



Innovation Centre for Education



**YENEPLOYA INSTITUTE OF ARTS, SCIENCE, COMMERCE AND MANAGEMENT**  
(A constituent unit of Yeneploya Deemed to be University)

**PROJECT REPORT**

# **AR Based Furniture Visualization App**

**BACHELOR OF COMPUTER APPLICATION**  
BCA-METaverse, GAMING, GRAPHIC DESIGN , AR&VR WITH IBM

**SUBMITTED BY :**

**BINIL SIMON**  
**22BCMGG07**  
**22451@yeneploya.edu.in**

**GUIDED BY: Mr. Shashank – IBM SME**

# INDEX

## TABLE OF CONTENTS

<b>1. INTRODUCTION 3 -</b>	<b>4</b>
1.1 OVERVIEW OF THE PROJECT	
1.2 OBJECTIVE OF THE PROJECT	
1.3 PROJECT CATEGORY	
1.4 TOOLS AND PLATFORM TO BE USED	
1.5 OVERVIEW OF THE TECHNOLOGIES USED	
1.5.1 Hardware Requirements	
1.5.2 Software Requirements	
1.5.3 Front End Back End Programming Languages	
1.6 ORGANIZATION PROFILE	
1.7 STRUCTURE OF THE PROGRAM	
1.8 STATEMENT OF THE PROBLEM	
<b>2. SOFTWARE REQUIREMENTS SPECIFICATION-----</b>	<b>5 - 8</b>
2.1 INTRODUCTION	
2.1.1 Purpose	
2.1.2 Scope of the project	
2.1.3 Intended audience and Reading Suggestions	
2.1.4 Definitions, Acronyms and Abbreviations	
2.1.5 References	
2.1.6 Overview	
2.2 OVERALL DESCRIPTION	
2.2.1 Product Perspective	
2.2.2 Product Features	
2.2.3 User Characteristics	
2.3 OPERATING ENVIRONMENT	
2.3.1 Design and Implementation Constraints	
2.3.2 General Constraints	
2.3.3 Assumptions and Dependencies	
2.4 SPECIFIC REQUIREMENTS	
2.4.1 External Interface Requirements	
2.4.1.1 User Interface	
2.4.1.2 Hardware Interface	
2.4.1.3 Software Interface	
2.4.1.4 Communication Interface	
2.4.2 Functional Requirements	
2.4.3 Performance Requirements	
2.4.4 Design Constraints	
2.4.5 Other Requirements	
<b>3. SYSTEM ANALYSIS AND DESIGN -----</b>	<b>9 - 13</b>
3.1 INTRODUCTION	
3.2 DATA FLOW DIAGRAM	

3.3	SYSTEM DESIGN IMPLEMENTATION	
3.3.1	Use case	
3.3.2	Class Diagram	
3.3.3	Activity Diagram	
3.3.4	Sequence Diagram	
3.4	USER INTERFACE DESIGN	
<b>4.</b>	<b>TESTING-----</b>	<b>14-16</b>
4.1	INTRODUCTION	
4.2	TESTING OBJECTIVE	
4.3	TEST CASES	
4.3.1	Launch AR Viewer	
4.3.2	Plane Detection (Horizontal)	
4.3.3	Plane Detection (Vertical)	
4.3.4	Furniture Model Placement	
4.3.5	Object Manipulation	
4.3.6	Product Info Display	
4.3.7	Purchase Redirection	
4.3.8	Delete Furniture Object	
<b>5.</b>	<b>SYSTEM SECURITY -----</b>	<b>17</b>
6.1	INTRODUCTION	
6.2	SOFTWARE SECURITY	
<b>6.</b>	<b>CONCLUSION-----</b>	<b>18</b>
<b>7.</b>	<b>FUTURE ENHANCEMENTS -----</b>	<b>19</b>
<b>8.</b>	<b>WEEKLY PROGRESS REPORTS-----</b>	<b>20-31</b>
<b>9.</b>	<b>APPENDIX-----</b>	<b>32-34</b>
<b>10.</b>	<b>BIBLIOGRAPHY -----</b>	<b>35</b>

# **1. INTRODUCTION**

## **1.1 Overview of the Project**

This project involves the development of an Augmented Reality (AR) based mobile application that allows users to visualize furniture in their physical environment. By using the device camera, users can place, move, rotate, and resize 3D furniture models in real-time. This provides a realistic preview of how the furniture will appear and fit in a space, assisting users in making informed purchase decisions.

## **1.2 Objective of the Project**

The objective of this project is to:

- Help users visualize furniture in their own environment using AR.
- Allow manipulation of 3D furniture models (move, rotate, resize).
- Provide detailed product information .
- Enable users to browse and purchase furniture through integrated e-commerce links.
- Create an intuitive and user-friendly interface.

## **1.3 Project Category**

This project falls under the category of Mobile Application Development with a focus on Augmented Reality and E-Commerce Integration.

## **1.4 Tools and Platforms to be Used**

- Unity 3D: Game engine for building the AR application.
- AR Foundation (ARCore/ARKit): AR development toolkit.
- Blender: For creating and editing 3D furniture models.
- C#: Primary scripting language in Unity.

## **1.5 Overview of the Technologies Used**

### **1.5.1 Hardware Requirements**

- Android smartphone with AR support
- Development PC with Unity

### **1.5.2 Software Requirements**

- Unity 3D Engine
- AR Foundation & ARCore packages
- Blender

### **1.5.3 Front-End and Back-End Programming Languages**

- Front-End: Unity (C#), UI designed using Unity's Canvas system
- Back-End: Unity (C#)

## **1.6 Organization Profile**

The project is developed as a part of the academic curriculum for the Bachelor of Computer Applications (BCA) final year project. It is undertaken independently by the student to demonstrate skills in AR mobile app development.

## **1.7 Structure of the Program**

The application is structured into the following modules:

- AR Visualization Module: Handles 3D model placement, movement, rotation, and scaling.
- Product Information Part: Provides the website link about product details,
- E-commerce Part: Provides website link to purchase selected furniture.
- User Interface Module: Manages user interaction with buttons, panels, and navigation.

## **1.8 Statement of the Problem**

Furniture shopping is challenging without the ability to visualize products in real-world settings. Customers often face issues with size estimation, color mismatches, and fitting furniture in a room. This project aims to solve these problems by providing an immersive AR experience that bridges the gap between physical and digital shopping.

## **2. SOFTWARE REQUIREMENTS SPECIFICATION**

### **2.1 INTRODUCTION**

#### **2.1.1 Purpose**

The purpose of this document is to outline the software requirements for an augmented reality (AR) mobile application that enables users to visualize furniture in their real-world environments. It defines the functional and non-functional requirements, interfaces, and design constraints that the system must adhere to for successful implementation.

#### **2.1.2 Scope of the Project**

This AR mobile application provides users with an interactive platform to place, move, rotate, and resize 3D models of furniture in real-world surroundings using their device's camera. Users can preview how furniture items will look and fit within their space before making purchase decisions. The app will also provide details such as dimensions, colors, prices, and offer a direct link to purchase items through an integrated e-commerce platform. The system aims to enhance user decision-making and improve the shopping experience.

#### **2.1.3 Intended Audience and Reading Suggestions**

- Students/Developers: For understanding the structure and implementation details of the AR app.
- Reviewers/Faculty: For evaluating the project in terms of technical design and feasibility.
- End Users: To understand the intended features and scope of the application. Readers are encouraged to start with the Overview and System Requirements sections for a high-level understanding, and then proceed to Design and Testing chapters for technical depth.

#### **2.1.4 Definitions, Acronyms and Abbreviations**

- AR – Augmented Reality
- UI – User Interface
- E-commerce – Electronic Commerce
- SDK – Software Development Kit

### **2.1.5 References**

- Unity Documentation: <https://docs.unity3d.com/>
- AR Foundation Documentation:  
<https://docs.unity3d.com/Packages/com.unity.xr.arfoundation>
- Official documentation of 3D model formats (GLTF, FBX)

### **2.1.6 Overview**

This document provides a detailed description of the AR-based furniture visualization system. Section 2.2 outlines the product's overall functionality. Section 2.3 covers the operating environment and system constraints. Section 2.4 includes detailed functional, interface, and performance requirements.

## **2.2 OVERALL DESCRIPTION**

### **2.2.1 Product Perspective**

The AR app is a standalone mobile application developed using Unity and AR Foundation. It utilizes the mobile device's camera and sensors to detect planes and place 3D models of furniture. It also integrates a database for storing product information and uses Firebase or a similar backend for data management and authentication if required.

### **2.2.2 Product Features**

- AR-based furniture visualization AR-based furniture visualization
- Real-time placement, movement, rotation, and resizing
- Vertical and horizontal surface detection
- Display product information(website)
- E-commerce link integration for purchase(website)
- Intuitive and user-friendly UI design
- Object selection and management

### **2.2.3 User Characteristics**

- Users with basic smartphone proficiency
- No technical knowledge of AR required
- Expected age group: 18–50
- Preference for mobile shopping and online purchasing

## **2.3 OPERATING ENVIRONMENT**

### **2.3.1 Design and Implementation Constraints**

- Must be compatible with Android 10+ and iOS 12+
- Requires ARCore (Android) or ARKit (iOS) support
- Built using Unity 2022 or higher
- Uses AR Foundation for cross-platform compatibility
- Internet connection required for product info updates

### **2.3.2 General Constraints**

- Device must have an AR-compatible camera and sensors
- Application performance depends on hardware capabilities
- Requires appropriate lighting and surface conditions for accurate detection

### **2.3.3 Assumptions and Dependencies**

- Users have internet access for data sync and model downloads
- Furniture 3D models are optimized for mobile use
- Users grant necessary permissions (camera, storage)

## **2.4 SPECIFIC REQUIREMENTS**

### **2.4.1 External Interface Requirements**

#### **2.4.1.1 User Interface**

- Home screen with navigation buttons (AR World, Products, Purchase, About App)
- AR screen with 3D preview and furniture placement features
- Product details screen with images and info
- Navigation and interaction via touch gestures and buttons

#### **2.4.1.2 Hardware Interface**

- Smartphone camera
- Gyroscope and accelerometer for plane detection
- GPU for rendering 3D models

#### **2.4.1.3 Software Interface**

- Unity Engine with AR Foundation plugin
- Mobile OS (Android/iOS)



#### 2.4.1.4 Communication Interface

- HTTPS for backend communication

#### 2.4.2 Functional Requirements

- Detect flat surfaces (horizontal and vertical)
- Place 3D furniture on detected surfaces
- Tap to select furniture, with options to , resize, or delete
- View furniture info and pricing
- Navigate to purchase link within the app

#### 2.4.3 Performance Requirements

- Real-time AR response with <1 second latency
- Load 3D models within 3 seconds
- Maintain 30+ FPS rendering for a smooth experience
- Minimal app crash rate (<1%) during usage

#### 2.4.4 Design Constraints

- App UI must adhere to red and white theme
- Optimize for portrait mode
- Limited to low-poly 3D models for performance

#### 2.4.5 Other Requirements

- Privacy policy for camera usage
- Consent dialog for data usage
- App should support future upgrades and feature additions

### 3. SYSTEM ANALYSIS AND DESIGN

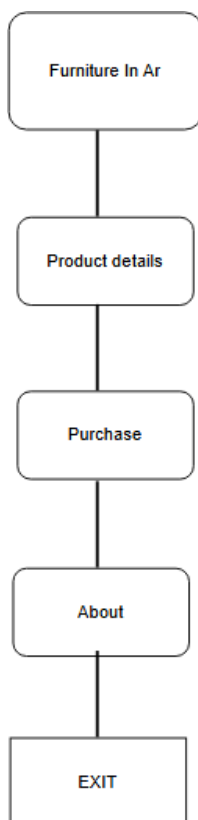
#### 3.1 INTRODUCTION

System analysis and design involve understanding the system requirements and constructing a structured framework for implementation. This chapter presents the overall system architecture, user interactions.

The system aims to allow users to preview furniture in their physical environment using augmented reality, manipulate 3D objects, and access product details to make informed purchase decisions.

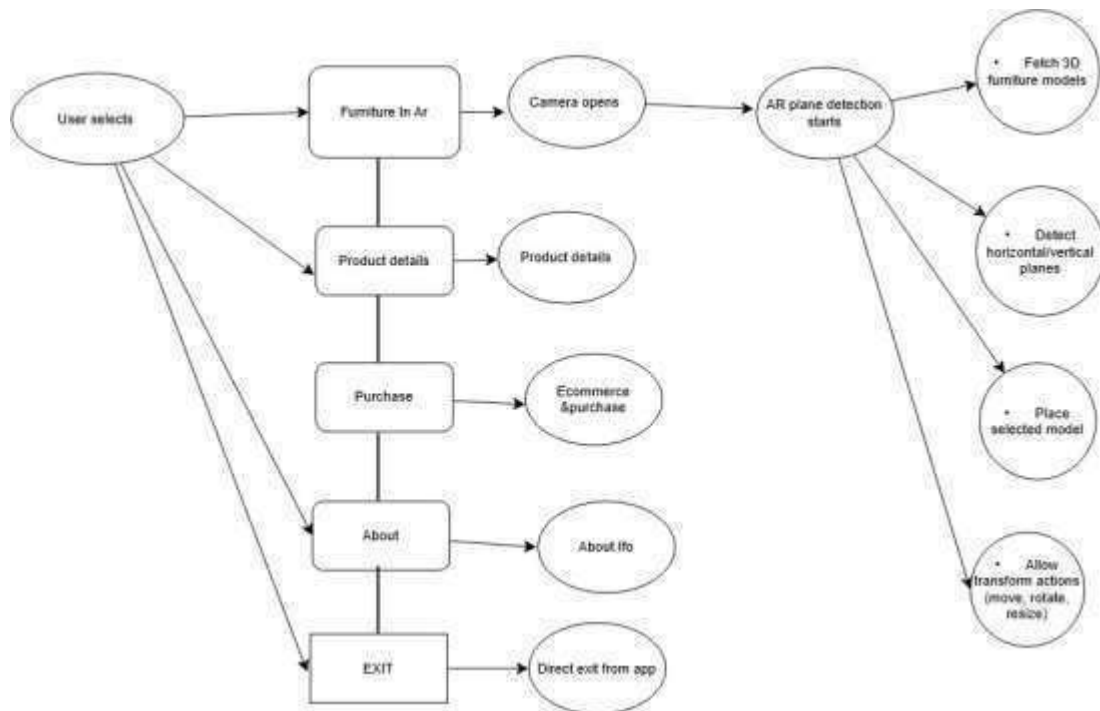
#### 3.2 DATA FLOW DIAGRAM (DFD)

##### Level 0 DFD (Context Level Diagram)



## Level 1 DFD

- Input: User selects AR mode → Camera opens → AR plane detection starts



- Output: Visual preview and interaction with furniture, access to product info and purchase link

## 3.3 SYSTEM DESIGN IMPLEMENTATION

### 3.3.1 Use Cases

Actors:

- User

Use :

- Launch AR Viewer
- Select Furniture
- Place & Manipulate 3D Object
- View Products
- Access Purchase Website Link

### 3.3.2 Class Diagram

Classes:

#### 1. Furniture

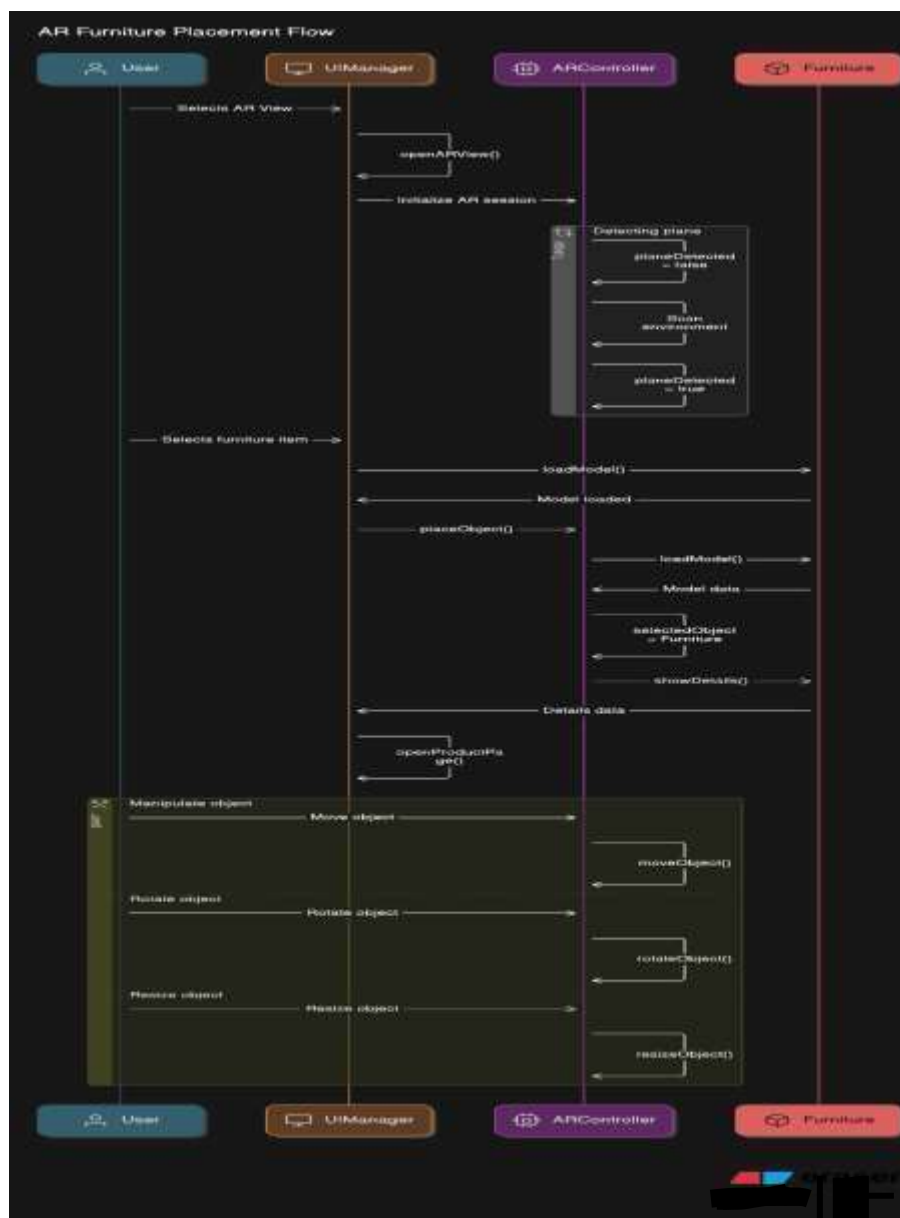
- Methods: loadModel(), showDetails()

#### 2. ARController

- Attributes: selectedObject, planeDetected
- Methods: placeObject(), moveObject(), rotateObject(), resizeObject()

#### 3. UIManager

- Attributes: currentScreen, selectedMenu
- Methods: openARView(), openProductPage(), openPurchaseLink()



\*\*Class Diagram of AR APP



### 3.4 USER INTERFACE DESIGN

Screens:

1. Welcome Page – “Get Started” button
2. Main Menu – Options: AR World, Products, Purchase, About App
3. AR World – Live camera, furniture selection menu, object manipulation buttons (select, delete, rotate)
4. Product Details Page – Info with image, dimensions, price
5. Purchase Page – Ecommerce Integration.
6. About App – Info about the app, developers, and contact details

UI Theme: Red and white, consistent with clean icons and minimal clutter for better UX.



**\*\*The Main Menu**

## 4. TESTING

### 4.1 INTRODUCTION

Testing is a critical phase in the software development life cycle to ensure that the application performs as expected under various scenarios. This chapter outlines the testing strategies, objectives, and detailed test cases for the AR furniture visualization app.

The purpose of testing is to validate functionality, performance, and user interactions, and to ensure that the AR environment is reliable and provides a seamless experience to the user.

### 4.2 TESTING OBJECTIVE

The main objectives of testing this application are:

- Ensure AR features work accurately (plane detection, object placement, manipulation).
- Confirm user interactions with UI elements perform expected actions.
- Validate data retrieval from the backend and ensure accurate product information is displayed.
- Guarantee the app functions without crashes across supported devices.
- Ensure responsiveness and real-time interaction across various screen sizes.

### 4.3 TEST CASES

#### 4.3.1 Launch AR Viewer

Test Case ID	TC001
Description	Check if AR viewer launches correctly
Input	Tap on “AR World” button.
Expected Result	AR camera view launches and begins surface detection
Actual Result	Works as expected
Status	Pass

#### **4.3.2 Plane Detection (Horizontal)**

Test Case ID	TC002
Description	Detect horizontal surface in real-time
Input	Point camera at floor.
Expected Result	Blue plane overlay appears
Actual Result	Plane detected and highlighted
Status	Pass

#### **4.3.3 Plane Detection (Vertical)**

Test Case ID	TC003
Description	Detect vertical surface like a wall
Input	Point camera at wall.
Expected Result	Red plane overlay appears
Actual Result	Works as expected
Status	Pass

#### **4.3.4 Furniture Model Placement**

Test Case ID	TC004
Description	Place a 3D furniture model on detected plane
Input	Select a model and tap once on the screen.
Expected Result	Model appears on the plane at tapped position
Actual Result	Works as expected
Status	Pass

#### **4.3.5 Object Manipulation**

Test Case ID	TC005
Description	Move, rotate, and resize placed furniture
Input	Tap & drag to move, two fingers to resize/rotate.
Expected Result	Model moves, rotates and resizes correctly
Actual Result	Works as expected
Status	Pass



#### **4.3.6 Product Info Display**

Test Case ID	TC006
Description	View product page.
Input	Tap on the product button.
Expected Result	Opens external browser web view to products page
Actual Result	Display is accurate
Status	Pass

#### **4.3.7 Purchase Display**

Test Case ID	TC007
Description	View Purchase page.
Input	Tap on the Purchase button.
Expected Result	Opens external browser web view to purchase page
Actual Result	Display is accurate and Redirect successful
Status	Pass

#### **4.3.8 Delete Furniture Object**

Test Case ID	TC008
Description	Delete a selected furniture object from the AR view.
Input	Tap on the "Delete" button.
Expected Result	Last placed object disappears from scene
Actual Result	Works as expected
Status	Pass

## **5. SYSTEM SECURITY**

### **5.1 INTRODUCTION**

System security ensures user data, device interaction, and third-party links are protected against unauthorized access and misuse. Though the app doesn't store sensitive personal data or include login features, basic security measures are implemented for safe usage.

### **5.2 SOFTWARE SECURITY**

#### **5.2.1 Data Privacy**

- No personal data storage: The app doesn't collect or store user information.
- Camera usage limited to AR only: No recordings or location tracking.

#### **5.2.2 API & External Link Security**

- HTTPS is used for all external links and API calls.
- Minimal permissions: Only camera access is requested, with runtime permission prompts.

#### **5.2.3 Device Safety**

- AR compatibility check: Ensures app runs only on ARCore/ARKit-supported devices.
- Safe exit: App exits gracefully without background tracking or unwanted resource use.

#### **5.2.3 Best Practices**

- Secure coding guidelines followed .
- No debug logs in production.
- Regular updates for dependencies and AR libraries.

## 6. CONCLUSION

This project successfully developed an AR-based mobile application that enables users to visualize furniture in their real environment before purchase. By combining real-time AR interaction with product details and e-commerce links, the app offers a practical and user-friendly solution for modern furniture shopping.

### Highlights:

- **AR Visualization:** View and place 3D furniture in real-world space.
- **Interactive Controls:** Move, rotate, and resize models.
- **Product Info:** View dimensions, colors, and prices.
- **Purchase Links:** Direct access to external buying platforms.
- **Optimized UX:** Smooth, efficient performance on AR-supported devices.

The project enhanced the skills in mobile AR development, UI/UX design, and real-world application of software engineering concepts.

## 7. FUTURE ENHANCEMENTS

To further enrich the functionality and user experience of the AR-based furniture visualization mobile application, the following enhancements are proposed for future development:

- **Save Room Layouts:**  
Users could be given the ability to save their customized room setups, including furniture arrangements and configurations. This would allow them to revisit and modify their layouts later, enabling long-term planning and design comparisons..
- **Ceiling Placement:**  
The current version supports placement on horizontal and vertical surfaces. Future updates could introduce support for ceiling surface detection, allowing users to place items like ceiling lights, fans, or hanging décor, giving a complete interior design experience..
- **AR Measurement Tool:**  
Integrating a built-in AR-based measurement tool would help users measure room dimensions directly through their mobile camera. This would provide accurate space assessments before placing furniture, ensuring better fit and usability.
- **Virtual Walkthrough:**  
A virtual walkthrough feature would allow users to move around the room while viewing furniture from various angles, just like a real-world inspection. This would greatly enhance spatial awareness and realism during the decision-making process.
- **Voice Commands:**  
To improve accessibility and hands-free interaction, voice commands could be implemented for core actions such as placing, moving, rotating, or deleting furniture. This would make the app more user-friendly and inclusive
- **AI Recommendations:**  
Using artificial intelligence, the app could analyze user preferences, past interactions, and room layouts to recommend suitable furniture items. Personalized suggestions would help users make quicker and more informed purchase decisions.
- **User Accounts & Wishlist:**  
Allowing users to create accounts and maintain wishlists would enable them to save their favorite furniture items for future reference. This feature would also facilitate personalized shopping experiences and targeted offers.
- **Cross-Platform Support:**  
Currently available on Android, the application could be expanded to support iOS and web-based platforms. This would increase accessibility and allow users to explore and plan from any device.



## 8. WEEKLY PROGRESS REPORTS

### WEEKLY PROJECT PROGRESS REPORT (WPPR)– 1

For week commencing 3 March 2025

Programme: BCA (METAVERSE,GAMING,GRAPHIC DESIGN,ARVR)IBM

Student Name: BINIL SIMON

Register Number: 22BCMGG07

WPPR: 1

Internal Guide's Name: MS.SINDHU SANDHESH

MAJOR PROJECT Title:

AR-Based Furniture Visualization Application

Targets set for the current week:

Finalize project idea and research AR technologies.  
Set up Unity with AR Foundation and configure ARCore support.  
Begin planning UI and feature list.

Progress/Achievements for the current week:

Chose AR Foundation (ARCore/ARKit) for markerless AR development.  
Installed Unity with AR Foundation and configured the AR scene.  
Set up test project and validated AR tracking on mobile device.



Future Work Plans (for the upcoming week):

Implement horizontal plane detection.  
Begin placing basic furniture prefabs on detected planes.

Implementation shown:

☐

Yes

☐

No

Remarks by the Internal Guide:

---

---

---

**Signature of the student**

**Signature of the Internal Guide**



**WEEKLY PROJECT PROGRESS REPORT (WPPR)– 2**

**For week commencing 10 March 2025**

**Programme: BCA (METAVERSE,GAMING,GRAPHIC DESIGN,ARVR)IBM**

Student Name: BINIL SIMON

Register Number: **22BCMGG07**

WPPR: 2

Internal Guide's Name: MS.SINDHU SANDHESH

MAJOR PROJECT Title:

AR-Based Furniture Visualization Application

Targets set for the current week:

Integrate plane detection and surface visualization.

Load and place 3D furniture models at touch position.

Set up UI buttons to place and clear objects.

Progress/Achievements for the current week:

Successfully implemented horizontal plane detection using AR Foundation

Enabled real-time surface tracking and visual indicators.

Imported and placed sample furniture models (chair, sofa) in AR space via touch.



Future Work Plans (for the upcoming week):

Add support for object scaling .

Implement object selection and delete functionality.

Implementation shown:

☐

Yes

☐

No

Remarks by the Internal Guide:

---

---

---

**Signature of the student**

**Signature of the Internal Guide**





**WEEKLY PROJECT PROGRESS REPORT (WPPR)– 3**

**For week commencing 17 March 2025**

**Programme: BCA (METAVERSE,GAMING,GRAPHIC DESIGN,ARVR)IBM**

Student Name: BINIL SIMON

Register Number: **22BCMGG07**

WPPR: 3

Internal Guide's Name: MS.SINDHU SANDHESH

MAJOR PROJECT Title:

AR-Based Furniture Visualization Application

Targets set for the current week:

Add object scaling (pinch-to-scale).

Implement object deletion

Improve UI interaction for selecting placed objects.

Progress/Achievements for the current week:

Successfully Implemented object scaling via touch gestures.

Added UI buttons for deleting the last placed object.



Future Work Plans (for the upcoming week):

Add vertical plane detection (walls).

Implementation shown:

☐

Yes

☐

No

Remarks by the Internal Guide:

---

---

---

**Signature of the student**

**Signature of the Internal Guide**



**WEEKLY PROJECT PROGRESS REPORT (WPPR)– 4**

**For week commencing 17 March 2025**

**Programme: BCA (METAVERSE,GAMING,GRAPHIC DESIGN,ARVR)IBM**

Student Name: BINIL SIMON

Register Number: **22BCMGG07**

WPPR: 4

Internal Guide's Name: MS.SINDHU SANDHESH

MAJOR PROJECT Title:

AR-Based Furniture Visualization Application

Targets set for the current week:

Implement vertical plane detection for wall placement.

Allow placing of wall-mounted items.

Design UI screens (Welcome, Menu, AR World, Products, About).

Integrate Ecommerce.

Progress/Achievements for the current week:

Integrated vertical surface detection using AR Foundation.

Users can now place objects on walls.

Designed and implemented welcome page and main menu with 4 options.

Successfully added ecommerce purchase feature through an external website.



Future Work Plans (for the upcoming week):

Optimize model loading and app performance.

Implementation shown:

☐

Yes

☐

No

Remarks by the Internal Guide:

---

---

---

**Signature of the student**

**Signature of the Internal Guide**



**WEEKLY PROJECT PROGRESS REPORT (WPPR)– 5**

**For week commencing 31 March 2025**

**Programme: BCA (METAVERSE,GAMING,GRAPHIC DESIGN,ARVR)IBM**

Student Name: BINIL SIMON

Register Number: **22BCMGG07**

WPPR: 5

Internal Guide's Name: MS.SINDHU SANDHESH

MAJOR PROJECT Title:

AR-Based Furniture Visualization Application

Targets set for the current week:

Optimize performance and reduce 3D model size.

Progress/Achievements for the current week:

Reduced model size and optimized textures for smoother AR performance.



Future Work Plans (for the upcoming week):

Conduct device testing and finalize UI/UX polish.  
Prepare project documentation and demo.

Implementation shown:

☐

Yes

☐

No

Remarks by the Internal Guide:

---

---

---

**Signature of the student**

**Signature of the Internal Guide**



**WEEKLY PROJECT PROGRESS REPORT (WPPR)– 6**

**For week commencing 7 April 2025**

**Programme: BCA (METAVERSE,GAMING,GRAPHIC DESIGN,ARVR)IBM**

Student Name: BINIL SIMON

Register Number: **22BCMGG07**

WPPR: 6

Internal Guide's Name: MS.SINDHU SANDHESH

MAJOR PROJECT Title:

AR-Based Furniture Visualization Application

Targets set for the current week:

Test app on multiple devices.

Fix bugs, polish UI, finalize features.

Complete final project documentation and presentation.

Progress/Achievements for the current week:

Conducted testing on various Android ARCore-supported devices.

Finalized all app features including wall/floor furniture placement,delete, and ecommerce .



Future Work Plans (for the upcoming week):

Submit final build and give project presentation.

Implementation shown:

☐

Yes

☐

No

Remarks by the Internal Guide:

---

---

---

**Signature of the student**

**Signature of the Internal Guide**



## 9. APPENDIX

### A. Source Code

- Written in **C#** using **Unity**.
- Includes ARCore/ARKit integration for AR support.
- Scripts for object placement, manipulation, and UI interaction.
- Website link integration for displaying product data and linking to external sites

### B. Test Cases

1. Object Placement – Verifies accurate AR placement.
2. Object Manipulation – Tests rotation and resizing.
3. E-Commerce Link – Checks redirection to product site.
4. UI Responsiveness – Validates layout on various screens.

### C. System Requirements

#### Hardware:

- AR-supported Android/iOS device
- 1.8 GHz processor, 3GB RAM, 500MB storage

#### D. Software:

- Android 7.0+ / iOS 12+
- Unity 2023.1+, ARCore/ARKit
- Product websites (for item details and links)

#### E. Screenshots:

- Source codes
- Main UI
- AR Scenes
- Ecommerce website view.

## Code used for the development

```
private void PlaceFurniture(ARPlane hitPlane)
{
    if (SpawnableFurniture == null) return;

    Pose hitPose = raycastHits[0].pose;
    Quaternion rotation = GetCorrectRotation(hitPlane, hitPose.rotation);

    Vector3 correctPosition = hitPose.position;
    if (hitPlane.alignment == PlaneAlignment.HorizontalUp)
    {
        correctPosition.y = hitPlane.center.y;
    }

    GameObject newFurniture = Instantiate(SpawnableFurniture, correctPosition, rotation);
    placedFurniture.Add(newFurniture);
    selectedFurniture = newFurniture;

    if (previewFurniture != null)
    {
        Destroy(previewFurniture);
        previewFurniture = null;
    }
}

private Quaternion GetCorrectRotation(ARPlane hitPlane, Quaternion defaultRotation)
{
    if (hitPlane.alignment == PlaneAlignment.Vertical)
    {
        Vector3 planeNormal = hitPlane.normal;
        return Quaternion.LookRotation(-planeNormal, Vector3.up);
    }
    return defaultRotation;
}
```

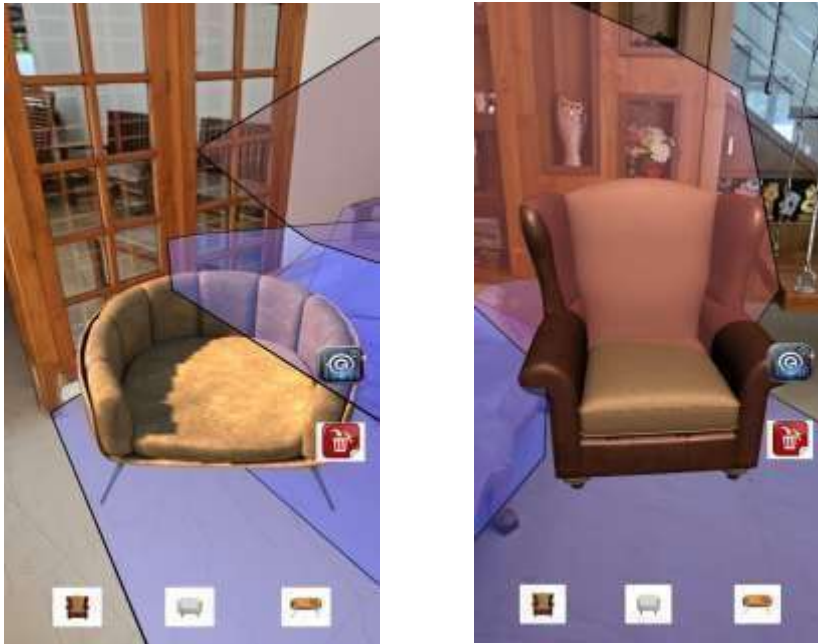
## Welcome UI



## Home UI



## AR Scenes: furniture placement and UI buttons



## Ecommerce integration as website



## 10. BIBLIOGRAPHY

- Unity Technologies. *UnityAR Foundation Documentation*.
- Google Developers. *ARCore Documentation*. <https://developers.google.com/ar>
- Bishop, S. (2024). *3D Game Development with Unity*. Packt Publishing.
- Skrzypczyk, P. (2024). *Mastering Augmented Reality with Unity and ARCore*. O'Reilly Media.
- Wang, X., & Huang, M. (2023). Designing User Interfaces for Augmented Reality Applications. *Journal of Interactive Media*, 15(2), 45-60.
- Mitchell, B. (2024). Understanding Augmented Reality for Furniture Shopping. *Furniture Journal*, 20(4), 112-119.
- Project Management Institute. (2025). *A Guide to the Project Management Body*