A Project Report on

HomeDecor : AR Enabled Home Styler Application

Submitted in partial fulfillment of the requirements for the award
of the degree of

Bachelor of Engineering

in

Information Technology

by

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UNIVERSITY OF MUMBAI

Academic Year 2020-2021

Approval Sheet

This Project Report entitled ***"HomeDecor : AR Enabled Home Styler Application"*** Submitted by ***"Tejas Khanted"(17104015),"Aniket Gaikwad"(17104032), "Kavan Naik"(17104006)*** is approved for the partial fulfillment of the requirenment for the award of the degree of ***Bachelor of Engineering*** in ***Information Technology*** from ***University of Mumbai***.

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(Prof.Kaushiki Upadhyaya)
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Head Department of Information Technology

Place:A.P.Shah Institute of Technology, Thane
Date:

CERTIFICATE

This is to certify that the project entitled ***"HomeDecor : AR Enabled Home Styler Application"*** submitted by ***"Tejas Khanted" (17104015),"Aniket Gaikwad" (17104032),"Kavan Naik" (17104006)*** for the partial fulfillment of the requirement for award of a degree ***Bachelor of Engineering*** in ***Information Technology***,to the University of Mumbai,is a bonafide work carried out during academic year 2020-2021.

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Declaration

We declare that this written submission represents our ideas in our own words and where others' ideas or words have been included, We have adequately cited and referenced the original 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. We understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

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Date:

Abstract

In today's world information and communication technology supports the development of human interaction with physical, computer and virtual environment such as science, commercial, 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 users wanted to buy a furniture 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 project is to develop a windows application for trying different furniture in virtual way. The application will eliminate the human efforts by physically visiting the furniture store which is very time consuming activity. Purchasing products for interior design always has a problem that the purchased product may not satisfy customers because they cannot put them into their own place before buying. The purpose of this project is to study and develop an android application with the use of Augmented Reality technology will help customers visualize how furniture pieces will look and fit in their homes and can also provide details of the product to support customer decision along with additional facilities like space management .The principle of the application is started with analysing images from the rear camera of a smartphone or tablet using ground plane detection technique for displaying products detail and displaying 3D model and calculation of position to display a 3d model over real world image.

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List of Abbreviations

AR:	Augmented Reality
AWS:	Amazon Web service

Chapter 1

Introduction

Augmented Reality (AR) is used to describe a combination of technologies that enable real-time mixing ofcomputer-generated content with live video display. AR is based on techniques developed in VR and interacts not only with a virtual world but has a degree of interdependence with the real world. When we started to focus on the human being and on his perception of the world then we realized Reality cannot be increased but its perceptions can be. Unity 3D is a fully integrated development engine that provides out-of-the-box functionality for the creation of interactive 3D content. Using Unity, you can publish to multiple platforms such as PC, Web, iOS, Android and Xbox. Complete toolset, intuitive workspace and on- the-fly play testing and editing feature of Unity makes developers to save the time and effort. The AR Extension for Unity enables vision detection and tracking functionality within the Unity and allows developers to create AR applications.

Augmented Reality is technology from which we can see the virtual objects in physical world.Though AR we can experience the virtual furniture in user's real home structure before buying. From this user will be able to choose furniture objects a lot easier. This will provide the actual feel of real furniture object in real world virtually and due to mobile application, the user can choose furniture without going to furniture stores as this will reduce the time-consuming activity.

The main purpose of this project is to develop an application for various furniture items in furniture stores virtually without using the actual means that is incredibly exhaustive and time consuming activity. By using this application, it will be convenient for the user to try out the furniture items in their room and they will be able to see how it will look after placing furniture in it. User can attempt multiple combination of furniture objects virtually without physically moving the furniture items. Our motivation here is to increase the time efficiency and additionally improve the accessibility of furniture try on by making this layout in augmented reality.

In this, we are going to display the 3D furniture objects like sofa, tables, chair, lamps etc. For implementing the application, we have used Unity 3D. We have added interaction mechanism that detect ground plane through mobile camera, then displaying a virtual plane surface as detected surface on that detected surface objects can be placed. This interaction is done by AR plugins to make application more efficient and realistic, feature like Rotation, Zoom In - Zoom Out, Changing Furniture Texture are added by using Unity Scripts and prefab

1.1 Objective

- To create an mobile based application for furniture placement using augmented reality technology.
- To develop an app, user can visual furniture at they are own spaces and it will help them to buy the best furniture.
- To develop an augmented reality mobile application in furniture placement which is more convenient to the user.
- To produce realistic virtual furniture model in mobile app similar to the real furniture.

Chapter 2

Literature Review

- From IEEE paper Augmented Reality and its effect on our life (2019) it gives all detail of evolution of augmented reality and its application, uses and advantages disadvantages. From this we have founded to use Superimposition Based Augmented Reality. In this type of reality, the original view of an object is either partially or fully replaced with a newly augmented view of that same object. Here, object recognition plays an important role. E.g. IKEA - Augmented Reality Furniture catalogue. It is a virtual furniture app that augments furniture onto real floor. As Other option are not suitable of our project.

- From IEEE paper AR Development for Room Design (2018) In this paper, Room Designed using multiple marker. Using Technology like Vuforia but in this problem is that every model require QR marker but distributing QR to every user is not possible. Due to this drawback we are using ground plane detection of ARCore. From this research paper, we founded to included feature to user that user will able to customize its own furniture by changing color. So that user can visualize that furniture that can suits the best in his/her home environment

- From IJARIIE Paper,Research on Object Based Augmented Reality Using Unity3d in Education System. This paper explains how Augmented Reality and Unity 3d can work together in learning and training and how can it as potential impact in education.

- From Paper Use of Augmented Reality in the furniture Industry.In this paper, explains how furniture industry can used marker based AR and application in which connect via database for storing models, textures, colour and also provide complete detail of requirements required in making marker based application which works with AR glasses.

Chapter 3

Project Design

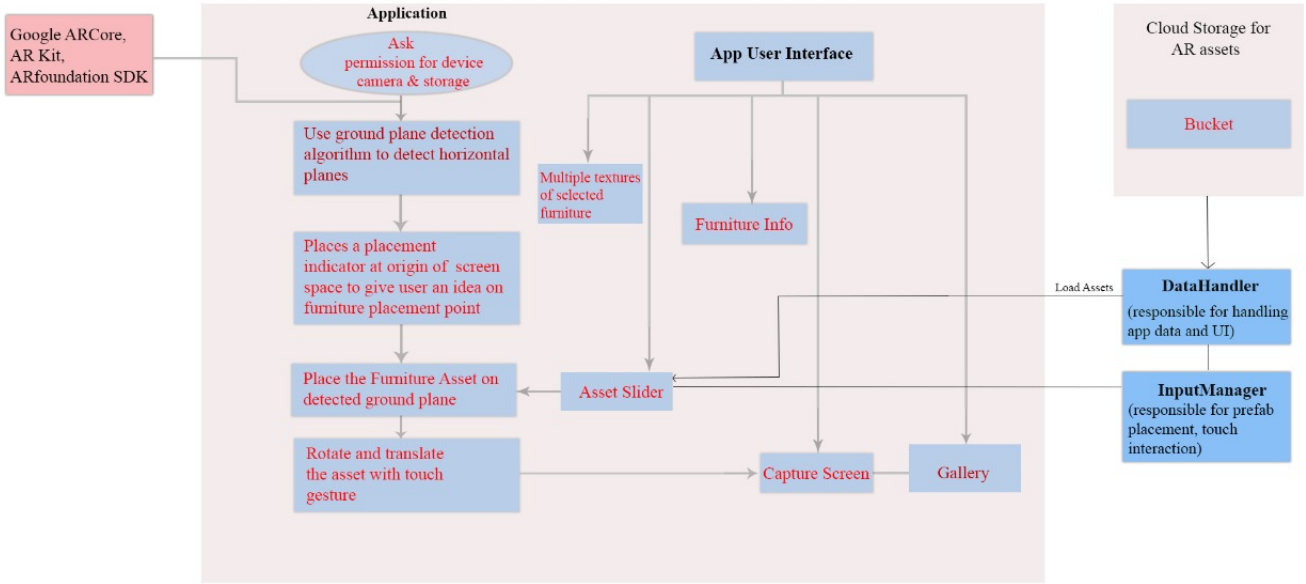


Figure 3.1: System Architecture

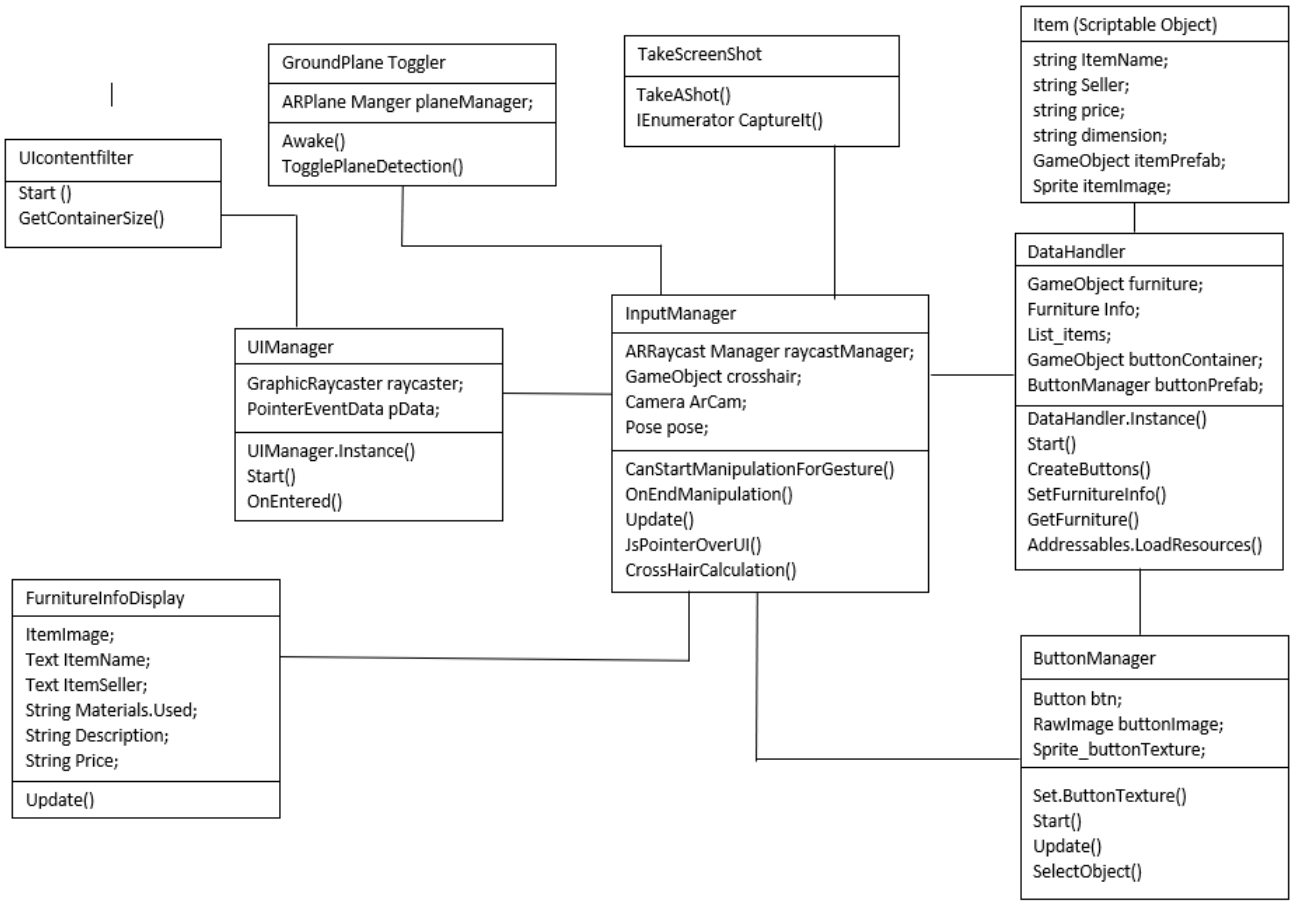


Figure 3.2: Class Diagram

The above diagram depicts the class diagram for this project which consists of various scripts, their attributes and their methods. As shown in the diagram, the track script keeps track of all the steps to performed. And hence is linked with every other script.

Figure 3.3: User Case Diagram

Here,in the above diagram, User is the actor and is able to visualize the Augmented World, detects ground plane, place objects on it,change texture of it,check information related to it and can buy it.

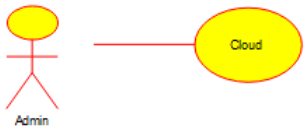


Figure 3.4: Admin Case Diagram

Here,in the above diagram, Admin is the actor and have access of cloud to add asset for application.

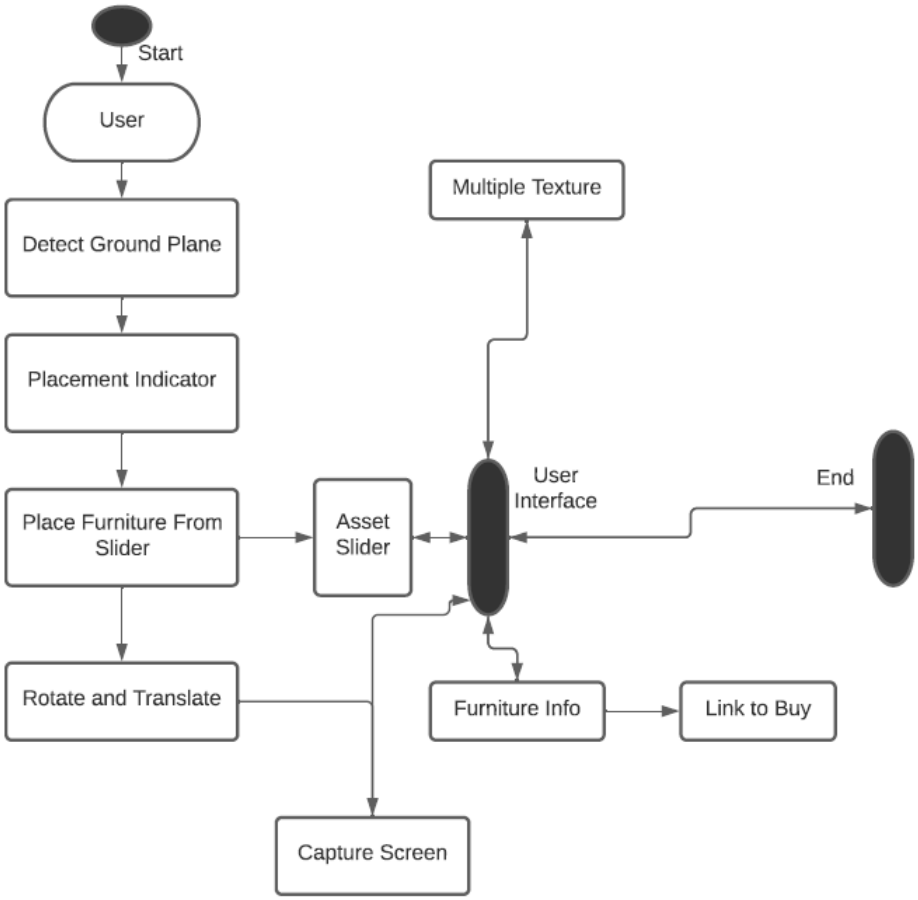


Figure 3.5: Activity Diagram

As the above activity diagram depicts, Firstly the user needs to detect ground level through which the user will be able to place model to it and then user can rotate, translate, change texture of it, view information of it and also access the link to buy it.

- Google AR Core - With AR Core, build new augmented reality experiences that seamlessly blend the digital and physical worlds. AR Core in our project is used to detect ground plane so that application can understand the surface on which the augmentation of models can happen.

- Ground plane detection - Ground Plane is detected as an AR application that doesn't have prior knowledge of a user's environment to overlay 3D content into a scene and hold it to a fixed point in space. Ground plane detection displays a horizontal plane in the application so that the user can understand the detected plane and can place 3D objects on it. Detection of the ground is done by using Marker less Technique on AR Core in Unity 3D. For AR Core mobile device must have Android version 8.1 (API 27) or later.

- Storing Assets on Cloud - Storing the Assets in the cloud using AWS and loading it while required in real time. So that it will help mobile application to be of a smaller size as a mobile phone may have storage constraints. Also, this help to improve scalability as can add more assets in Application via cloud even after build on application.

- Select furniture objects from Asset Slider - The Asset Slider in user interface will help the user to easily find out the required furniture objects like a table, chair, lamp, TV unit, etc from available furniture on Application Cloud and then on click the required furniture object will be loaded from the database and will be visualized in the user environment. The Slider is created using Unity 3D UI toolkit and models will be fetched from the database.

- Rotation and Translate of Object - Rotating and Translate of Object, we will be done creating Furniture prefabs. By using user can rotate the object using single-touch gesture on an object and resizing will done by using double touch on a mobile screen. By using user can place an object on a perfect location in the detected plane and also resize according to user requirement. It will user help to visualize the object more efficiently.

- Furniture Information and Screen Capture - In User Interface there are button that provide complete description of Furniture object like price, dimensions and all other Furniture details which is currently placed on the virtual plane with button to buy that furniture. and also it will capture the current screen on the mobile phone in terms of the image will be saved in phone storage. This can be done by using writing script to fetch all real time detail of size, price and display it on screen and capture the current mobile screen and using UI toolkit of Unity 3D for creating a button on screen..

Chapter 4

Project Implementation

- Ground plane Detection -

  The Ground Plane Detection in the application is done with the help of Google's ARCore SDK. It uses feature points to detect planes in an environment. ARCore looks for clusters of feature points that appear to lie on common horizontal or vertical surfaces, like tables or walls, and makes these surfaces available to your app as planes. ARCore can also determine each plane's boundary and make that information available to your app. Concurrent Odometry and Mapping (COM) algorithm is used by ARcore for environmental understanding.

- AR Session, AR camera and Plane Detection Mode - AR session is responsible to

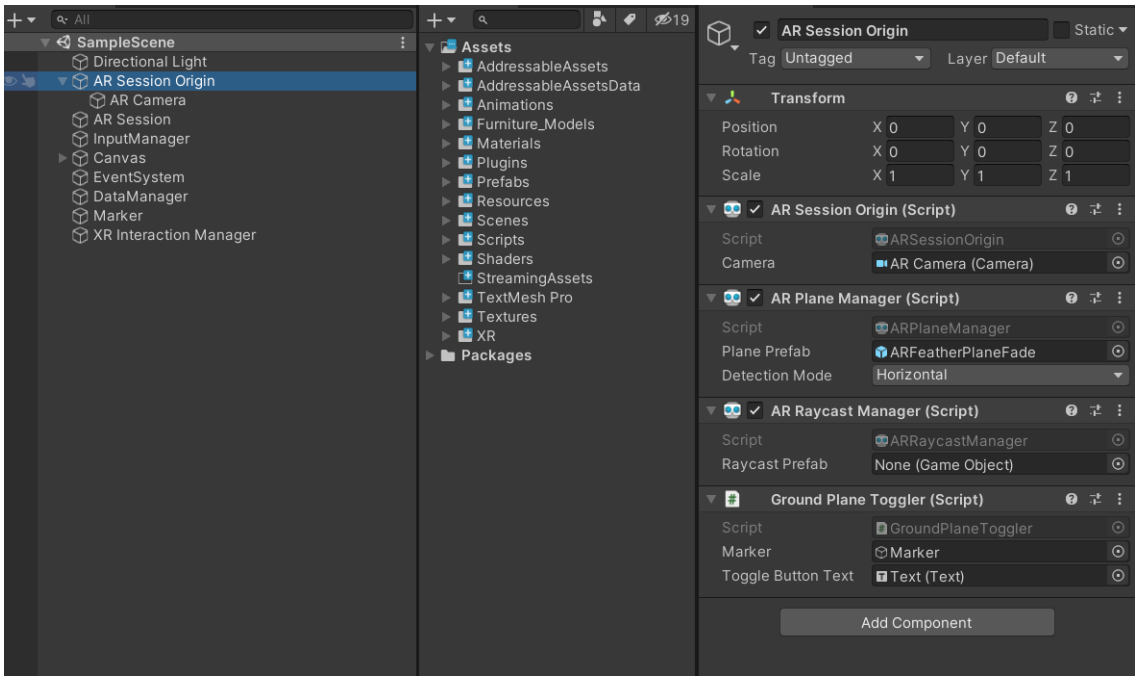


Figure 4.1: AR Session, AR camera and Plane Detection Mode

create a session for AR setup.It also has AR camera component. We can set the plane detection mode in AR Plane manager script as vertical, horizontal or both.

- Use of scriptable object for clean code architecture -

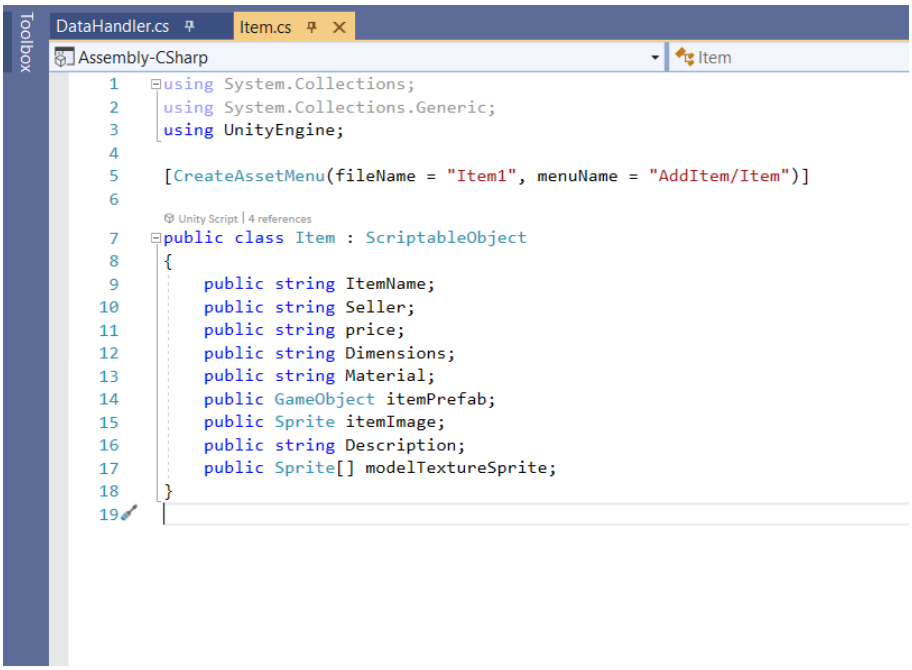


Figure 4.2: Item.cs

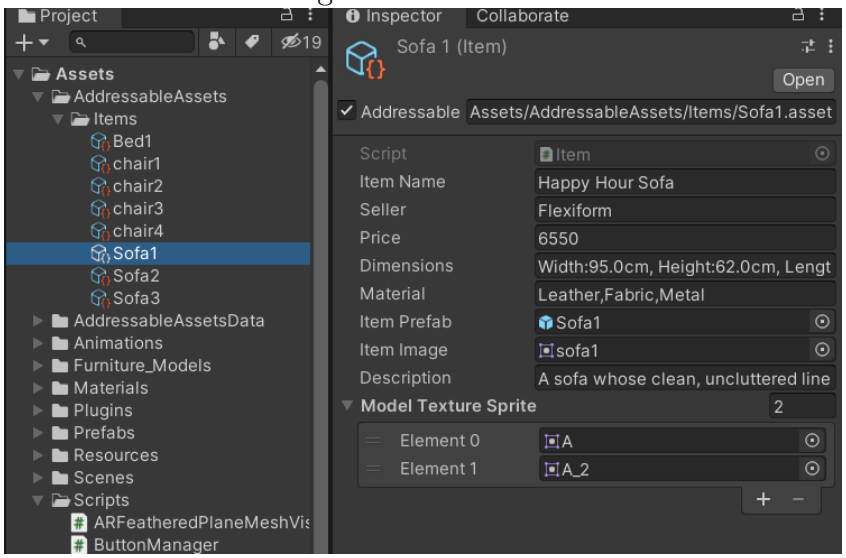


Figure 4.3: Store information about each furniture in a single container using scriptable object method

- Input Manager -

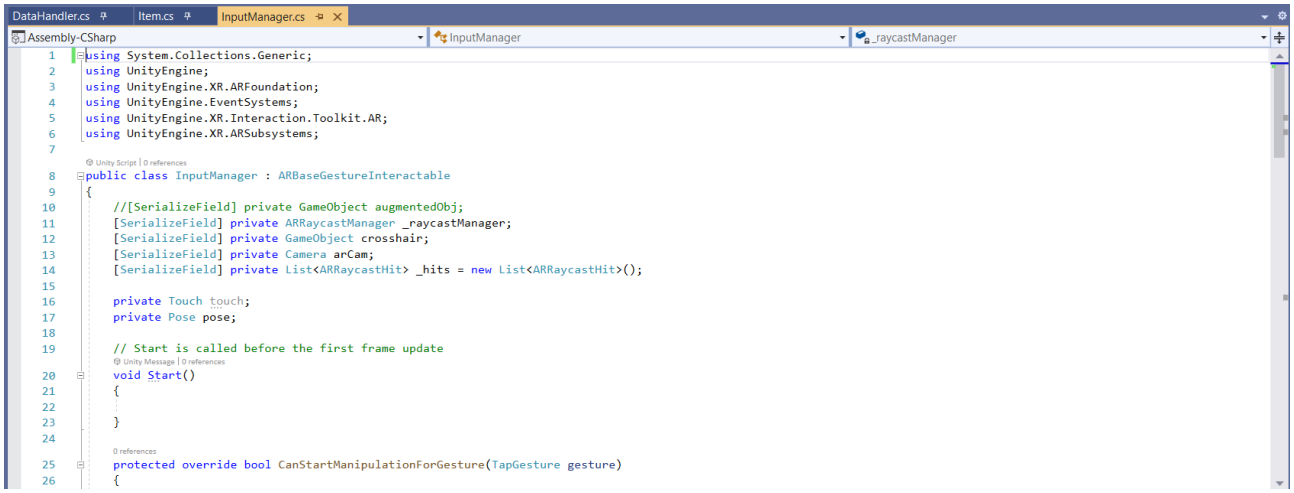


Figure 4.4: InputManager.cs(a)

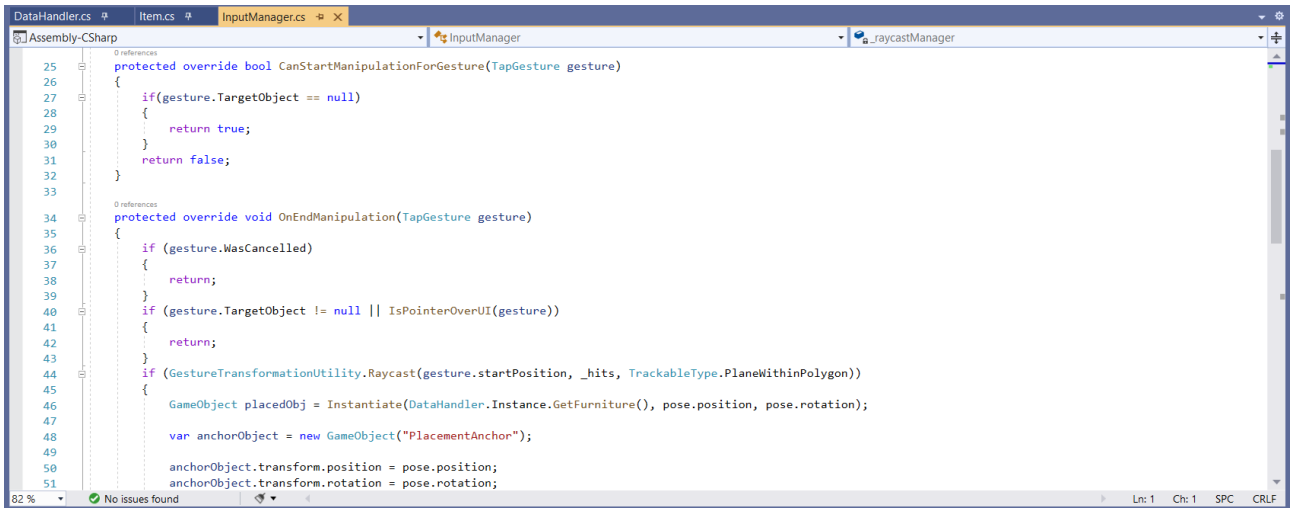


Figure 4.5: InputManager.cs(b)

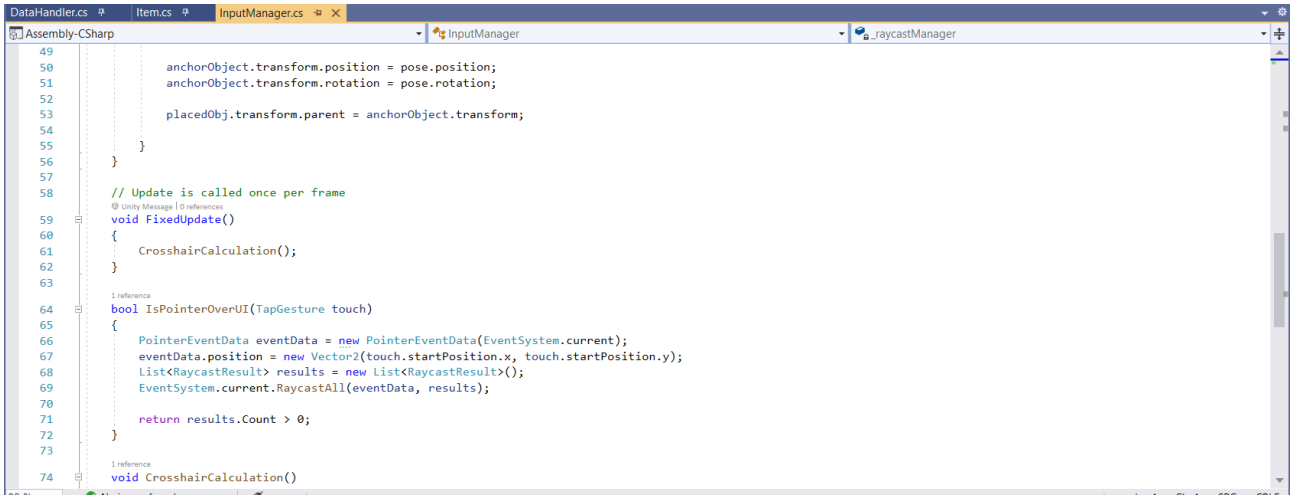


Figure 4.6: InputManager.cs(c)

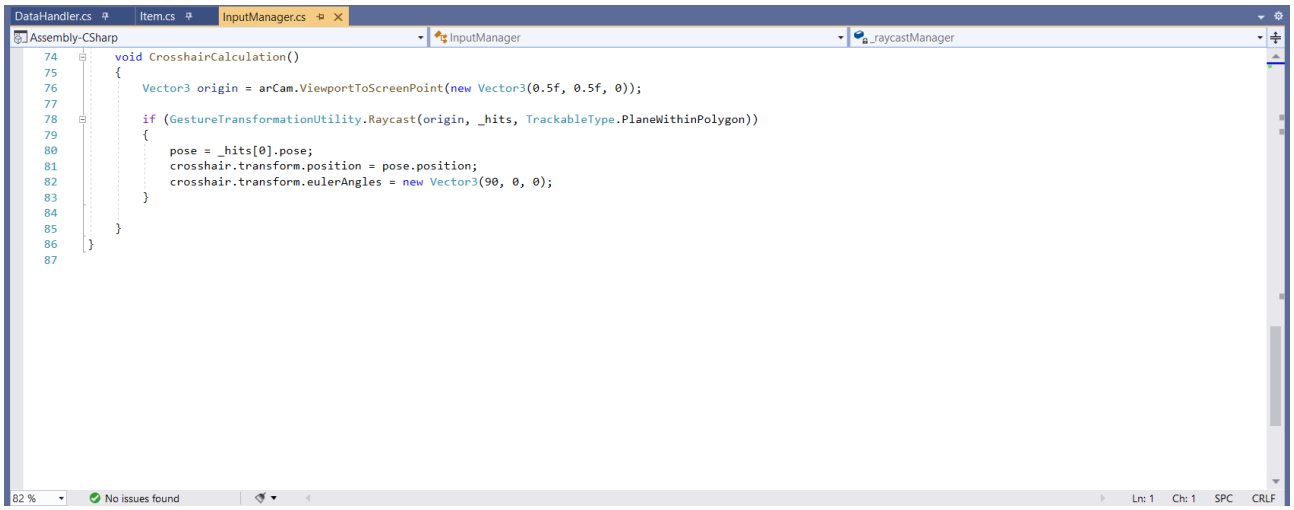


Figure 4.7: InputManager.cs(d)

The Input Manager is responsible for placing the selected object on detected surface. Also Input Manager is responsible for touch gestures that is used to transform the furniture model.

- Data Handler -

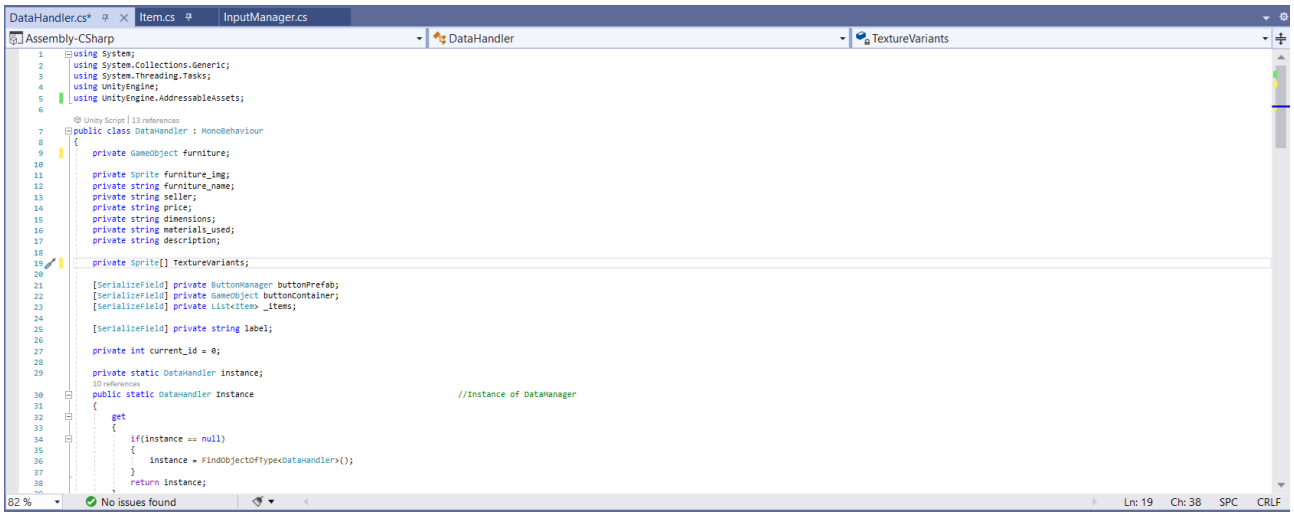


Figure 4.8: DataHandler.cs (a)

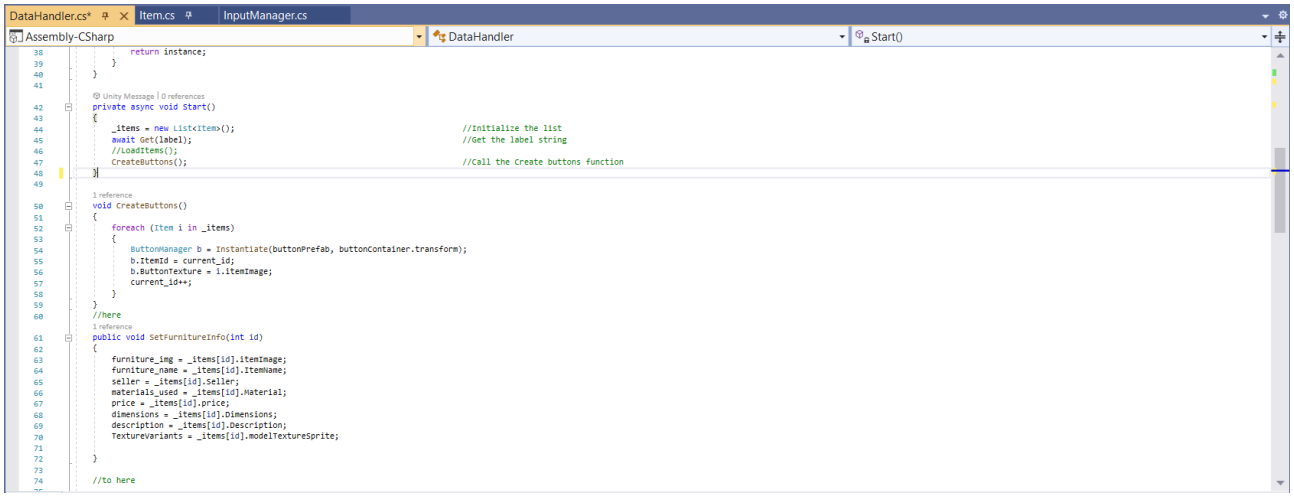
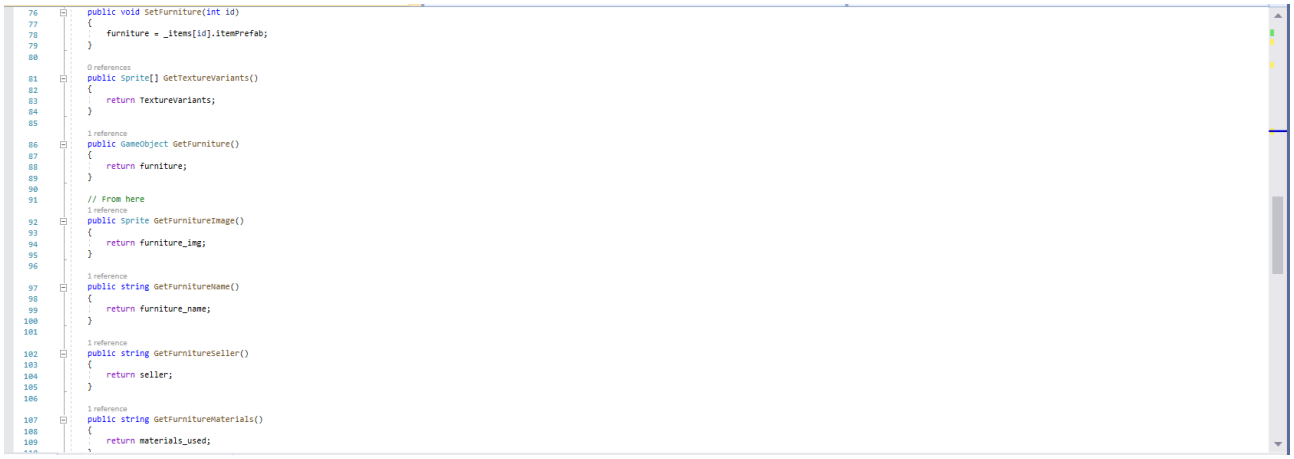
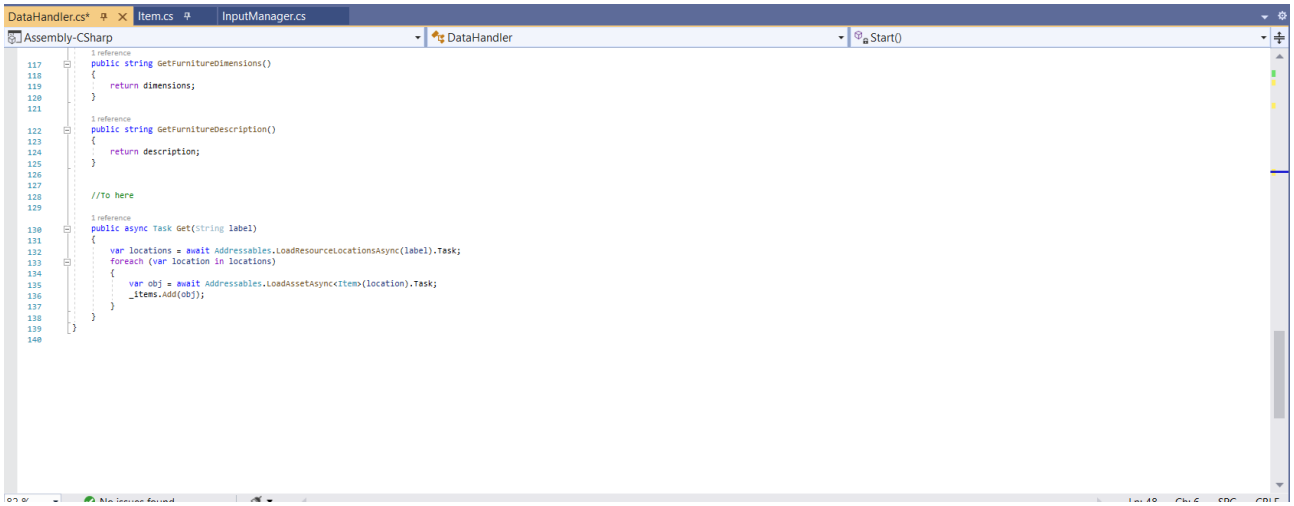


Figure 4.9: DataHandler.cs (b)



```
76      public void SetFurniture(int id)
77      {
78          furniture = _items[id].itemPrefab;
79      }
80
81      0 references
        public Sprite[] GetTextureVariants()
82      {
83          return textureVariants;
84      }
85
86      1 reference
        public GameObject GetFurniture()
87      {
88          return furniture;
89      }
90
91      // From here
        1 reference
92      public Sprite GetFurnitureImage()
93      {
94          return furniture_img;
95      }
96
97      1 reference
        public string GetFurnitureName()
98      {
99          return furniture_name;
100     }
101
102     1 reference
        public string GetFurnitureSeller()
103     {
104         return seller;
105     }
106
107     1 reference
        public string GetFurnitureMaterials()
108     {
109         return materials_used;
```

Figure 4.10: DataHandler.cs (c)



```
DataHandler.cs*   Item.cs   InputManager.cs
Assembly-CSharp   DataHandler   Start()
117     1 reference
        public string GetFurnitureDimensions()
118     {
119         return dimensions;
120     }
121
122     1 reference
        public string GetFurnitureDescription()
123     {
124         return description;
125     }
126
127
128     //To here
129
130     1 reference
        public async Task Get(string label)
131     {
132         var locations = await Addressables.LoadResourceLocationsAsync(label).Task;
133         foreach (var location in locations)
134         {
135             var obj = await Addressables.LoadAssetAsync<Item>(location).Task;
136             _items.Add(obj);
137         }
138     }
139 }
140
```

Figure 4.11: DataHandler.cs (d)

DataHandler is responsible for handling furniture data and app data

- Button Manager -

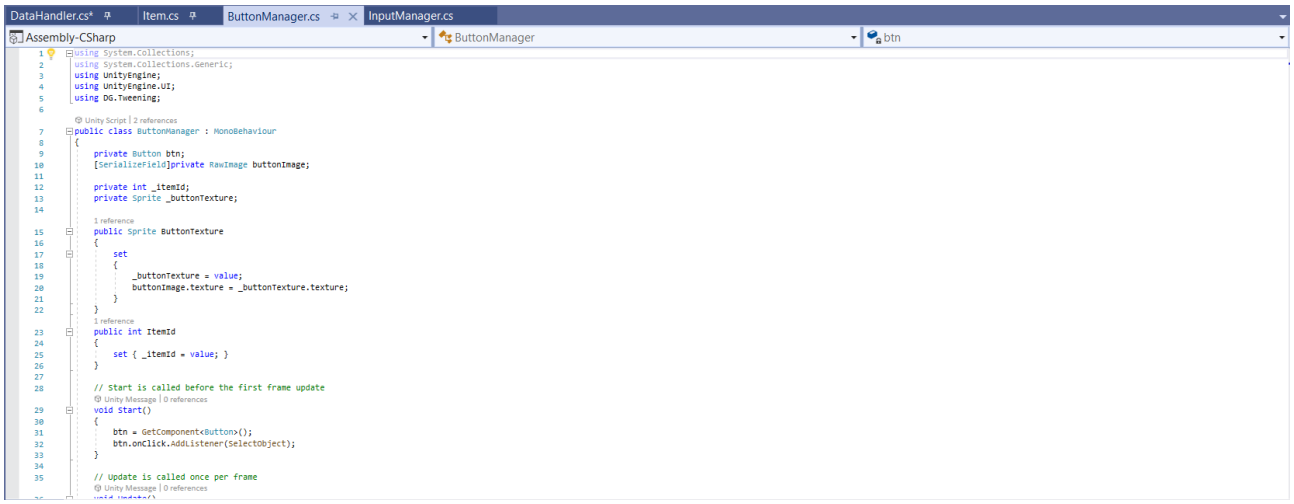


Figure 4.12: ButtonManager.cs (a)

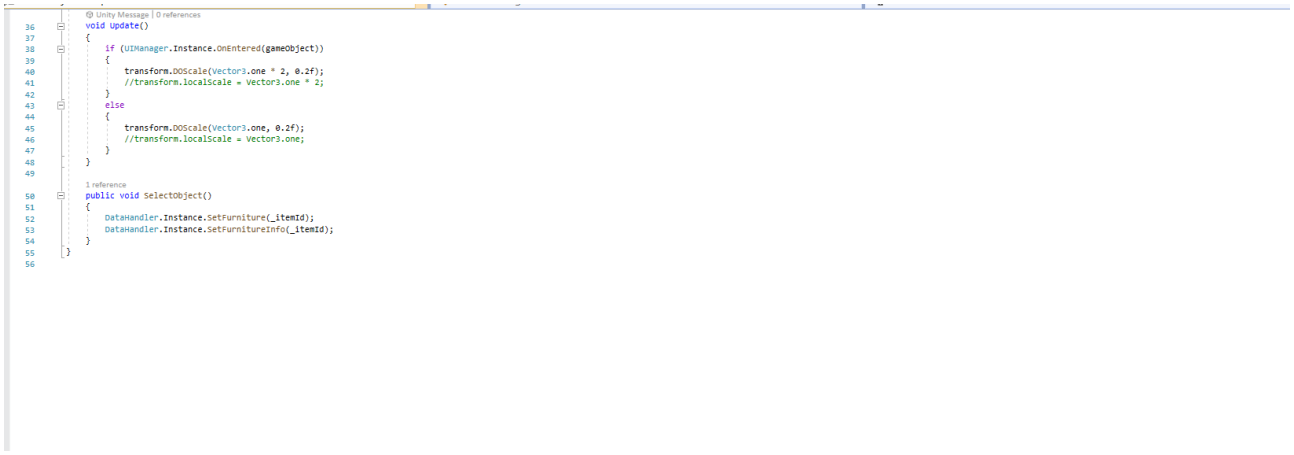


Figure 4.13: ButtonManager.cs (b)

Button Manager is responsible for creating Button in Slider and mapping particular furniture prefab to the relevant button.

- Use of Unity AddressablesAssets to increase app performance and cloud connectivity

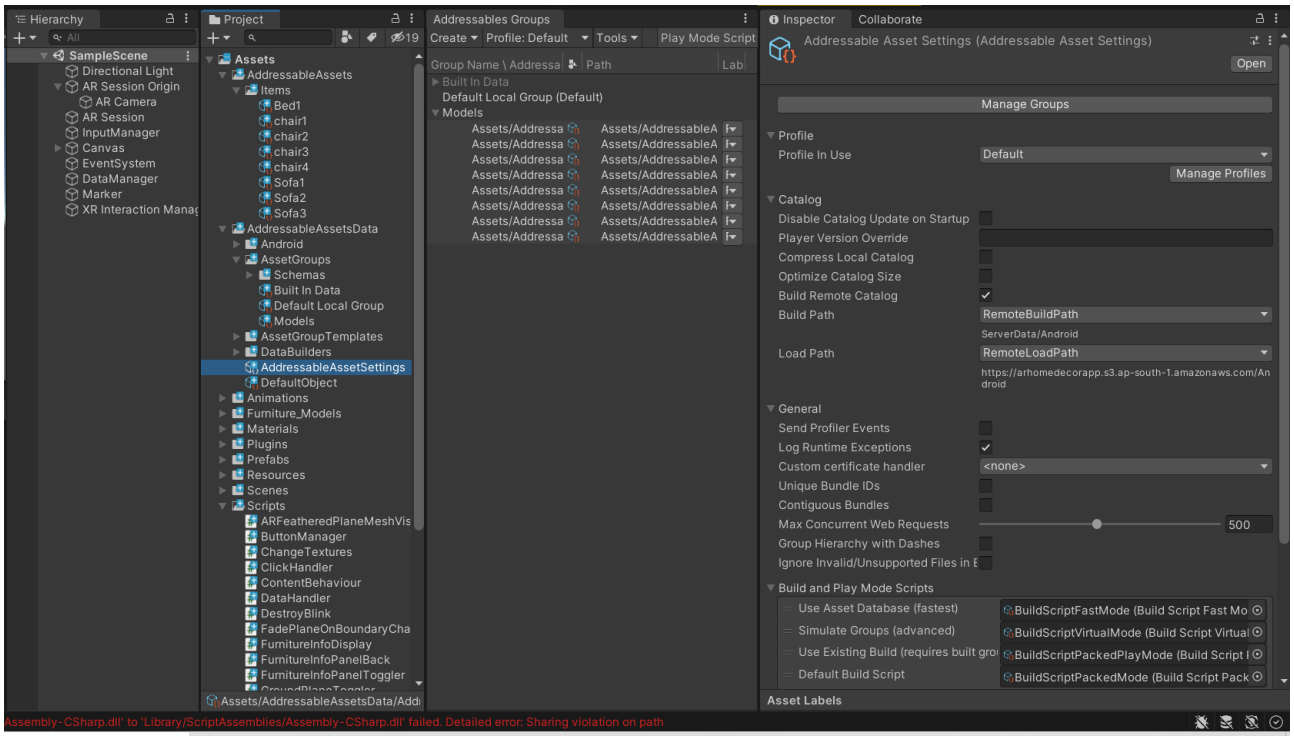


Figure 4.14: Use of AddressableAssets to Remote Storage

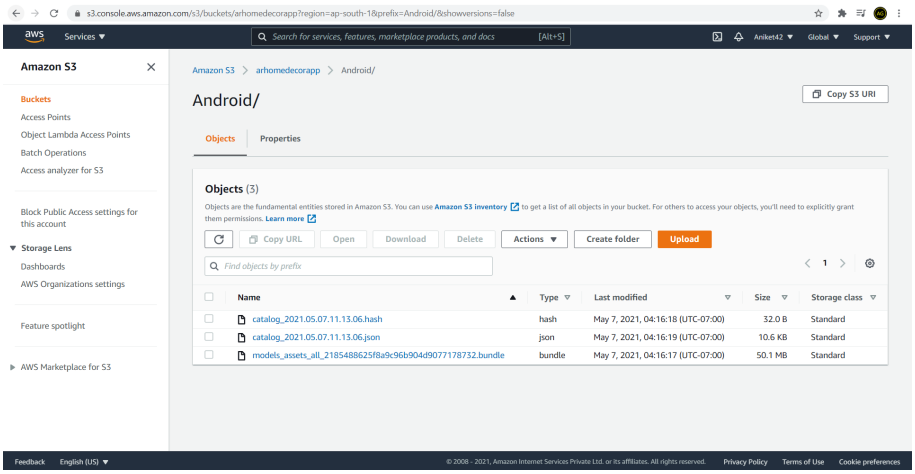


Figure 4.15: Assets stored on AWS cloud storage

- Object Manipulation -

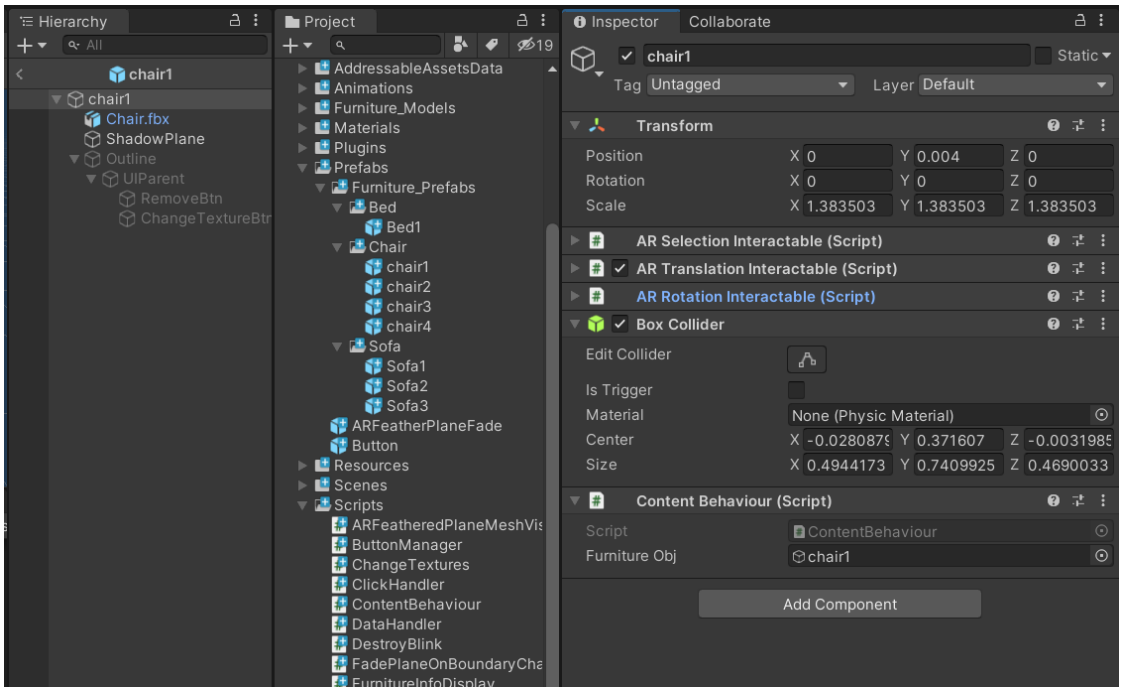


Figure 4.16: Rotation, translation and selection scripts attached to each prefab

- Change Textures -

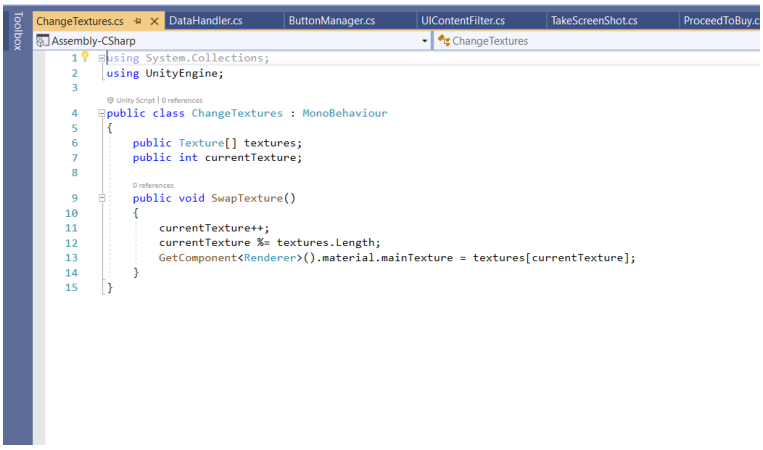


Figure 4.17: Change Texture on Furniture Models

Chapter 5

Testing

Test No.	Test Name	Expected Resulted	Actual Result
1	Use Device Camera	Device Camera must be turned on while using the app.	Device's camera turned on successfully.
2	Ground Plane Detection	Ground Plane must be detected on Horizontal Surfaces	Ground Planes are successfully detected

Figure 5.1: Test Case 1: Basic App Functionalities.

Test No.	Test Name	Expected Resulted	Actual Result
1	App Scalability	The assets used in app must be stored on cloud.	The assets are stored in S3 storage successfully.
2	Load Assets	The assets must be loaded into application from cloud.	The assets are loaded into application from cloud successfully
3	Asset Prefab Placement	The selected asset should be placed on detected ground plane on touch	The selected asset is placed on detected ground plane successfully
4	Detect touch gestures	The application must be able to detect number of touch inputs	The app is able to detect touch inputs successfully
5	Crosshair(Placement Indicator)	The app must place a crosshair on detected ground plane at origin of screen space	Crosshair is placed successfully.

Figure 5.2: Test Case 2: Main app functionalities.

Test No.	Test Name	Expected Resulted	Actual Result
1	Asset Selection	Placed asset must be able to select.	Placed asset is selected successfully.
2	Asset Rotation	Placed asset must be rotated on two finger gesture.	Placed asset is successfully rotated.
3	Asset Translation	Placed asset must be able to translate to any position on the detected ground plane.	Asset is translated successfully
4	Texture Change	Assets must be able to change texture if it has.	Textures is successfully changed.
5	Remove Placed Asset	Placed asset must be removed.	Placed asset is removed successfully.

Figure 5.3: Test Case 3: Asset(Prefab/furniture model) functionalities

Test No.	Test Name	Expected Resulted	Actual Result
1	Load Buttons dynamically in slider relevant to asset.	Buttons be loaded into slider dynamically w.r.t assets.	Buttons are successfully loaded into slider dynamically w.r.t assets.
2	Screenshot	App must be able to take screenshot of the scene.	Screenshot is taken successfully.
3	Ground Plane toggling	App must show/hide detected ground plane on button clicks.	Ground plane toggling is done successfully.
4	Furniture information display	App must display a UI regarding the selected asset information, dynamically.	Asset information of selected asset is displayed on UI successfully.

Figure 5.4: Test Case 4: UI functionality

Chapter 6

Result

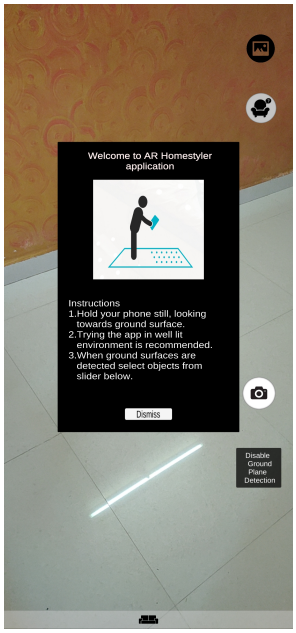


Figure 6.1: Welcome User Interface

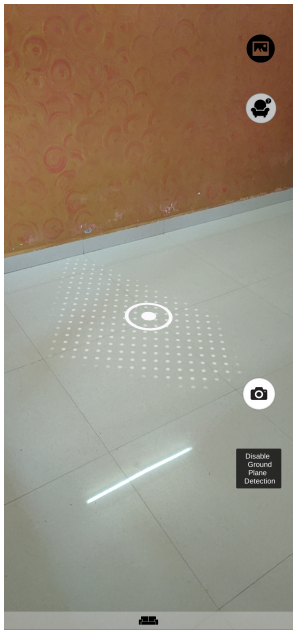


Figure 6.2: Ground Plane Detection

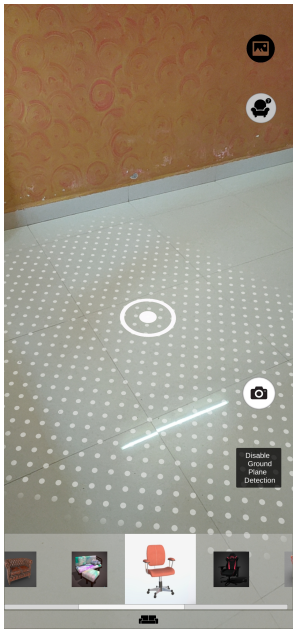


Figure 6.3: Assets loaded into Slider

Figure 6.4: Single Object Placement

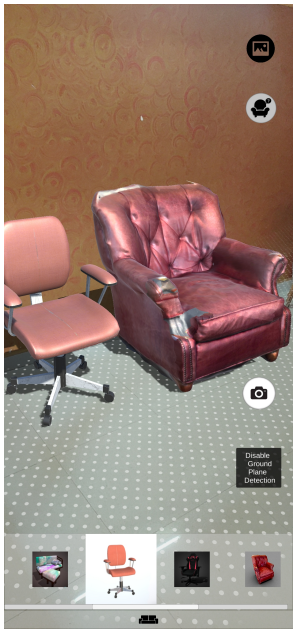


Figure 6.5: Multiple Object Placement

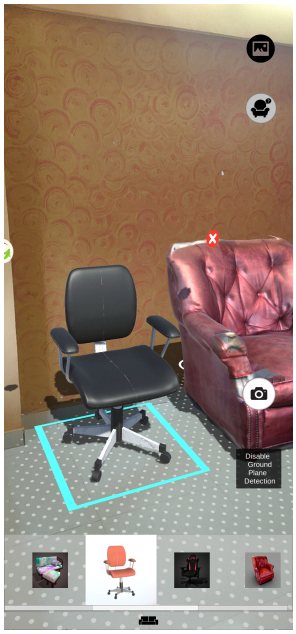


Figure 6.6: Change Textures Of Selected Object

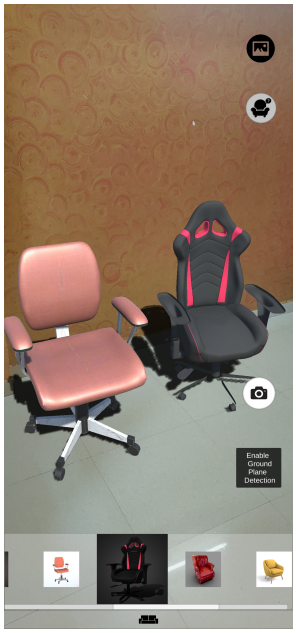


Figure 6.7: Disable Ground Plane Detection

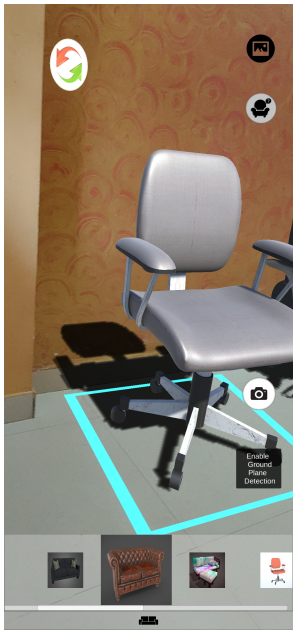


Figure 6.8: Furniture Shadow

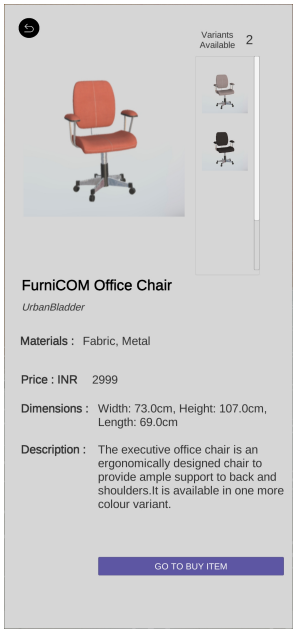


Figure 6.9: Furniture Information

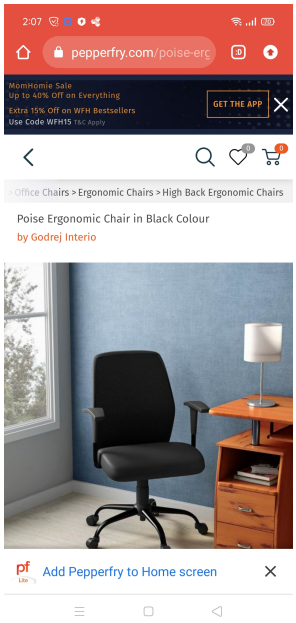


Figure 6.10: Redirect to Website for Buying

Chapter 7

Conclusions and Future Scope

- In this AR environment, the user is able to adjust the properties of virtual furniture and create its own arrangements in the real world.
- Through the mobile camera the user can detect the plan surface and select the furniture through the application and place it on the screen.
- As a design solution, this application can help cut the prototyping costs and help simulate a better experience for the customer.
- It also enables the User to be the designer themselves and make their home as they want it to be.
- This application will also prove beneficial to the companies for boosting sales online.
- Adding More Feature like Measuring Distance using AR will user ease to find the dimensions of furniture before order it

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Appendices

Steps For Installation of Required Software.

Appendix-A: Unity 3D Setup environment for Windows

1. Download and install the Unity Editor from the link: https://unity3d.com/get-unity /download/archive.

2. Clicking on the Download (for Windows) button, will show a drop down list of options - Unity Editor (64-bit) - Unity Installer - Unity Editor (32-bit)

3. Select Unity Editor(64-bit) package.

4. The installer uses a Download Assistant and has detailed instructions that you need to follow. Unity Download Assistant is a light weight, small sized executable (.exe) program, that will let you select the components of the Unity Editor, which you want to download and install.

5. Select the editor component to install and then click the Next button.

6. In the next step, if you're not sure which components you want to install, you can leave the default selections, click Next to continue, and follow the installer's instructions. Some of the check boxes are: - Microsoft Visual Studio tools for Unity (is required). - Windows Build Support (if you are planning to make Windows phone based application as well). - Android Build Support (if you are planning to make Android based application using Unity 3D). Rest, leave default selected check-boxes.

7. Click on Next Button after Selecting the desired check boxes. The Unity will get installed in the System.

8. Add External Package ARCore.