Splashscreen*

## 3.3 Welcome and User Authentication screens

The splash screen navigates the user to a Welcome window which then assists the user with multiple options on what to do next which includes signing up if they are not already signed up, login if they already have an account or access the application directly without creating any accounts.

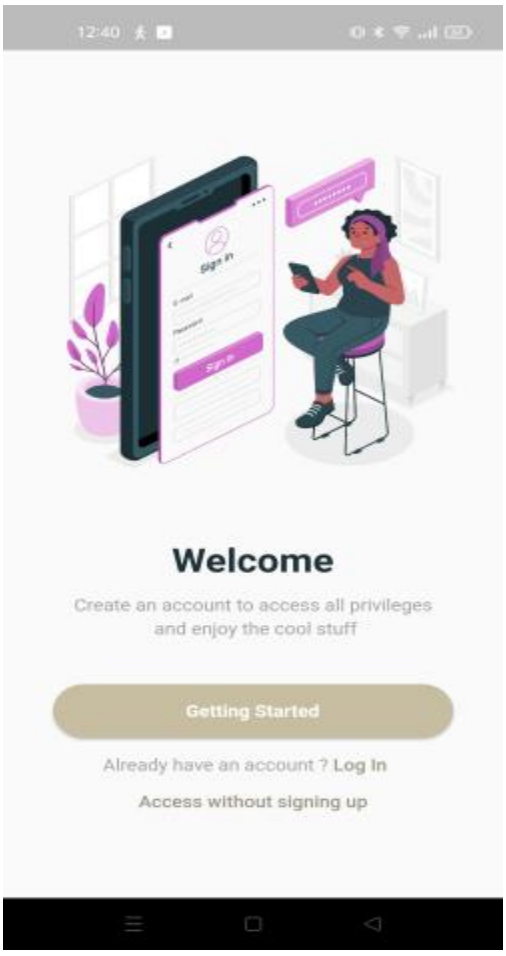


*Figure 7 – DesignAR Welcome Window*

Following are the user authentication screens, the database used to store user credentials is Firebase's Cloud Firestore which assigns a user with a unique user ID when first logged in and then later it performs a check whenever that key is used for logging in by matching the client and server-side key IDs, if they keys aren't matched the user cannot access the application unless correct information is specified. Along with the normal authentication, third party authentications are also added such as google and facebook's sign-in options.

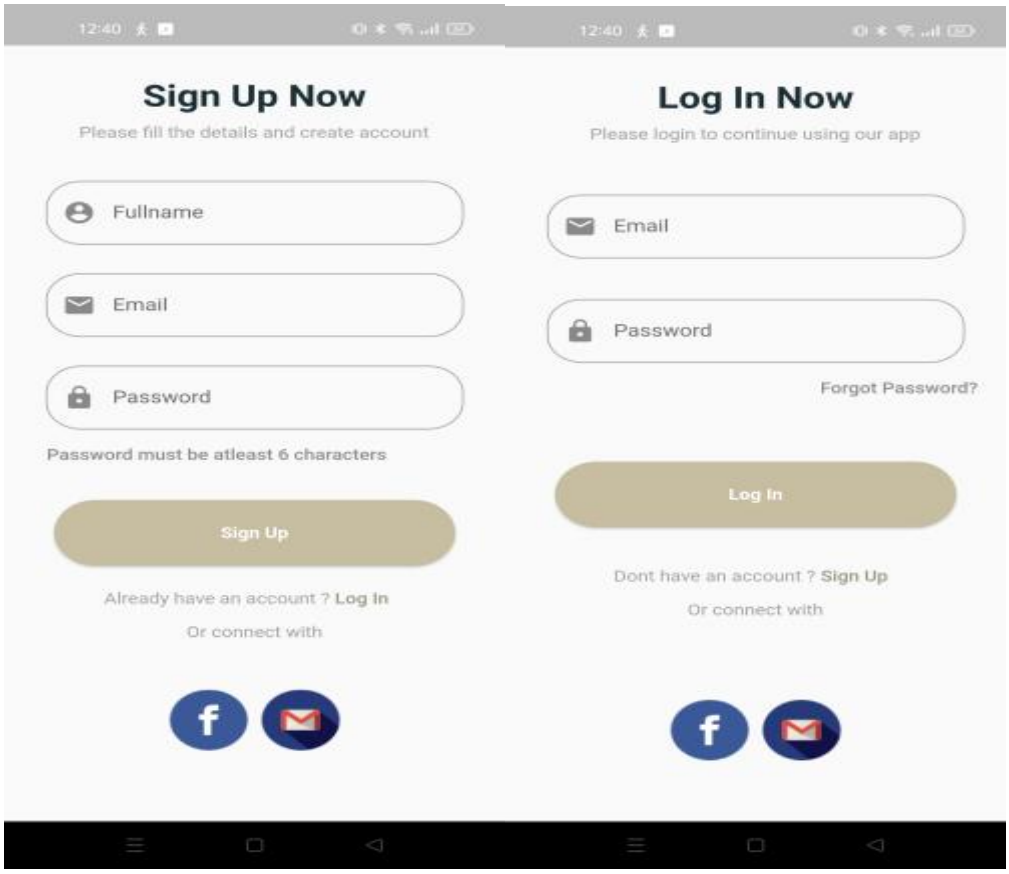


*Figure 8 – DesignAR Signup and Login Screens*

## 3.4 Furniture Store

This is the main UI of the application consisting of a Top Navigation Bar, which consists of multiple tabs for different categories of furniture.

The body section of the application consists of a Carousel Slider, which basically is a slider which is constantly sliding and animating the images.

The next section is the grid which consists of Cards in which the data for the products is shown and are represented in the form of images

Lastly, we have the Bottom Navigation Bar which consists of multiple tabs other than Home(which has the actual shop).

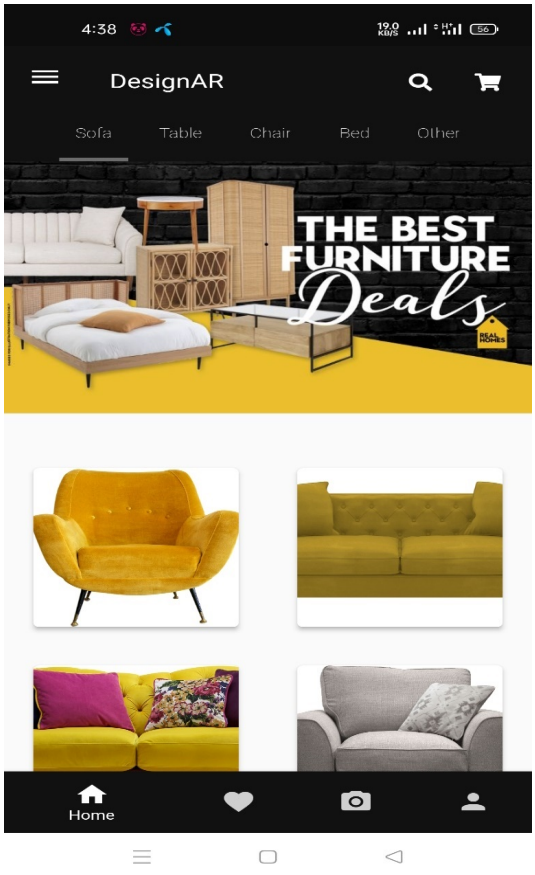


*Figure 9 – Furniture Store*

To check any of the interior objects like sofa , chair etc , user have to click on cards of that particular thing , click will open the camera and then it start to detect plane and after detecting the plan , application will place objects like sofa , chair , table just like shown in the figure below.


*Figure 10 – Furniture Illustration*

## 3.5 SideDrawer

The Sidebar contains different options and settings along with user credentials and an option to logout.

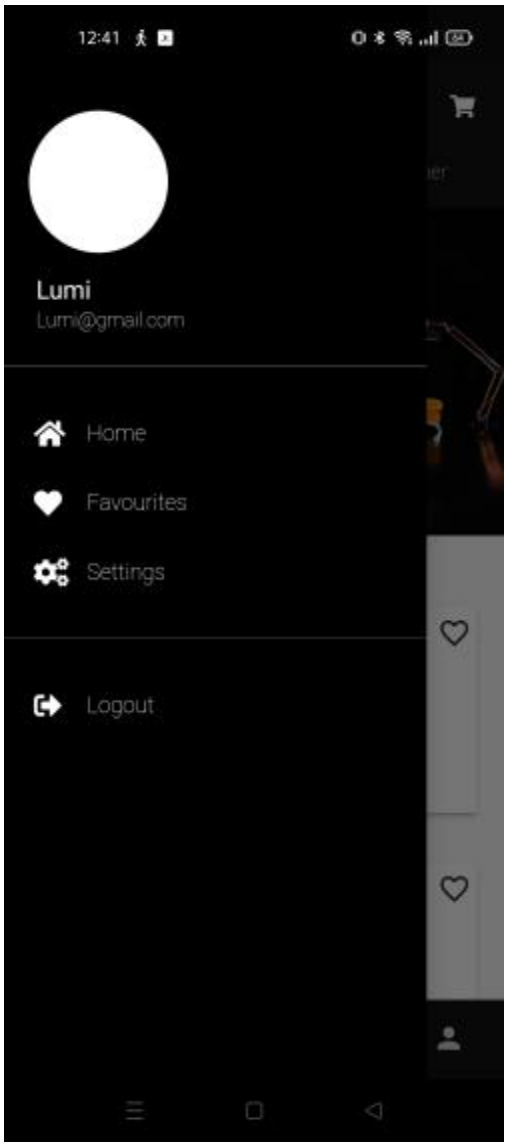


*Figure 11 – SideDrawer*

# CHAPTER 4

# SOFTWARE SYNCRONIZATION AND INSTALLATION

## Client-Side Integration

To fetch the data from the server an Application Programming Interface is created at the backend (Firebase). The API fetches the images and user credentials data from Firebase, which stores the data in the form of NoSQL objects.

## Authentication

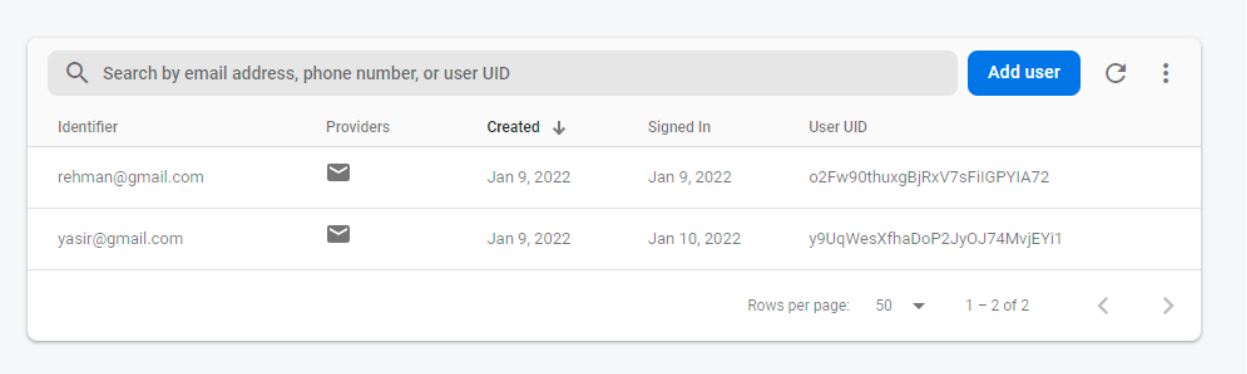


*Figure 12 – Client Authentication*

# Cloud Firestore

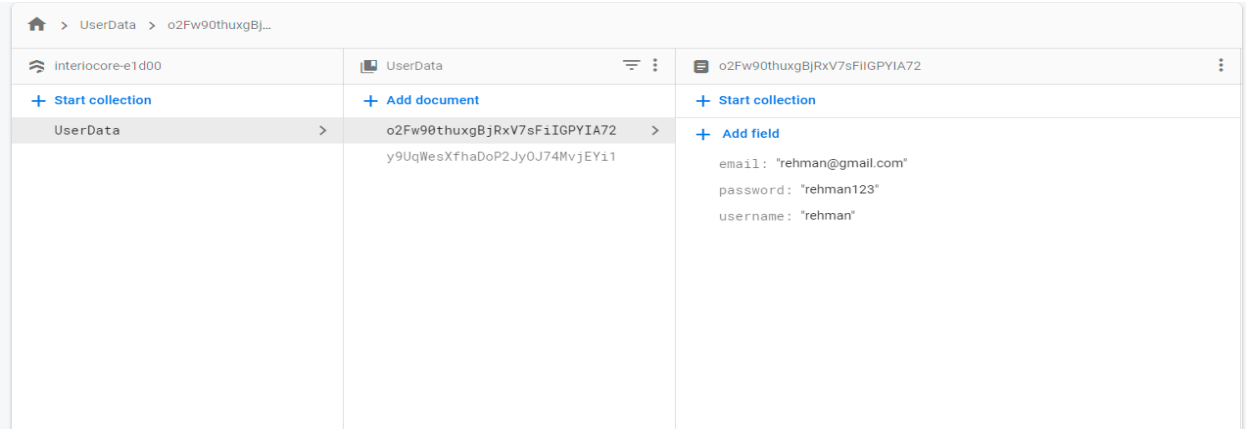


*Figure 13 – Client Firestore*

# Image Storage

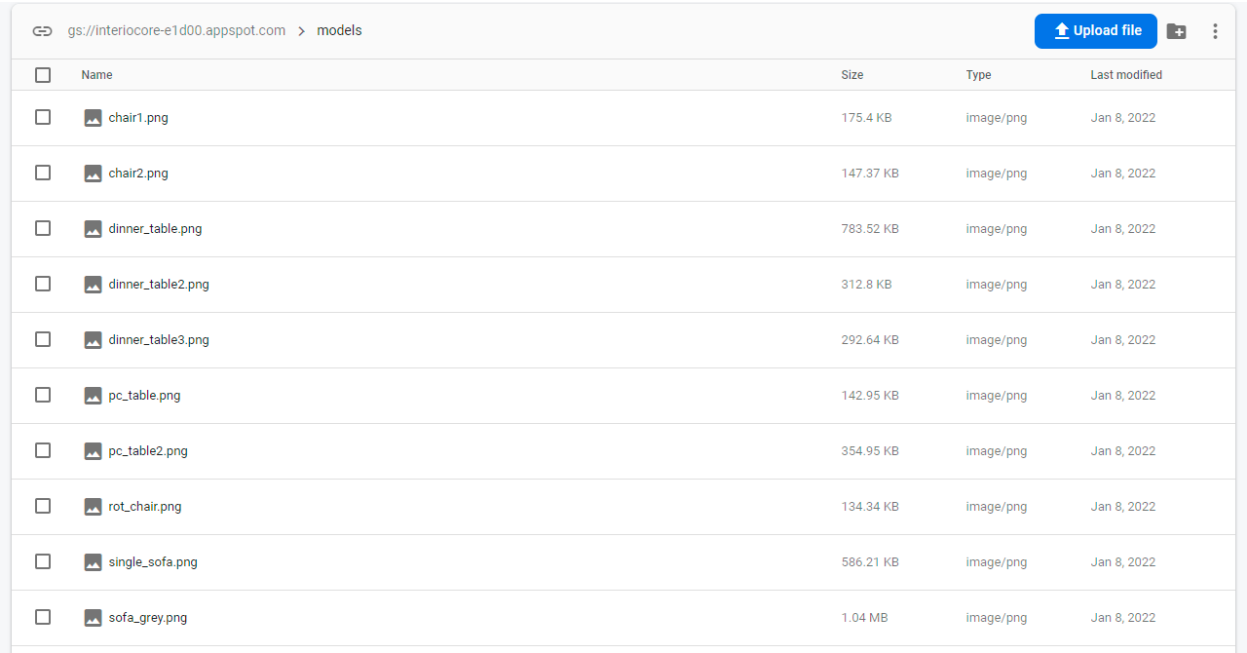


*Figure 14 – Client Storage*

# CHAPTER 5

# CONCLUSION AND FUTURE DIRECTIONS

## 5.1 Conclusion

Because of these framework client will come to know how their home structure would care for buying and setting the furnishings object. This proposed framework would let the client to attempt on numerous mixes of item for all intents and purposes without physically moving the furnishings objects. These will help the purchaser in deciding how to setup the furnishings in their home structure. Customer will have the careful view that how to set up the workplace, house and any space which is required for the used. User can experiment with different blends for all intents and purposes, without physical development of furniture items. In AR thinks about, not just the estimation of the camera postures and position, the acknowledgment of the genuine conditions, and the Augmented Reality interfaces are fundamental for understanding the AR, yet in addition the client's assessment are essential issue. This framework is to look out for staying away from hazardous formats of furniture, thinking about the space between the furnishings and rooms.

## 5.2 Future Directions

In future works, we have to think about the criticism of client's assessment as a human interface. In AR contemplates, not just the estimation of the camera postures and position, the acknowledgment of the genuine situations, and the Augmented Reality interfaces are fundamental for understanding the AR, yet in addition the client's assessment are imperative issue. This framework is to look out for staying away from risky formats of furniture, thinking about the space between the furnishings and rooms. In future our venture dataset and degree will be adaptable. The client may not exclusively have the capacity to experiment with various furniture questions however they can likewise experiment with this application by attempting on articles of clothing, goggles, watches, haircuts and so forth. It can likewise be utilized for different applications in shopping centers, inside planning, Medical Science and so forth.

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