



**DEPARTMENT OF INFORMATION TECHNOLOGY AND
COMMUNICATION**

**DIPLOMA IN INFORMATION TECHNOLOGY
(DIGITAL TECHNOLOGY)**

AR OFFICE DESIGN

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SESSION: 2 2022/2023 (SHORT SEMESTER)

DECLARATION

We hereby declare that the technical report entitled “AR Office Design” is based on original work under supervision and guidance of Madam Nur Hazimah binti Khalid except for citations and quotations which have been duly acknowledged. We also declare that it has not been previously and concurrently submitted for any other diploma or award at Polytechnic or other institutions.

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ABSTRACT

The project "AR Office Design" is an application built to assist students and lecturers of the Department of Commerce in facilitating the teaching and learning process. This project utilizes AR 3D and interactive quizzes to enhance the visualization of office layouts, aiming to improve learning and modern imagination by offering a clear picture of workplace arrangements. The application helps students who are not familiar with office layouts by providing a virtual workplace experience without the need for physical viewing. The objective of this project are to develop a learning mobile application that will enable the students to learn and visualise each office design layout and office types in real life, design an Augmented Reality (AR) 3D model of office layout and office types and measure student understanding on the topic through interactive quizzes as a formative assessment. The methodology used for the "AR Office Design" project is Agile Scrum, where the application is developed using the programming languages Unity 3D, Vuforia, and C#. This enables students to enhance their understanding through various 3D AR models and quizzes. Overall, the project strives to create an immersive and impactful learning experience that enhances users' comprehension of office layouts and related topics.

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1.0 PROJECT PLAN

1.1 PROBLEM STATEMENT

The problem statement of this project are:

- i. There are few interactive components in current teaching and learning methods for various office types and layouts.
- ii. During the learning sessions, the students have difficulties visualising the many sorts of offices and workplace layouts.
- iii. There are physical space limits that prevent a large number of students from touring the office space.

1.2 OBJECTIVE

The objective of this project are:

- i. To develop a learning mobile application that will enable the students to learn and visualise each office design layout and office types in real life.
- ii. To design an Augmented Reality (AR) 3D model of office layout and office types for assisting the students to visualise the office space during the learning process.
- iii. To measure student understanding on the topic through interactive quizzes as a formative assessment.

1.3 SCOPE

User Scope (Student)

- i. Students will see images of the office in augmented reality (AR) on their phones, so they don't have to see the office in reality. Physical visits to the office will disturb the workers in the office. In order to prevent this from happening, the use of AR on each phone really helps students see the state of the office more clearly without disturbing anyone.
- ii. Students will be able to find out information about offices according to examples of offices seen. The information related to the examples given is based on the notes learned, so students can strengthen their memory of the topics learned.
- iii. Students can answer the questions provided in this application to strengthen the reinforcement. The questions provided are based on the notes found in this application. So to further strengthen students' understanding of the topic studied, students can answer some prepared questions. Students can also find out the correct answer if they make a mistake.
- iv. Students can choose various examples of office appearance. This will make it easier for students to refer to the office examples they have studied. Students also do not need to browse images of office examples on the internet.
- v. Students can engage with augmented reality 3D models of various workplace types and layouts. In this section, the student can easily observe the design.
- vi. Students can view models via augmented reality. This is because all of the designs have already been created in 3D to help pupils understand.

System Scope

- i. The application shall display options of office types for students.

1.4 LITERATURE REVIEW

Table 1.1 : Literature Review

Logo			
Name of Application	Room Planner	Houzz	IKEA Place
Links to referred	Room Planner	Houzz	Ikea App Page
Programming Language Use	i. JavaScript ii. Swift (iOS user) - Java /Kotlin (Android user)	i. Objective-C ii. Swift (iOS user) iii. Java / Kotlin (Android user)	Mobile App Development : i. JavaScript ii. Swift (iOS user) iii. Kotlin (Android user) Augmented Reality Development : i. ARKit ii. ARCore iii. Unity 3D iv. Unreal Engine
Strength (Features)	i. Room Planner can be downloaded for Android and iOS users ii. It can be downloaded for Android and iOS users iii. It can be used without an internet connection.	i. Houzz using the AR concept in arranging furniture	i. You may quickly arrange objects in your space and browse the huge IKEA catalogue for certain products in AR form. ii. Ikea Place smooth use of AR without interruptions

Weakness (Features)	i. Room Planner has an interface for arranging furniture in 2D and 3D only. ii. It does not use augmented reality (AR) to display furniture items. This is not the same as our goal to use AR to display images.	i. Houzz can take a long time to display the image in AR form. ii. It requires a strong internet connection, so it is quite difficult for users to use this application especially for those who have internet problems. iii. Houzz does not have a user manual, this is quite difficult for new users to use this application. They had to learn the application before they could use it.	i. Sometimes Ikea Place takes a long time to process the image in AR form
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Based on these three applications, it can be concluded that each application has its own special features. Among the weaknesses found in these three applications is that there are applications that use augmented reality (AR) in displaying images, but the displayed images have glitches and take a long time to display. Through this weakness, we can improve the quality of the images used to avoid a glitch situation, and the display time for the image to be displayed is short. In addition, there are applications that require a strong internet connection. If there is no internet connection, the application cannot be used. To improve on this problem, the application that will be developed must be one that does not require a stronger internet connection so that the user can be anywhere without any problem.

1.5 METHODOLOGY



Figure 1.1 : Agile Scrum for methodology

This project's methodology is to use the Agile Development Model. The detailed activities are as shown in Table 1.2. This methodology was chosen because it is suitable for either small or large projects. Agile is important because it helps students arrange their projects to be on time and within budget. Agile is also better suited for application development, where system requirements frequently change during the development process. Agile development is also easy to use and understand especially for the development team.

The major benefits of choosing the Agile Scrum methodology for this project are as follows:

Flexibility: Agile Scrum allows for adaptability and responsiveness to changing requirements throughout the development process, enabling the team to adjust and prioritise tasks effectively.

Collaboration: The methodology promotes close collaboration between team members, fostering effective communication, knowledge sharing, and collective decision-making.

Time and Budget Management: By breaking the project into smaller iterations, Agile Scrum helps manage time and budget effectively. The team can regularly assess progress and make necessary adjustments to ensure timely delivery within the allocated resources.

Table 1.2 : Methodology

No.	Phase	Activities
1.	Meet & Plan	i. Project team brainstormed ideas together. ii. Meet clients to perform fact finding and gathering requirements. iii. Conduct preliminary investigation. iv. Analyse preliminary investigation outcome.
2.	Design	i. Designing the architecture of layout projects. ii. Designing gantt charts to understand each function,system boundaries and the overall progress of the project. iii. Designing AR Office Design interface using Unity and another Software.
3.	Code & Test	i. In each layout design of this project adds use in the form of AR 3d models.
4.	Release	i. Improve and try before releasing the application. ii. Release the AR application to the client's environment.
5.	Feedback	i. Get the feedback from clients and perform maintenance if there's a bug. ii. Improve the application to be better.

1.6 GANTT CHART

The Gantt Chart of this project is as depicted in Figure 1.2.

AR OFFICE DESIGN GANTT CHART

PROJECT NAME		AR OFFICE DESIGN	START DATE	END DATE	OVERALL PROGRESS	MEMBERS : NUR AINA SYAHIRAH BINTI KHAIRIZAM	
PROJECT MANAGER		NURUL AIN SHUHARNI BINTI MOHD AINI	06/21/23		In Progress	MEMBERS : IMAN SOFEA BINTI IKMAL HISHAM	
NO	PHASES/ACTIVITIES	RESPONSIBLE	START	FINISH	DURATION in days	STATUS	COMMENTS
1	MEET & PLAN		21/06/2023	23/06/2023	2		
	Project team brainstormed ideas together.		21/06/2023	21/06/2023	1		
	Meet clients to perform fact finding and gathering requirements.		22/06/2023	22/06/2023	1		
	Conduct preliminary investigation.		22/06/2023	22/06/2023	1		
	Analyze preliminary investigation outcome.		22/06/2023	22/06/2023	1		
	Prepare project plan and project design		23/06/2023	23/06/2023	1		
2	DESIGN		26/06/2023	08/07/2023	13		
	Designing the architecture of layout projects.		26/06/2023	26/06/2023	1		
	Designing gantt charts to understand each function,system boundaries and the overall progress of the project.		27/06/2023	28/06/2023	2		
	Designing AR Office Design interface using Unity and another Software.		29/06/2023	07/07/2023	9		
	Demo presentation 1		08/07/2023	08/07/2023	1		
3	CODE TEST		09/07/2023	22/07/2023	14		
	Coding the functions and simulations of the project using the suitable project.		09/07/2023	14/07/2023	6		
	Try the 3D design office into AR.		15/07/2023	21/07/2023	7		
	Demo presentation 2		22/07/2023	22/07/2023	1		
4	REALEASE		23/07/2023	02/08/2023	7		
	Demo presentation 3		23/07/2023	23/07/2023	1		
	Improve and try before releasing the application.		24/07/2023	26/07/2023	3		
	Release the AR application to the client's environment.		27/07/2023	29/07/2023	3		
5	FEEDBACK		30/07/2023	11/08/2023	12		
	Get the feedback from clients and perform maintenance if there's a bug.		30/07/2023	31/07/2023	2		
	Improve the application to be better		01/08/2023	06/08/2023	6		
	Final presentation		07/08/2023	11/08/2023	4		

Figure 1.2 : Gantt Chart

2.0 REQUIREMENT SPECIFICATION

2.1 FUNCTIONAL REQUIREMENT

The AR Office Design application has its own functions that can attract users to learn more about the types of offices. In this application, the functional requirements are:

- i. The use of 3D models is displayed in augmented reality, which can be seen on each phone.
- ii. Use of audio to read information about office information.
- iii. The button on each page to change from one page to another works in good condition.
- iv. On the page there is a slider that can control the audio volume.
- v. The target image used for each AR is set and the model will not be displayed if the target image is not the same.
- vi. The AR 3D model can rotate, zoom in and zoom out.
- vii. The exit button will display a text box when pressed and will terminate the application.
- viii. The quiz provided is in the form of drag and drop, test, and match. All these quizzes need to be completed to know the score obtained.

2.2 NON-FUNCTIONAL REQUIREMENT

The non-functional requirement of this project is as shown in Table 2.1.

Table 2.1 : Non-Functional Requirement at AR Office Design

Requirement	Product
Performance	i. The application does not take long to display the interface.
Reliability	i. The application can be accessed and used by Android users without any problems.
Availability	i. The application can be accessed and used by Android users without any problem
Maintainability	-
Recoverability	-
Capacity	i. There is no user limit to use this application.
Serviceability	i. This application is built using C# programming and Unity software. To repair this application in the event of an error, the coding found in C# needs to be repaired. Changes to the code will affect Unity's functionality. ii. There are some situations that do not require coding, such as making AR, but require knowing some of the functions available in Unity.
Security	-
Manageability	i. There is coding used on some pages. If the project changes the coding, errors may occur, and the features available in Unity may change.
Environmental	-
Data integrity	-
Interoperability	i. The application interface can be adjusted according to the user's phone.
Usability	i. The application interface is user-friendly and easy to use. ii. The icon button that we use is familiar from other applications. iii. Most of the buttons in this application have text under the icon. iv. The text used in the application is clearly readable.

2.3 HARDWARE AND SOFTWARE REQUIREMENT

There are hardware and software components that are required for this project to run smoothly. The hardware requirement is as shown in Table 2.2, and the software requirement is as shown in Table 2.3.

Table 2.2 : Hardware Requirement

No	Hardware	Specification	Price (RM)
1.	Laptop Acer Aspire A514-54	i. 11th Gen Intel(R) Core(TM) i7-1165G7 @ 2.80GHz 2.80 GHz ii. Installed RAM 24.0 GB	3299.00
2.	Laptop HP 14s	i. AMD Ryzen 5 4500U with Radeon Graphics 2.38 GHz ii. Installed RAM 8.0 GB	3100.00
3.	Laptop VivoBook_Asus	i. Intel(R) Celeron(R) N4020 CPU @ 1.10GHz 1.10 GHz ii. Installed RAM 4.0 GB	2600.00
TOTAL COST			8999.00

Table 2.3 : Software Requirement

No	Software	Specification	Price (RM)
1.	Visual Studio	i. Using java, C++ and C# ii. For develop the application in unity	372.09
2.	Unity	i. For design the interface in this application ii. Creating and operating interactive, real-time 3D (RT3D) content.	94.00
3.	Canva	i. Free use online graphic design tools ii. Ready made templates tools for user	60.42
4.	Sketchup	i. Creating regular art, 3-dimensional models, and visual effects.	538.78
TOTAL COST			1065.20

2.4 SYSTEM CONFIGURATION

i. Hardware Components

For the hardware components, the project required at least 8 GB of RAM to develop and run the application because this project uses Unity software, which is quite heavy. A project built in Unity will use at least 1GB of laptop storage.

ii. Software Configuration

This project uses Unity version 2022.3.3f1. The use of Unity is suitable for building augmented reality and game projects because, in the AR Office Design application, augmented reality and quiz (games) are important elements.

3.0 FINAL DESIGN

3.1 LOGICAL DESIGN

3.1.1 Use-Case Diagram

A use case diagram shows how a user interacts with a project. The user can select the type of office as well as the layout of the office in this project. Aside from that, when the user enters 3D mode, they can view information. In AR mode, the user can also interact with the 3D model and view it. Finally, in this application, the user can take some quizzes. The Use-Case Diagram as shown in Figure 3.1.

Student

- i. The student shall choose types of office to view information and 3D models.
- ii. The student shall choose the office layouts to view information and 3D models.
- iii. The student shall view information of office types and office layouts.
- iv. The student shall interact with AR 3D models of office types and office layouts.
- v. The student shall choose AR 3D model variations of office types and office layouts.
- vi. The student shall view 3D models in AR modes.
- vii. The student shall answer quizzes to measure their understanding of the topic.

System

- i. The application shall display options of office types for students.

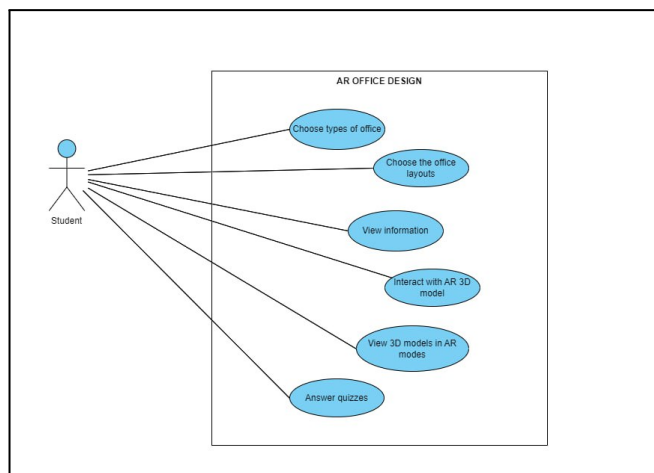


Figure 3.1 : Use Case Diagram

3.1.2 Functional Decomposition Diagram (FDD)

This is an analysis method for our project that will help us carry out the step-by-step process. Our project is divided into two processes: AR 3D and quiz questions. There are two pieces of information under AR 3D, namely view 3D modelling in AR and have information. Below the 3D view is a variety of each office layout, and you can view information before and during the 3D modelling view. Finally, the quiz allows the user to answer quizzes, receive feedback, and receive scores for each type of quiz answered. The Functional Decomposition Diagram as shown in Figure 3.2.

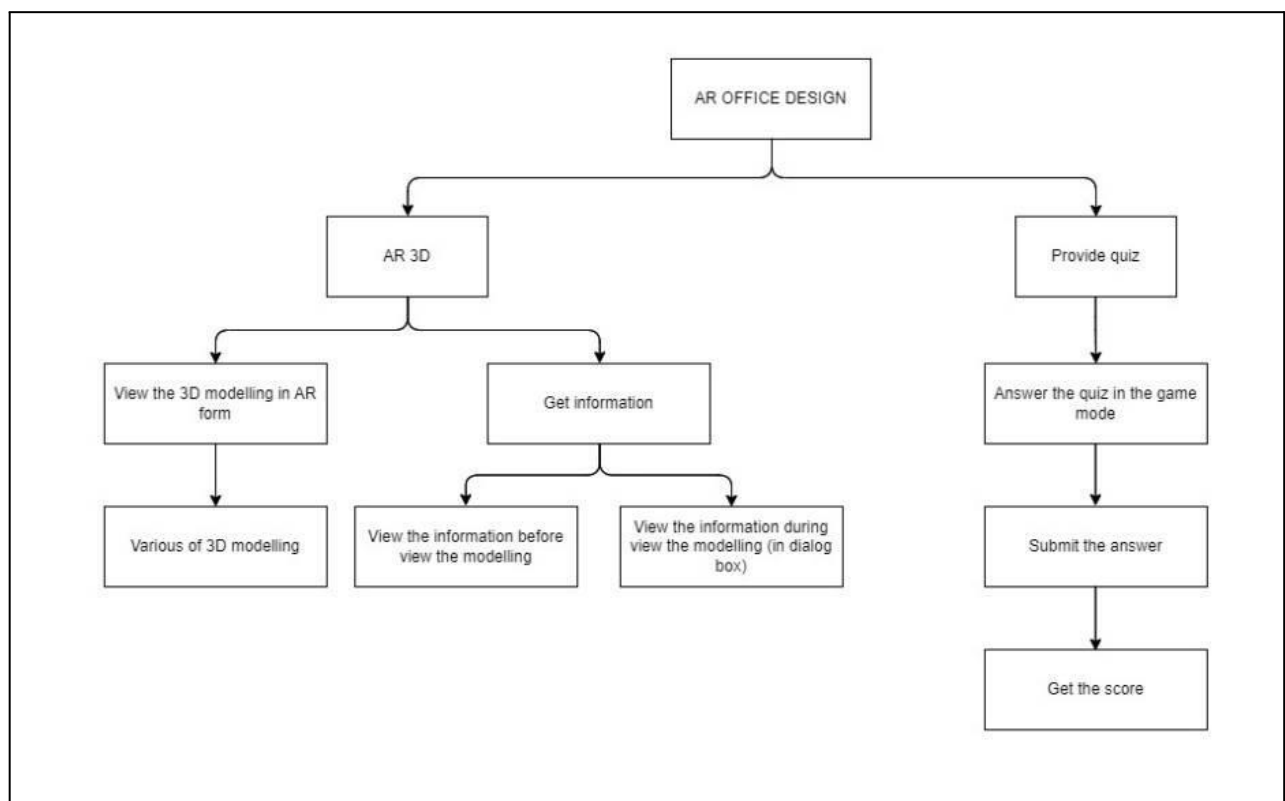


Figure 3.2 : Functional Decomposition Diagram

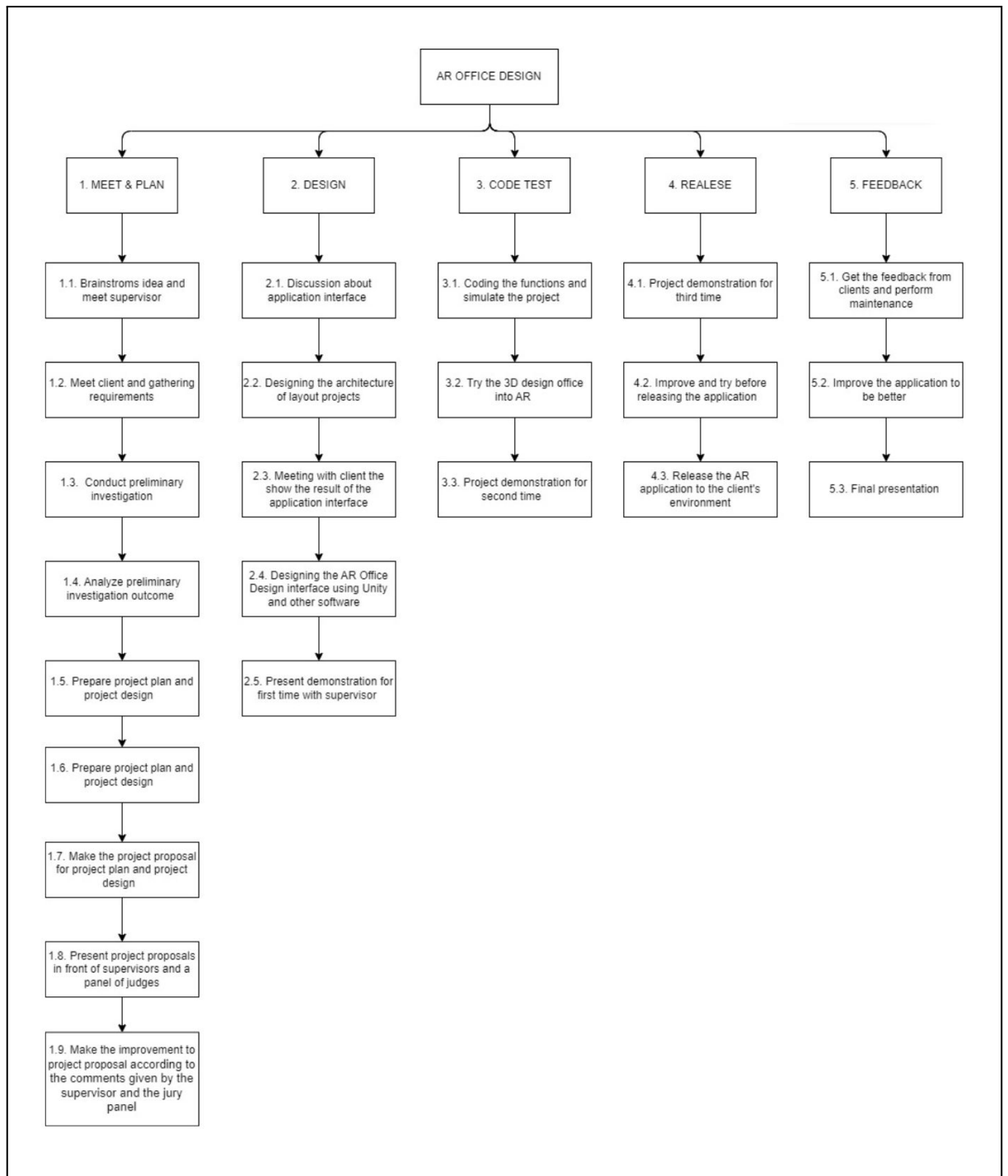


Figure 3.3 : FDD Diagram For Develop AR Design

3.2 PHYSICAL DESIGN

3.2.1 Start Page

On the first page, users will see the logo of AR Office Design and the button 'Let's Start' to start this application. The start page as shown in Figure 3.4.



Figure 3.4 : Start Page Interface

3.2.2. Main Menu Page

This page contains 3 buttons namely 'Type Of Office', 'Type Of Office Layout' and 'Quiz'. It also has 2 navigation buttons, 'Home' and 'Exit'. The main menu page as shown in Figure 3.5.

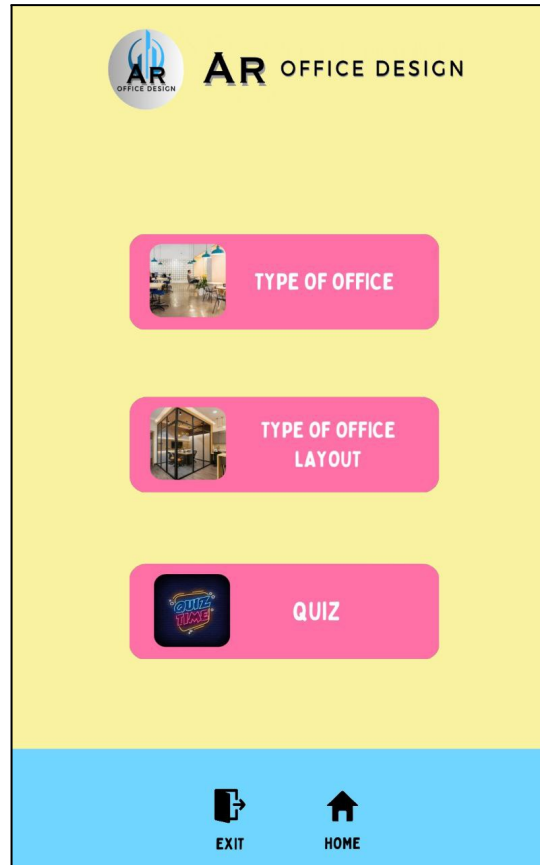


Figure 3.5 : Main Menu Interface

3.2.3. Menu For Type of Office Page

On this page, users can see two buttons for 'Open Office' and 'Private Office'. It will go to a different page based on what the user chooses. On the below page, there is a navigation bar to make it easier for users to go to the main page by clicking the icon home. The menu for the type of office page as shown in Figure 3.6.

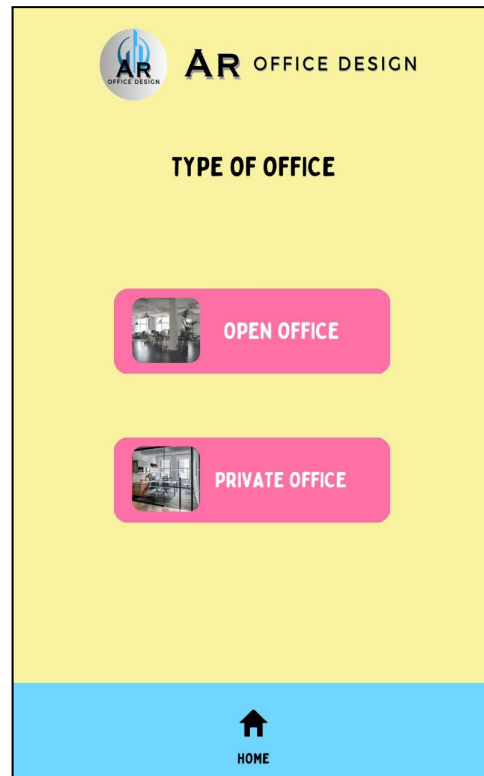


Figure 3.6 : Menu For Type of Office Interface

3.2.4 Type of Office (Open Office - AR Page by Image Target)

On this page, users can view the 3D model in AR form. On this page, users need the image target to view the model. On the below page, there are two buttons for variations of office. Users can choose the variation, and each variation has a different style of office. The type of office for the open office page as shown in Figure 3.7.

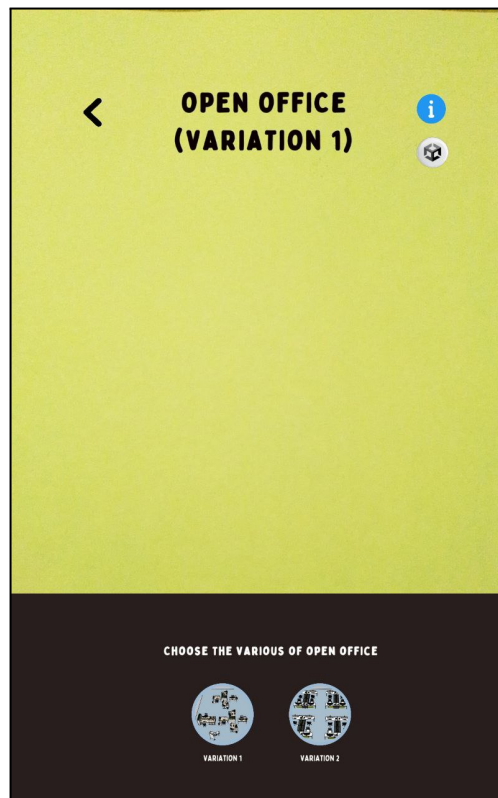


Figure 3.7 : Open office interface by image target

If the user presses the blue button at the top, they can see information about the office displayed. Users can close this information using the 'X' button. It also has a sound button (a speaker icon) if the user wants to hear office-related information on this page. The type of office open office (Image target) as shown in Figure 3.8.

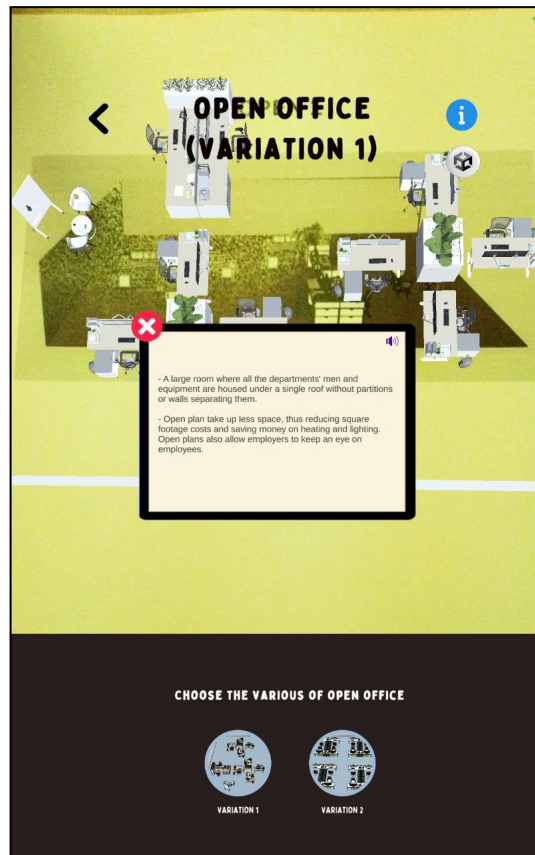


Figure 3.8 : Open office interface by image target(info)

3.2.5 Type of Office (Open Office - AR Page by Ground Plane) Page

On this page, there is the arrow button to go to the previous page. Users can see the AR model like a real life without using any image target. The type of office open office(ground plane) as shown in Figure 3.9.

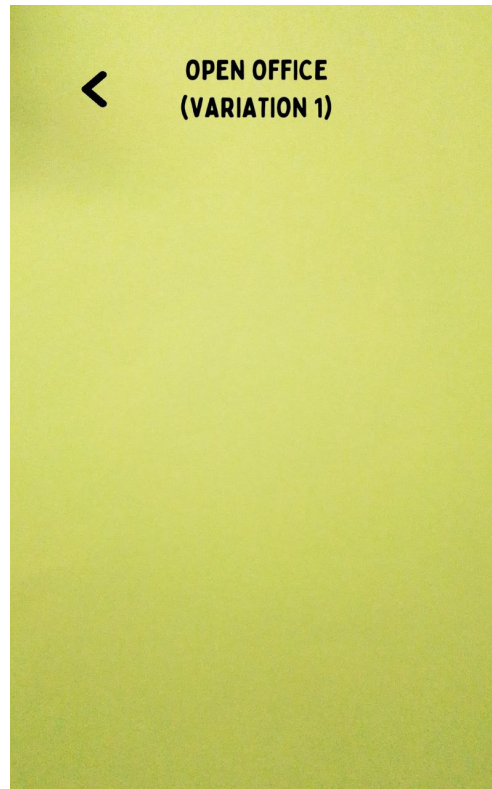


Figure 3.9 : Open office interface by ground plane

3.2.6 Type of Office (Private Office - AR Page)

On this page, users can view the 3D model in AR form. On this page, users need the image target to view the model. On the below page, there are two buttons for variations of office. Users can choose the variation, and each variation has a different style of office. The type of office private office(image target) as shown in Figure 3.10.

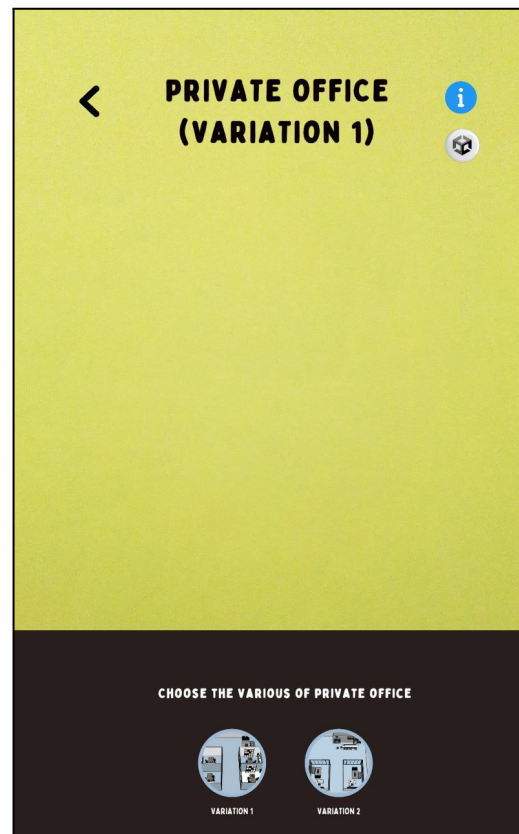


Figure 3.10 : Private office interface by image target

If the user presses the blue button at the top, they can see information about the office displayed. Users can close this information using the 'X' button. It also has a sound button (a speaker icon) if the user wants to hear office-related information on this page. The type of office private office(info) as shown in Figure 3.11.



Figure 3.11 : Private office interface by image target(info)

3.2.7 Type of Office (Open Office - AR Page by Ground Plane) Page

On this page, there is the arrow button to go to the previous page. Users can see the AR model like a real life without using any image target. The type of office private office(ground plane) as shown in Figure 3.12.

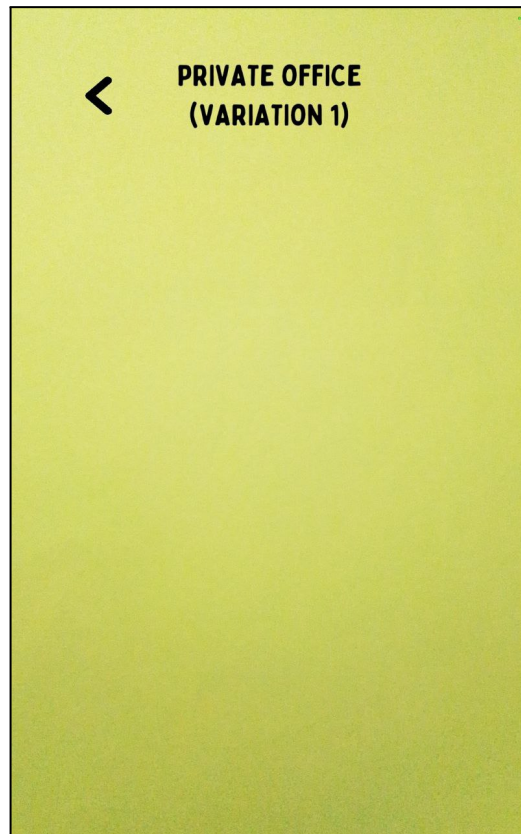


Figure 3.12 : Private office interface by ground plane

3.2.8 Type of Office Layout Page

On this page, users can see three buttons for 'Movable Partition', 'Landscape Office' and 'Modular Unit'. It will go to a different page based on what the user chooses. On the below page, there is a navigation bar to make it easier for users to go to the main page. The type of office layout interface as shown in Figure 3.13.

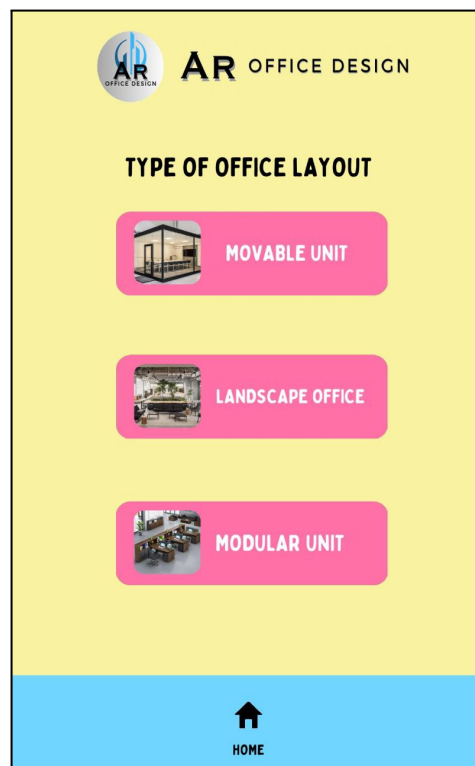


Figure 3.13 : Type of Office Layout Interface

3.2.9 Type Of Office Layout (Movable Partition-AR Page by Image Target) Page

On this page, users can view the 3D model in AR form. On this page, users need the image target to view the model. On the below page, there are two buttons for variations of office. Users can choose the variation, and each variation has a different style of office. The type of office layout(movable partition image target) as shown in Figure 3.14.

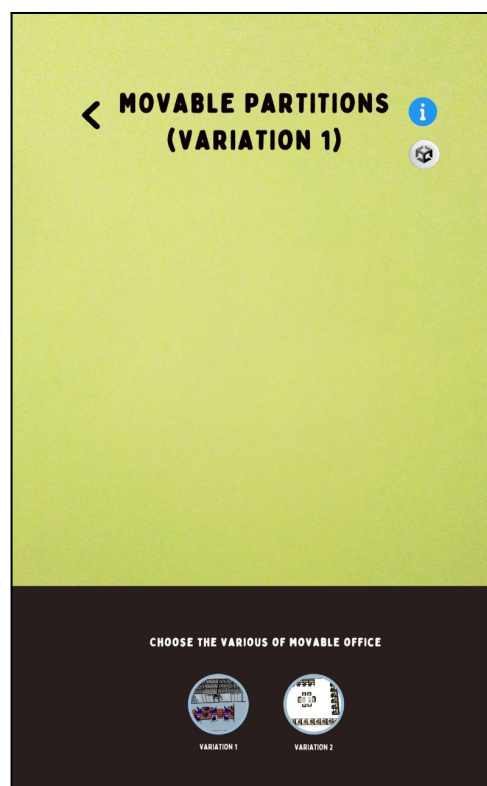


Figure 3.14 : Movable partition interface by image target

If the user presses the blue button at the top, they can see information about the office displayed. Users can close this information using the 'X' button. It also has a sound button (a speaker icon) if the user wants to hear office-related information on this page. The type of office layout (movable partition info) as shown in Figure 3.15.

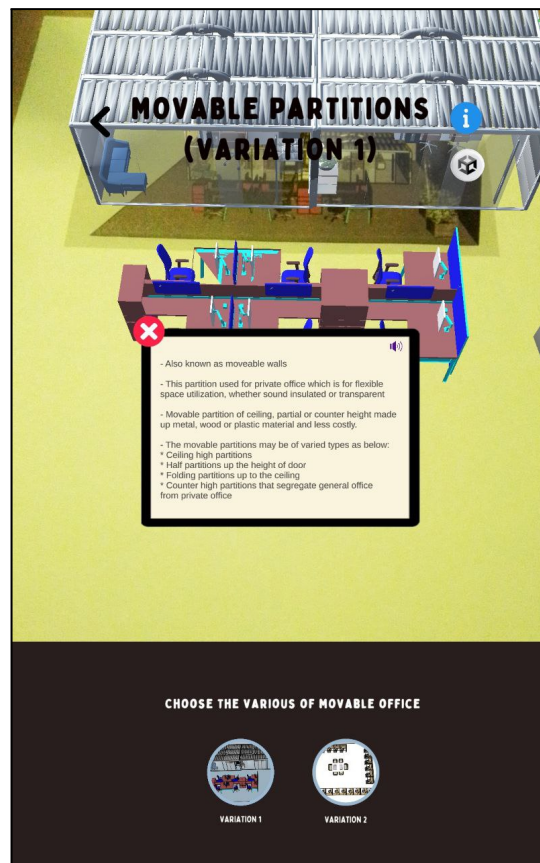


Figure 3.15 : Movable partition interface by image target(info)

3.2.10 Type Of Office Layout (Movable Partition - AR Page by Ground Plane) Page

On this page, there is the arrow button to go to the previous page. Users can see the AR model like a real life without using any image target. The type of office layout (movable partition ground plane) as shown in Figure 3.16.

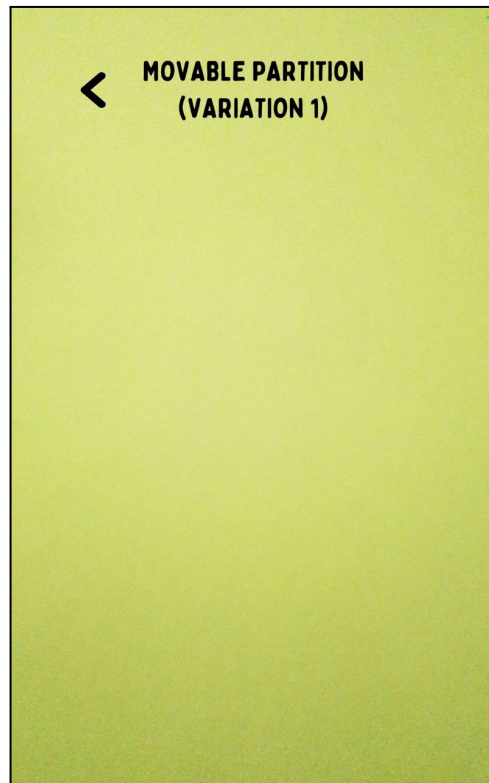


Figure 3.16 : Movable partition interface by ground plane

3.2.11 Type Of Office Layout (Landscape Office - AR Page by Image Target) Page

On this page, users can view the 3D model in AR form. On this page, users need the image target to view the model. On the below page, there are two buttons for variations of office. Users can choose the variation, and each variation has a different style of office. The type of office layout (landscaped office image target) as shown in Figure 3.17.

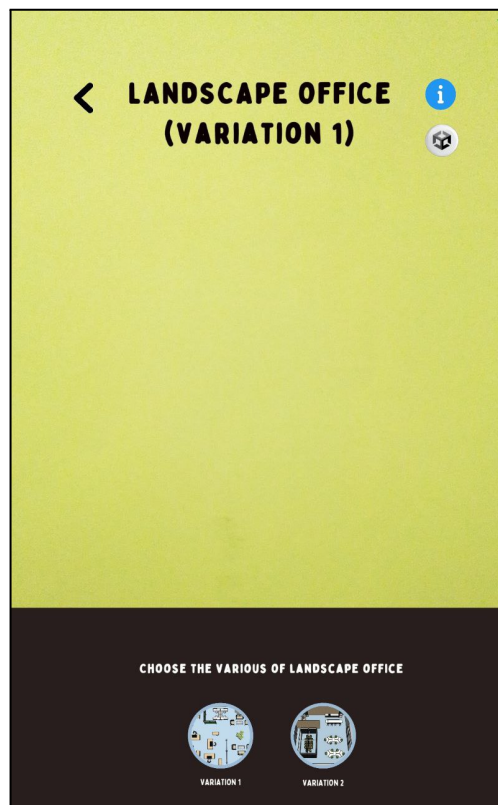


Figure 3.17 : Landscape office interface by image target

If the user presses the blue button at the top, they can see information about the office displayed. Users can close this information using the 'X' button. It also has a sound button (a speaker icon) if the user wants to hear office-related information on this page. The type of office layout landscaped office info) as shown in Figure 3.18.

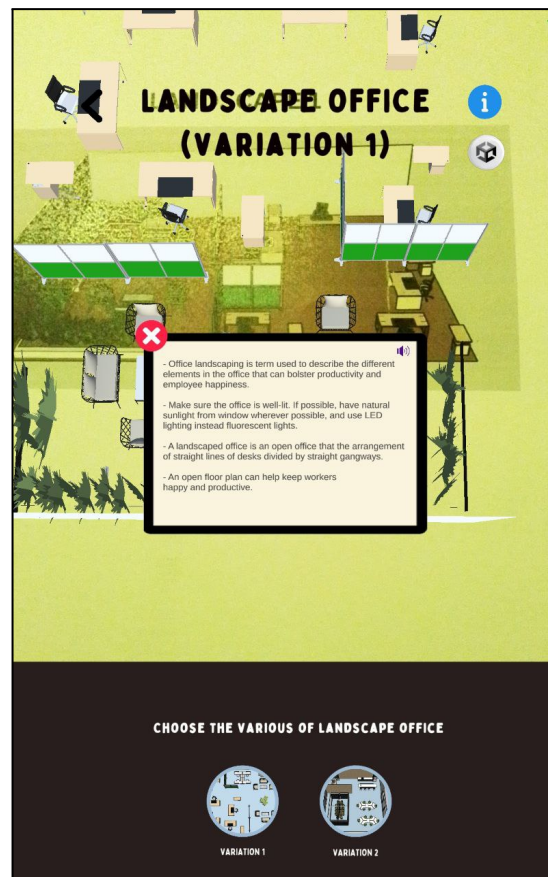


Figure 3.18 : Landscape office interface by image target(info)

3.3.12 Type Of Office Layout (Landscape Office - AR Page by Ground Plane) Page

On this page, there is the arrow button to go to the previous page. Users can see the AR model like a real life without using any image target. The type of office layout (landscaped office ground plane) as shown in Figure 3.19.

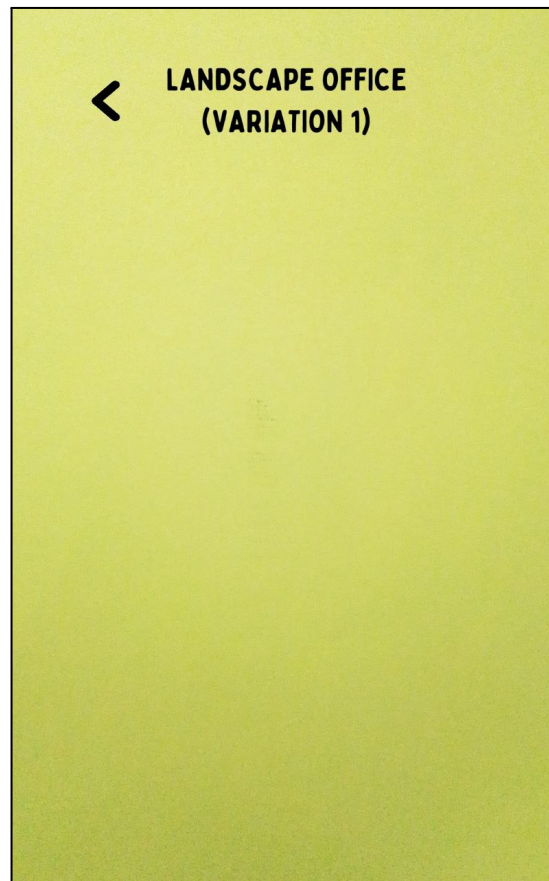


Figure 3.19 : Landscape office interface by ground plane

3.2.13 Type Of Office Layout (Modular Units - AR Page by Image Target) Page

On this page, users can view the 3D model in AR form. On this page, users need the image target to view the model. On the below page, there are two buttons for variations of office. Users can choose the variation, and each variation has a different style of office. The type of office layout (modular units image target) as shown in Figure 3.20.

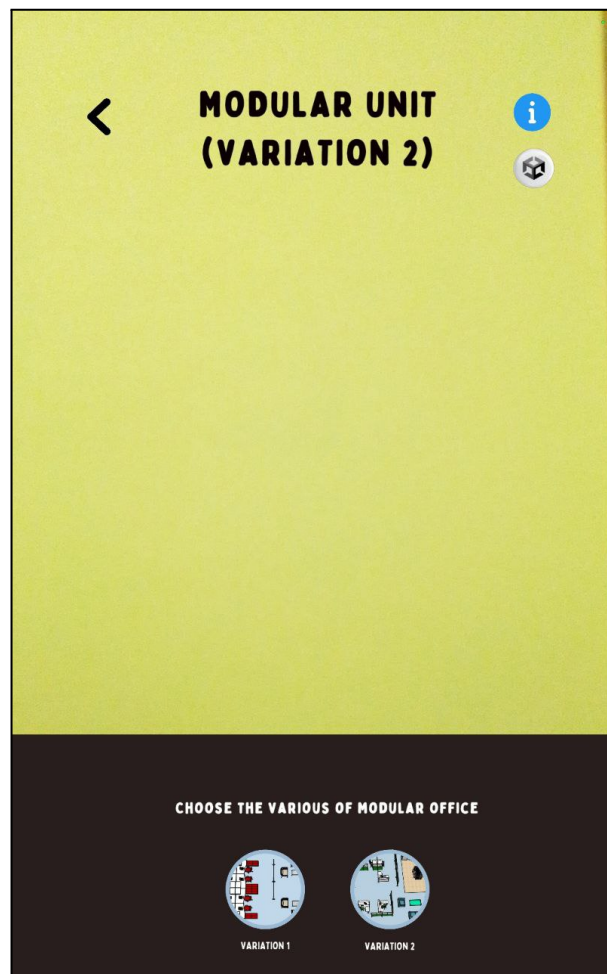


Figure 3.20 : Modular units interface by image target

If the user presses the blue button at the top, they can see information about the office displayed. Users can close this information using the 'X' button. It also has a sound button (a speaker icon) if the user wants to hear office-related information on this page. The type of office layout (modular Units info) as shown in Figure 3.21.

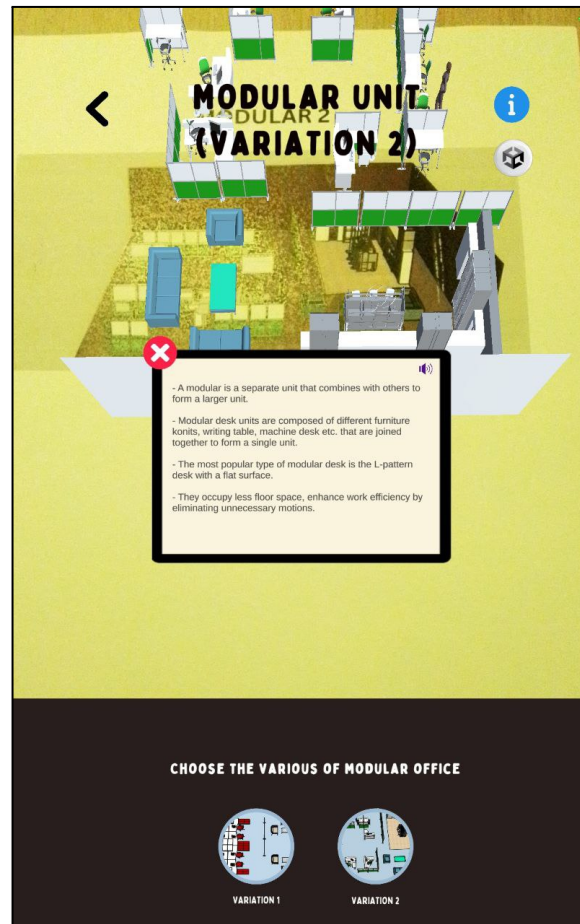


Figure 3.21 : Modular Units interface by image target(info)

3.2.14 Type Of Office Layout (Modular Units- AR Page by Ground Plane) Page

On this page, there is the arrow button to go to the previous page. Users can see the AR model like a real life without using any image target. The type of office layout (modular units ground plane) as shown in Figure 3.22.

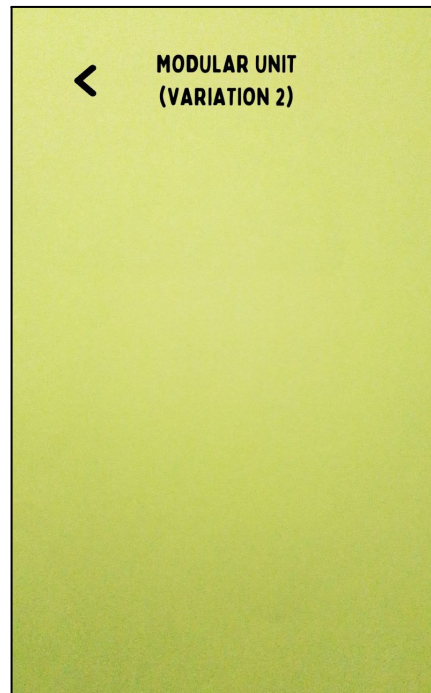


Figure 3.22 : Modular Units interface by ground plane

3.2.15 Quiz Game

This is an interface for a quiz with three variations: Drag & Drop, Test, and Match, with each variation testing the student's understanding. This quiz is similar to a game. For example, rag & drop quiz, users can drag a picture and drop it in the right box based on the question.. Aside from that, the test section is for students to practice, and it contains two types of questions: multiple choice and true/false. Finally, in this game, students can pick cards to match terms and definitions in the match section. The quiz game interface as shown in Figure 3.23.

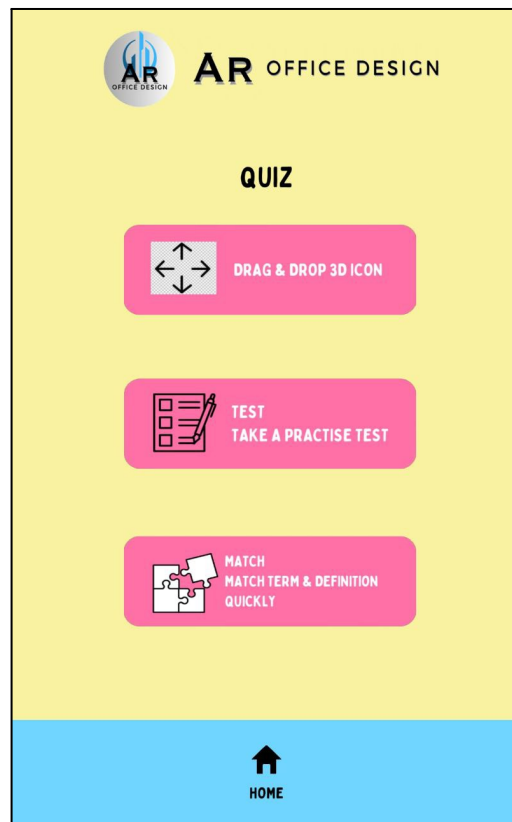


Figure 3.23 : Quiz Game Interface

3.2.16 Interface for Drag & Drop

This page has a start game button to enter the game page. And an exit button to go to the previous page. The drag & drop interface as shown in Figure 3.24.



Figure 3.24: Drag & Drop Interface

3.2.17 Interface for game Drag & Drop

In this game, the user is given the task to drag an image and drop it in the correct location. When the user has finished dropping all of the images, the score will be calculated and the user can press check for feedback. If the user presses the reset button, the score is reset and the images are arranged in the same way that they were before dragging the image. The drag & drop game interface as shown in Figure 3.25.

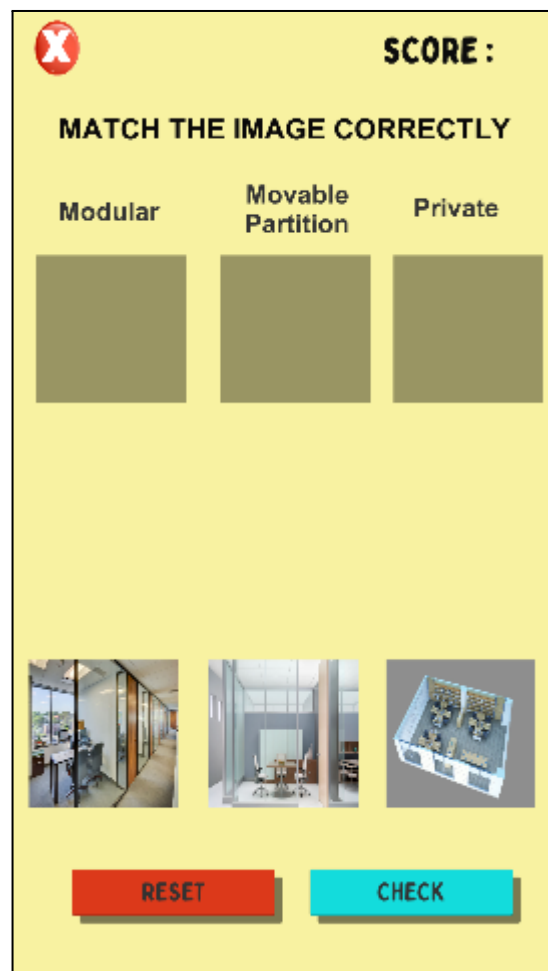


Figure 3.25 : Drag & Drop game interface

3.2.18 Interface for feedback game Drag & Drop

This is a feedback interface for drag & drop when the user has finished dragging all the pictures into the box. The feedback drag & drop game interface as shown in Figure 3.26.

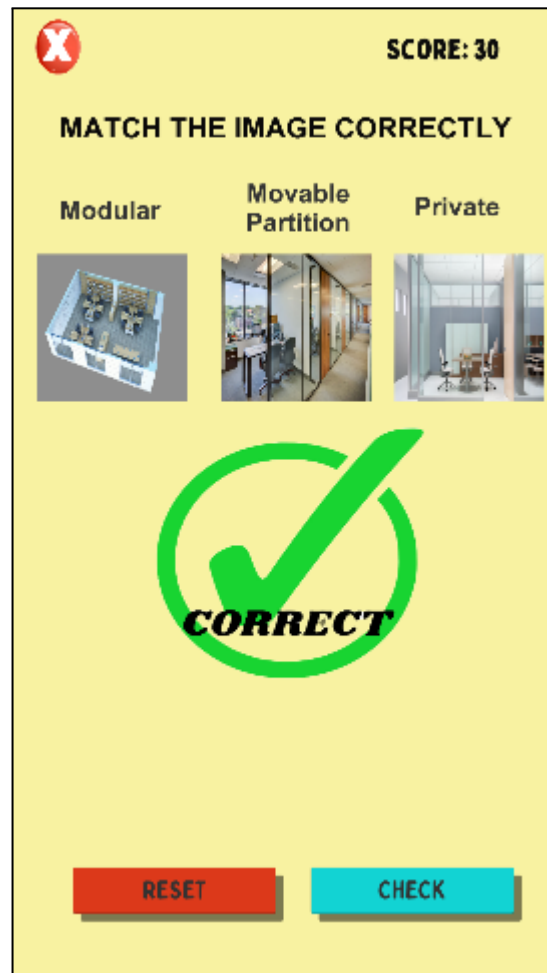


Figure 3.26 : Feedback Drag & Drop game Interface

3.2.19 Interface for test

This is the test's interface. There are two buttons here: one for the true/false game and one for the multiple choice game. This page also includes a setting button for adjusting the music volume. The test interface as shown in Figure 3.27.

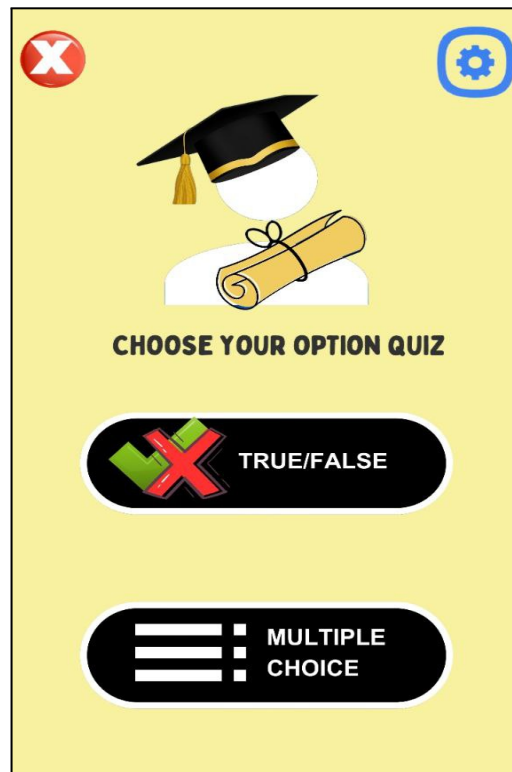


Figure 3.27 : Test setup Interface

3.2.20 Interface for test game

This is an example of a true/false test game interface. This interface contains ten questions that must be answered. This game also provides feedback based on whether the user answers the question correctly or incorrectly. The user must answer all of the questions. This game also keeps track of where each question is scored out of one. The interface for test game as shown in Figure 3.28.

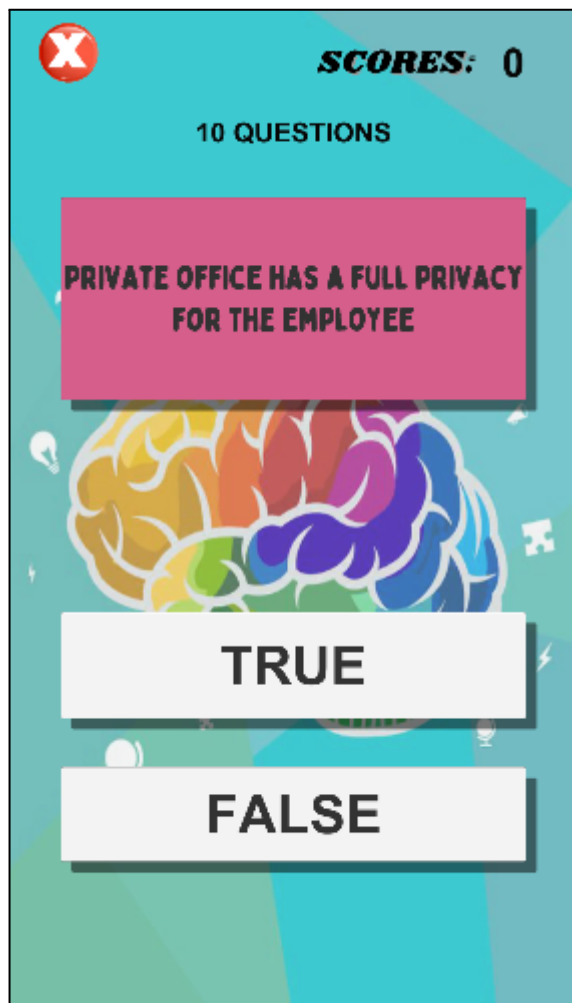


Figure 3.28 : Test game Interface

3.2.21 Interface for feedback test game(True/False)

This is a feedback interface. This page will be displayed once the user has completed all of the true/false questions. This page has two buttons: retry to answer the true/false question again and back to exit the game and return to the test page. The interface for feedback test as shown in Figure 3.29.



Figure 3.29 : Feedback Test game(True/false) Interface

3.2.22 Interface for setting

This is the setting interface. This interface has a button to set up music volume. In addition, the user can return to the test page by pressing the back button. The setting interface as shown in Figure 3.30.

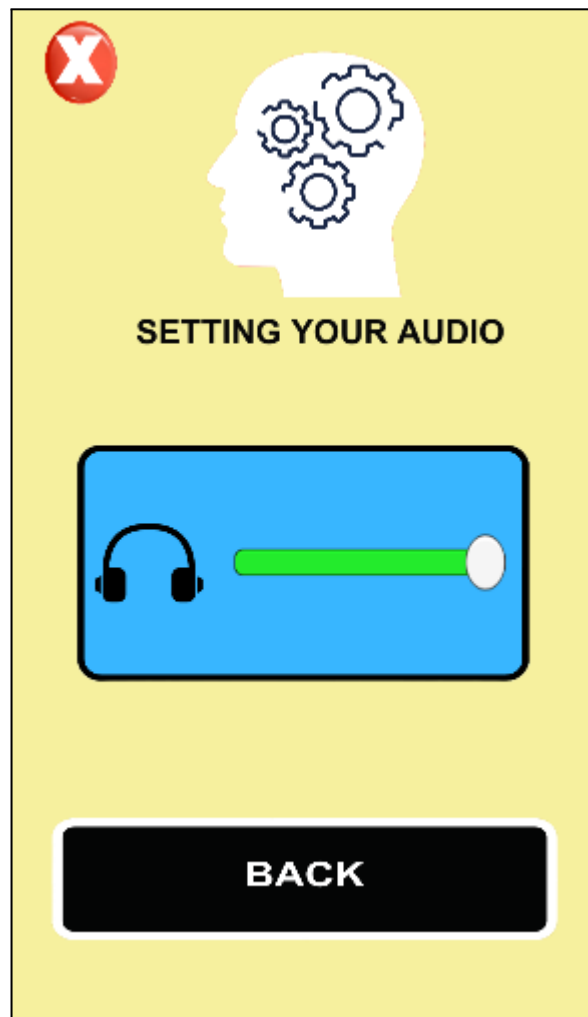


Figure 3.30 : Setting Interface

3.2.23 Interface for multiple choice game

This is an example of a multiple choice test game interface. This interface contains ten questions that must be answered. This game also provides feedback based on whether the user answers the question correctly or incorrectly. The user must answer all of the questions. This game also keeps track of where each question is scored out of one. The multiple choice game interface as shown in Figure 3.31.

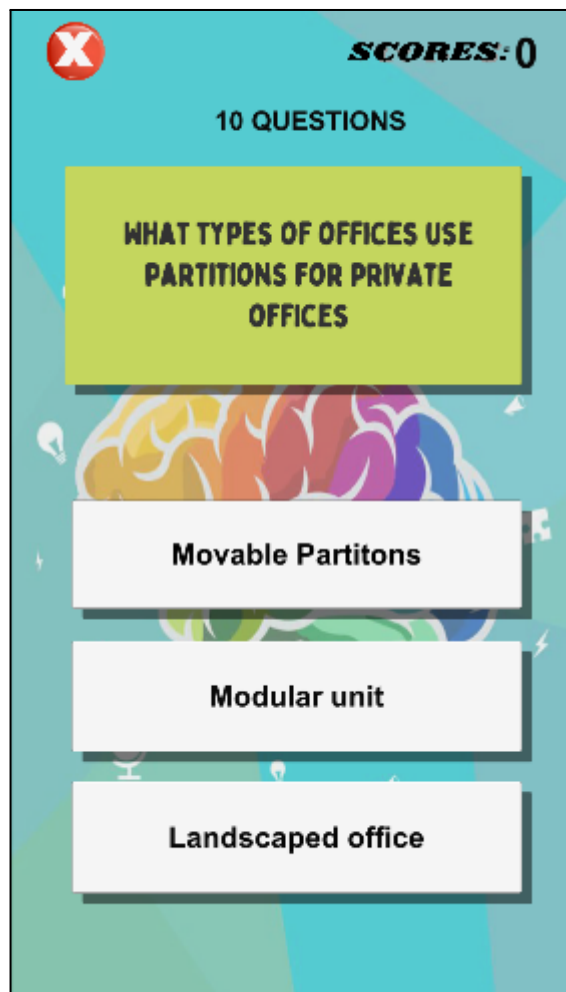


Figure 3.31 : Multiple Choice game Interface

3.2.24 Interface for feedback multiple choice game

This is a feedback interface. This page will be displayed once the user has completed all of the true/false questions. This page also shows the result of the correct answer question. This page has two buttons: retry to answer the true/false question again and back to exit the game and return to the test page. The feedback multiple choice game interface as shown in Figure 3.32.



Figure 3.32 : Feedback Multiple Choice game Interface

3.2.25 Interface for match page

This page has a start game button to enter the game page. And an exit button to go to the previous page. The match page game interface as shown in Figure 3.33.

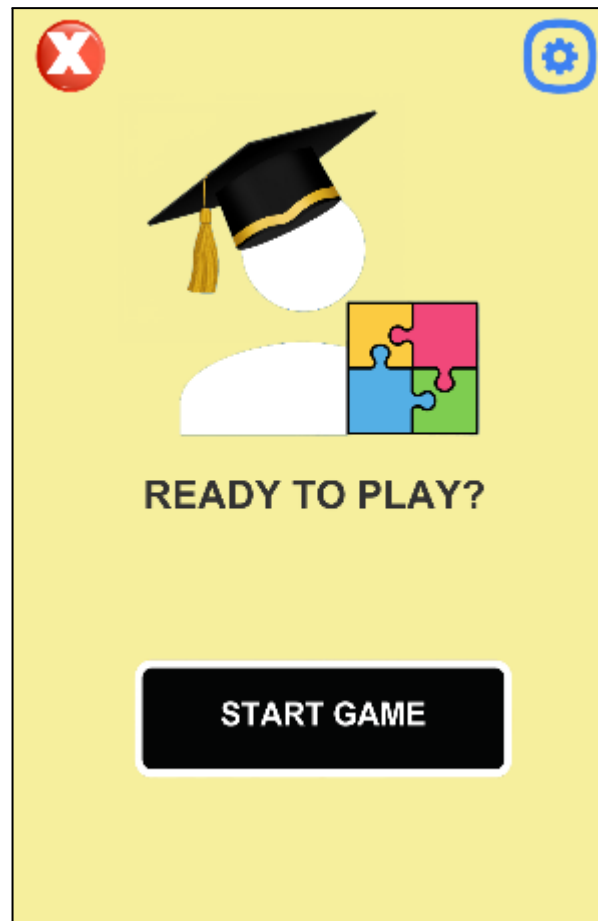


Figure 3.33 : Match page Interface

3.2.26 Interface for match game

This is the match game interface. On this page, users can choose each card that matches the terms and definitions. And in this game, a time limit of 2 minutes has been set to complete this game. The match game interface as shown in Figure 3.34.

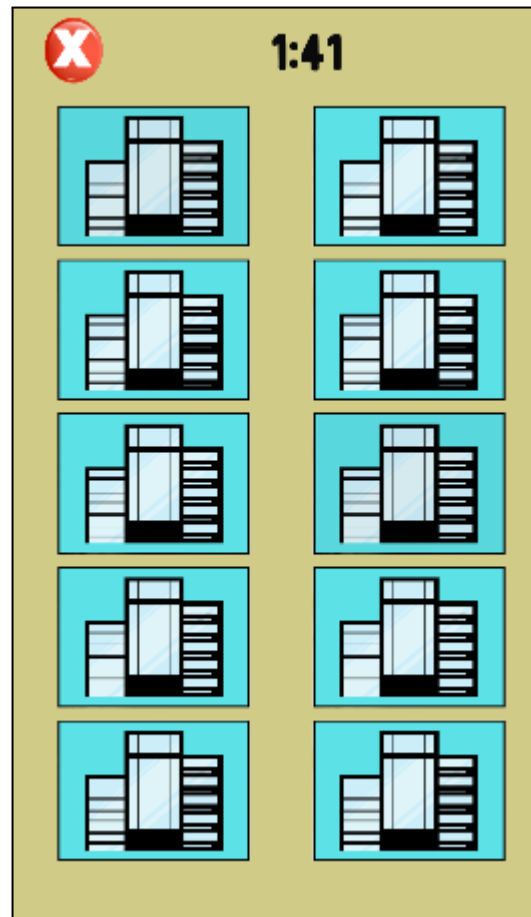


Figure 3.34 : Match game page Interface

3.2.27 Interface for feedback match game

This is feedback for the game match. This feedback will be displayed once the user has completed the match game. It will also show the user's time to complete the quiz game here. This page also includes a play again button for replaying the game and a back button for returning to the previous page. The feedback match game interface as shown in Figure 3.35.

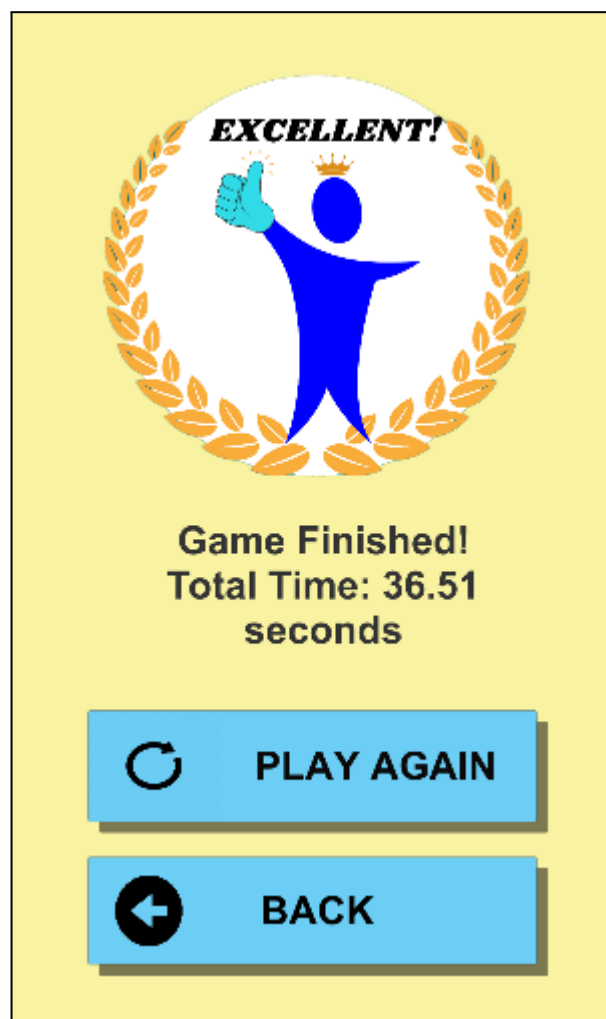


Figure 3.35 : Feedback Match page Interface

3.2.28 Open Office Layout 3D Models

For 3D models, there are two types of variations built using sketchup. Here is a 3D model for the open office. The open office model variation 1 and 2 as shown in Figure 3.36 and Figure 3.37.

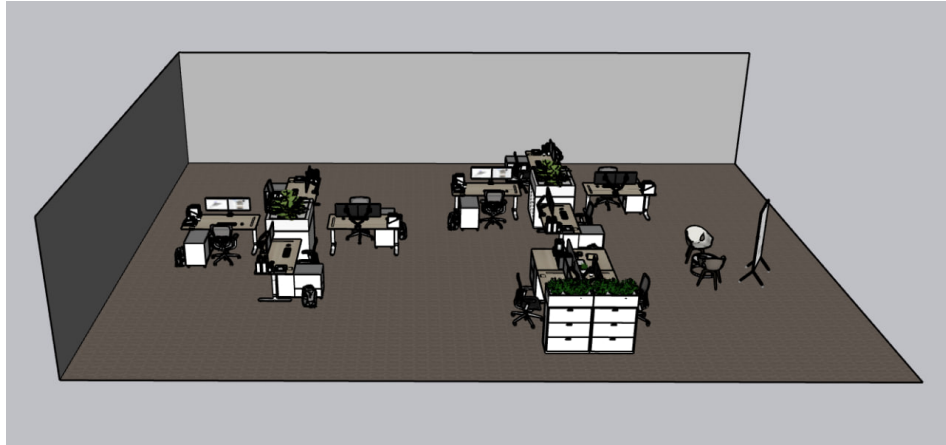


Figure 3.36 : Open Office model variation 1

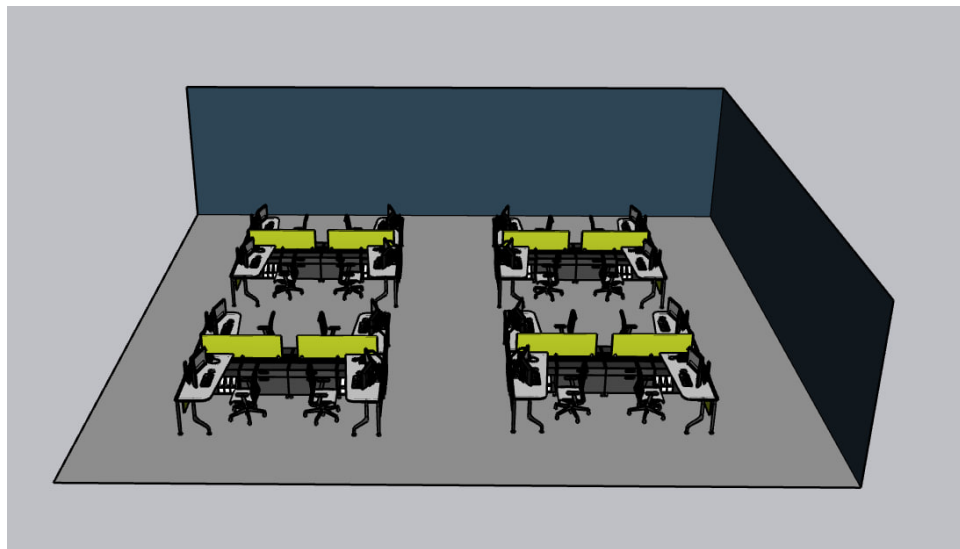


Figure 3.37 : Open Office model variation 2

3.2.29 Private Office Layout 3D Models

For 3D models, there are two types of variations built using sketchup. Here is a 3D model for the private office. The private office model variation 1 and 2 as shown in Figure 3.38 and Figure 3.39.

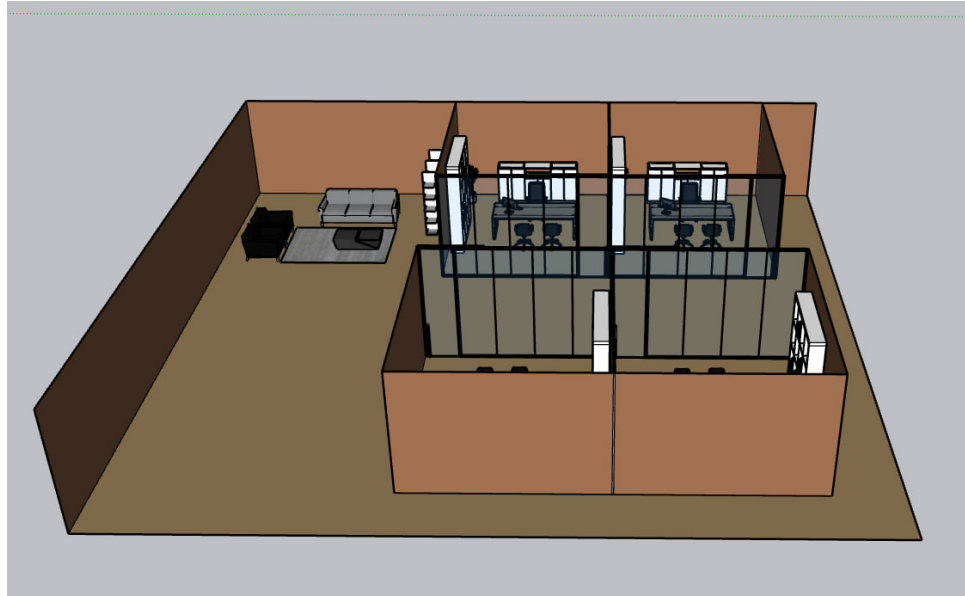


Figure 3.38 :Private Office model variation 1

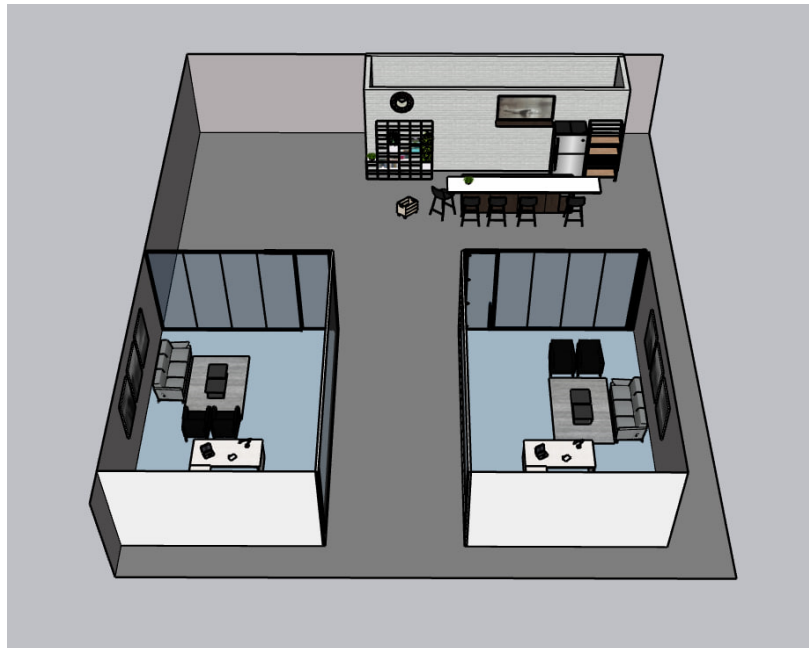


Figure 3.39 : Private office model variation 2

3.2.30 Modular Units Office Types 3D Models

For 3D models, there are two types of variations built using sketchup. Here is a 3D model for the modular unit. The modular unit model variation 1 and 2 as shown in Figure 3.40 and Figure 3.41.

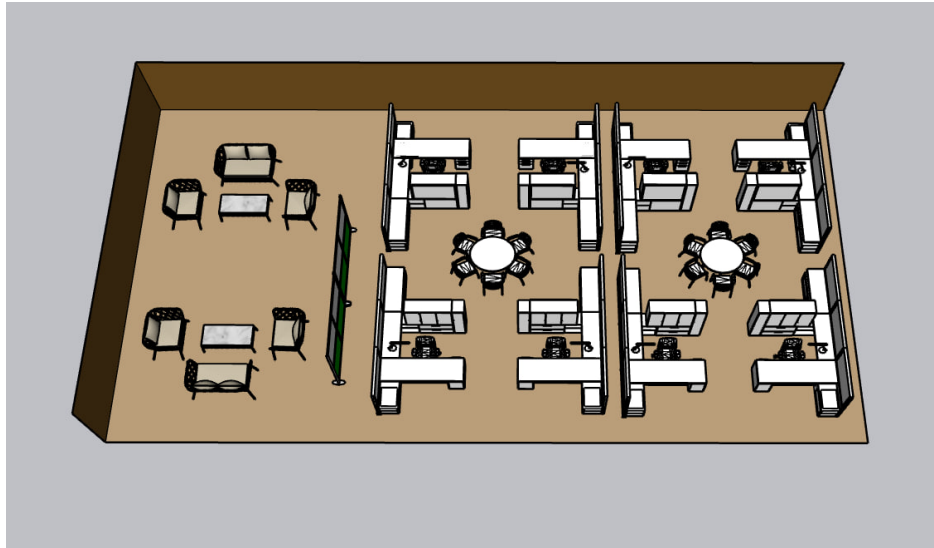


Figure 3.40 : Modular unit model variation 1



Figure 3.41 : Modular unit model variation 2

3.2.31 Landscape Office Types 3D Models

For 3D models, there are two types of variations built using sketchup. Here is a 3D model for the landscape office. The landscape office model variation 1 and 2 as shown in Figure 3.42 and Figure 3.43.

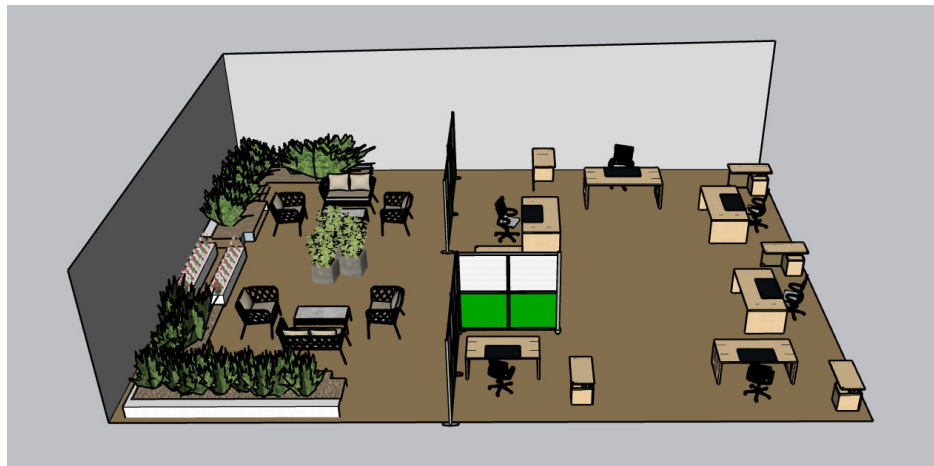


Figure 3.42 : Landscape office model variation 1

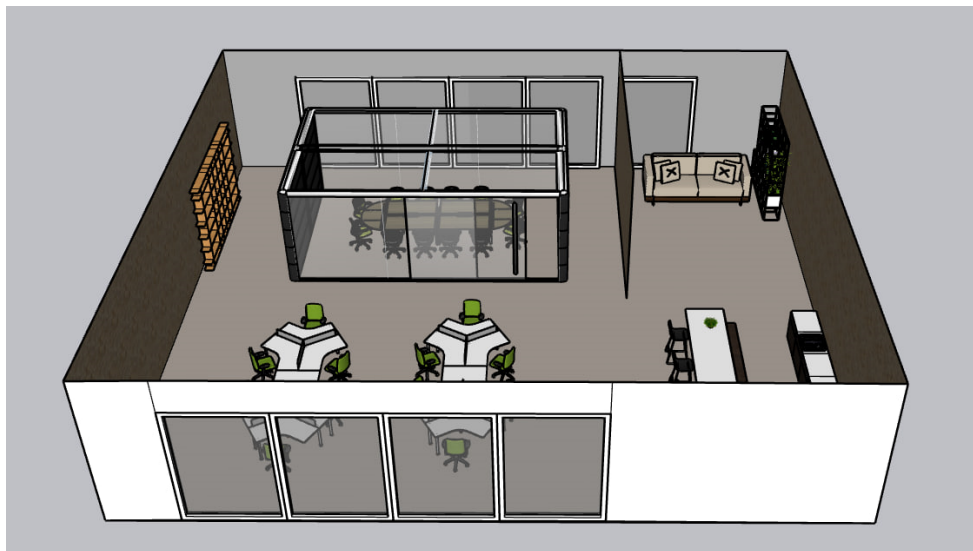


Figure 3.43 : Landscape office model variation 2

3.2.32 Movable Unit Office Types 3D Models

For 3D models, there are two types of variations built using sketchup. Here is a 3D model for the movable unit. The movable unit model variation 1 and 2 as shown in Figure 3.44 and Figure 3.45.

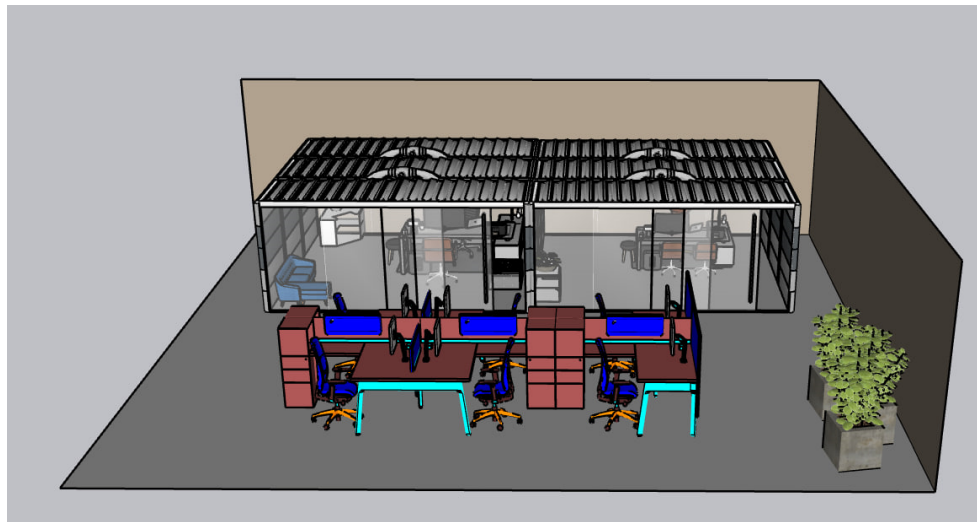


Figure 3.44 : Movable partitions model variation 1

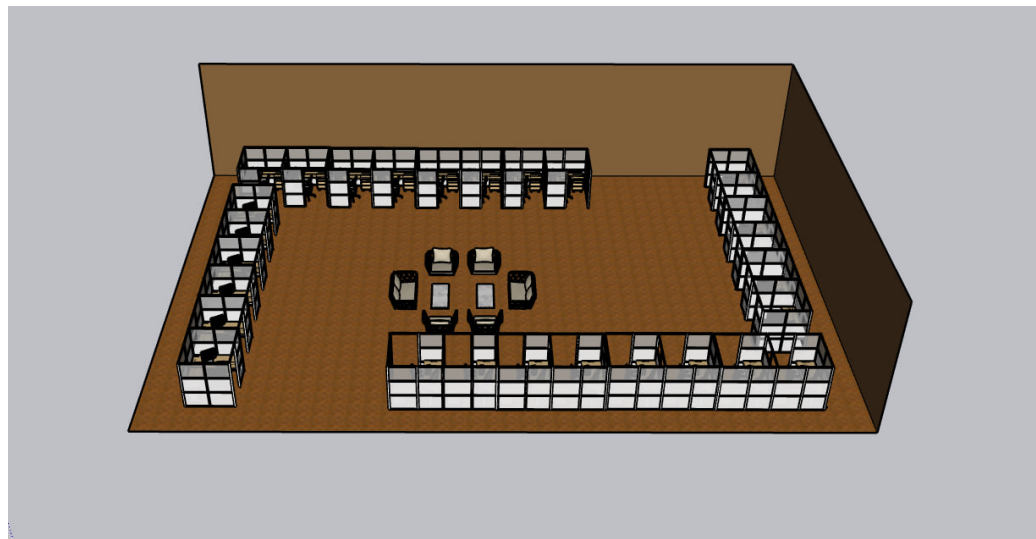


Figure 3.45 : Movable partitions model variation 2

4.0 TEST DESCRIPTION AND RESULTS

4.1.1 Unit Testing

The Unit Testing Plan is a process that focuses solely on the client. In this process, each component is tested individually and reviewed by the client. These components should be described thoroughly, which helps the client assess their suitability based on the project objectives, as outlined in sources like Table 4.1.

Table 4.1 : Unit Testing Plan (UTP)

UNIT TESTING PLAN (UTP)						
NO	Test Case Name	Test Procedure	Pre-condition	Expected Results	Tester	Result (Pass/Fail)
1.	3D Model displayed in Augmented Reality	User need to press button AR before going to AR real life.	User will stay at page image target first before going to Augmented Reality Life.	Ground plane will see for detect to display 3D model real life.	Mrs. Nur Nadia Saheera binti Ros Laili	Pass
2.	Button audio for information	User required to press button audio to hear the sound.	User need to scan the AR image target first before press the button information to hear voice.	The information will display and audio will play until end.	Mrs. Nur Nadia Saheera binti Ros Laili	Pass
3.	Audio setting music	User also can turn on or turn off the music in settings	User will hear the music and adjust the sound	The audio will adjust at setting.	Mrs. Nur Nadia Saheera binti Ros Laili	Pass

4.	Drag and drop function in quiz	User need to start the game first before playing.	User need to drag and drop the picture into the box and press button check to see the feedback. If the answer is incorrect the picture can't drag.	All the picture can drag and drop also will see the feedback.	Mrs. Nur Nadia Saheera binti Ros Laili	Pass
5.	Scanning AR using image target	User need select the variation of office then scan the flash card.	User also can zoom in, zoom out also drag the image 3D to see more interaction	All the image target will display the 3D image and it can zoom in, zoom out also drag.	Mrs. Nur Nadia Saheera binti Ros Laili	Pass
6.	Exit button	User need to press button exit to out from application.	The pop-up message will display to ask the user.	The app will automatically terminate from application if user press yes	Mrs. Nur Nadia Saheera binti Ros Laili	Pass

Based on this test, every function tested in this application works in good condition. Scanning AR and buttons can display the results the customer expects. The client's wishes for this project can be fulfilled in this application.

4.1.2 Integration Testing

Unit Integration Testing is a phase where programmers collaboratively assess each design element. Each component created should align with the project's objectives, ensuring comprehensive testing by programmers to confirm the functionality of the entire system in Table 4.2.

Table 4.2 : Integration Testing Plan (ITP)

INTEGRATION TESTING PLAN (ITP)						
NO	Test Case Name	Test Procedure	Pre-condition	Expected Results	Tester	Result (Pass/Fail)
1.	Starting page to main menu using button “Let’s Start”.	User is required press the button “Let’s Start” before going to another page.	User need to press the next page.	Automatic to next page.	NURUL AIN SHUHARNI BINTI MOHD AINI	Pass
2.	Button “Type of Office” to next page that has two various which is “Open Office” and “Private Office”.	User is required to choose button “Open Office” or “Private Office” before going AR mood.	User need to make sure the image target that choose are right.	Successful going into AR mood which is image target and AR real life.	IMAN SOFEA BINTI IKMAL HISHAM	Pass
3.	Button “Type of Office Layout” to next page that has three various which is “Movable Unit”, “Landscape Office” and “Modular Unit”.	User is required to choose button “Movable Unit”, “Landscape Office” or “Modular Unit” before going AR mood.	User need to make sure the image target that choose are right.	Successful going into AR mood which is image target and AR real life.	NURUL AIN SHUHARNI BINTI MOHD AINI	Pass

4.	Button “Quiz” to next page that has three various which is “Drag & Drop 3D Icon”, “Test” and “Match”.	User is required to choose button “Drag & Drop 3D Icon”, “Test” or “Match” before into interactive quiz and every quiz it has a different questions in 2D design.	User need to see the feedback after finish each question or user also can hear music special for quiz only.	Successful and finish answer will see the feedback and score for each question.	NUR AINA SYAHIRAH BINTI KHAIRIZAM	Pass
5.	Button “Home” for each page	Click “Home” button	Direct to Main menu page.	Direct to Main Menu page when user press button “Home”.	NURUL AIN SHUHARNI BINTI MOHD AINI	Pass
6.	Button “Exit” for Main Menu page	Message box “Do You Want To Exit This Application?”	User need to choose “Cancel” or “Exit” to terminate from this application.	Terminate form application automatic	IMAN SOFEA BINTI IKMAL HISHAM	Pass
7.	Button “Info” to display information for each office	Click “i” to read or view information.	User can see the button then its will display in pop-up menu.	Display all information office.	IMAN SOFEA BINTI IKMAL HISHAM	Pass

Based on this test, every button in the application interface works fine without any problems. Each button tested will display the desired expected result.

4.1.3 User Acceptance Testing

User Acceptance Testing serves as a tailored process designed for the client to rigorously assess the application's performance and functionality. This comprehensive testing phase enables the client to determine whether the application meets their requirements and operates as intended. The testing process includes a designated space where the client can provide valuable feedback, comments, and suggestions for potential enhancements. This mechanism fosters open communication and collaboration, allowing the client to effectively contribute insights that can lead to refinements and improvements. The feedback gathered during this testing phase is instrumental in aligning the application with the client's expectations and refining it according to the criteria outlined, akin to the illustrative table provided for reference in table 4.3, 4.4, 4.5, 4.6, 4.7, 4.8, 4.9, 4.10, 4.11, and 4.12.

Test Case: Exit

Table 4.3 : Test Case - Exit

Test Case ID	1		
Description	This test case is to verify: The ability to exit from application		
Use Case ID			
Pre-condition		Priority	High
Test Environment		Required Configuration	i. Need to press exit to out from application ii. Press cancel to stay
Comments / Results / Error Logs: None			
Tester Name: Mrs. Nur Nadia Saheera binti Ros Laili			

Table 4.4 : Test Script Steps / Procedure (Test Case - Exit)

Test Script Steps / Procedure					
No	Description / Case Scenario	Steps / Procedure	Expected Results	Actual Results	Pass / Fail
i.	Main menu	i. User stay in this page after open the	i. User will press the button exit on navigation to terminate from application	i. The button will pop-up and ask “Do you want to exit this application?” then depends on user answer.	Pass
ii.	Exit Button	i. When user press the button automaticall y the pop-up message will display	i. Automatically out from the application if user select “Exit”	i. The application will out and off .	Pass

Test Case: Type Of Office Page

Table 4.5 : Test Case - Type Of Office Page

Test Case ID	2		
Description	This test case is to verify: i. The ability to open type of office page.		
Use Case ID			
Pre-condition		Priority	High
Test Environment		Required Configuration	i. Need to press button type of office in main menu page ii. Select the one of the 2 various 3D design in “Open Office” and “Private Office” Choose image target or AR real life iii. Press button “I” to see and hear the sound of information.
Comments / Results / Error Logs: Good			
Tester Name: Mrs. Nur Nadia Saheera binti Ros Laili			

Table 4.6 : Test Script / Procedure (Test Case - Type Of Office Page)

Test Script Steps / Procedure					
No	Description / Case Scenario	Steps / Procedure	Expected Results	Actual Results	Pass / Fail
i.	Main menu to Type Of Office	i. User stay in this page, then press button “Type Of Office”. ii. Choose between “Open Office” or “Private Office”. iii. Choose the variation of 3D model and then scan the image target. iv. User also can select “i” button or “AR real life” button.	i. User will scan the image target then 3D model will display. ii. They hear the sound also read the information. iii. Then press button AR real life to see ground place to stay in 3D model and view it in real life.	i. All the variation in function and 3D model display. ii. The ground plane show the real life. iii. The sound and information display on image target	Pass

Test Case: Type Of Office Layout

Table 4.7 : Test Case - Type Of Office Layout

Test Case ID	3		
Description	This test case is to verify: The ability to open type of office layout page.		
Use Case ID			
Pre-condition		Priority	High
Test Environment		Required Configuration	i. Need to press button type of office layout in main menu page ii. Select the one of the 2 various 3D design in “Movable Unit” and “Landscape Office” also “Modular Unit” iii. Choose image target or AR real life iv. Press button “I” to see and hear the sound of information.
Comments / Results / Error Logs: Good			
Tester Name: Mrs. Nur Nadia Saheera binti Ros Laili			

Table 4.8 : Test Script / Procedure (Test Case - Type Of Office Layout)

Test Script Steps / Procedure					
No	Description / Case Scenario	Steps / Procedure	Expected Results	Actual Results	Pass / Fail
i.	Main menu to Type Of Office Layout	i. User stay in this page, then press button “Type Of Office Layout”. ii. Choose between “Movable Unit”, “Landscape Office” or “Modular Unit” iii. Choose the variation of 3D model and then scan the image target. iv. User also can select “i” button or “AR real life” button.	i. User will scan the image target then 3D model will display. ii. They hear the sound also read the information. iii. Then press button AR real life to see ground place to stay in 3D model and view it in real life.	i. All the variation in function and 3D model display. ii. The ground plane show the real life. iii. The sound and information display on image target	Pass

Test Case: Quiz

Table 4.9 : Test Case - Quiz

Test Case ID	4		
Description	This test case is to verify: The ability to open quiz page.		
Use Case ID			
Pre-condition	-	Priority	High
Test Environment		Required Configuration	i. Need to press button quiz in main menu page ii. Select the one of the quiz from 3 type quiz. iii. Answer it and see the score
Comments / Results / Error Logs: Very attractive and Good			
Tester Name: Mrs. Nur Nadia Saheera binti Ros Laili			

Table 4.10 : Test Script Steps / Procedure (Test Case - Quiz)

Test Script Steps / Procedure					
No	Description / Case Scenario	Steps / Procedure	Expected Results	Actual Results	Pass / Fail
i.	Main menu to Quiz	i. User stay in this page, then press button "quiz". ii. Choose the quiz between "Drag and Drop 3D Icon", "Test" or "Match" iii. Choose the variation of quiz iv. Answer it in the right answer.	i. User will play the quiz and see question. ii. They hear the sound special for quiz. iii. They will see the score and feedback after finish answer the question. iv. They also can out from quiz if they don't want finish just click button "X".	i. All the type quiz is function. ii. The sound very clear and nice also can adjust. iii. They also can see the feedback and score. iv. They also can out from quiz without finish the answer.	Pass

Test Case: Home

Table 4.11 : Test Case - Home

Test Case ID	5		
Description	This test case is to verify: The ability to go main menu page		
Use Case ID			
Pre-condition		Priority	High
Test Environment		Required Configuration	i. Need to press home to go main menu page from another page
Comments / Results / Error Logs: None			
Tester Name: Mrs. Nur Nadia Saheera binti Ros Laili			

Table 4.12 : Test Script Steps / Procedure (Test Case - Home)

Test Script Steps / Procedure					
No	Description / Case Scenario	Steps / Procedure	Expected Results	Actual Results	Pass / Fail
i.	Type Of Office to main menu page	i. User from another page and press this button at navigation bar will automatically go main menu	i. The page will change to main menu	i. The page change after user press button home	Pass

Based on this test, every function tested in this application works in good condition. The client's wishes for this project can be fulfilled in this application. All the interface can display the results the customer expects. There are no errors in this application.

5.0 MAJOR FINDINGS AND DISCUSSION

5.1 The Advantages of the Project

- i. By scanning the camera in a flat place and using a flashcard, this AR project can see the type of office layout in 3D design.
- ii. In this project, students can put their knowledge to the test by taking various types of quizzes.
- iii. Students can use the AR design office application to learn about different types of office design layouts that exist in each company.
- iv. The user can interact with 3D objects, such as zoom in and zoom out, and sit in the office in reality by using this AR application.

5.2 The Disadvantages of the Project

- i. Because this project is built in Unity for Android, it cannot be used by iOS users. If this project is to be built in the form of iOS, it must use an iOS device, such as a macbook, and a licence must be purchased.
- ii. A scan card is used in this Augmented Reality project. If the card is misplaced, it cannot be replaced.
- iii. When using this application, if the user has an older Android version, the smartphone will lag.

6.0 RECOMMENDATION AND CONCLUSION

6.1 Recommendation

AR Office Design is an application developed to help users better understand the office. One of the interesting things about the AR Office Design application is the use of augmented reality, which allows interaction between the system and the user. The interaction between the system and the user is one of the important things that adds interest and attraction to the developed application. The AR Office Design application has several buttons that work to change from one page to another, and there are buttons that can display information. The use of the button is one of the interactions between the application and the user. In addition, in the augmented reality section, users can rotate, enlarge, and reduce the size of the model displayed in augmented reality. In addition, the use of audio to read information is very useful for users with vision problems. They can hear information clearly without any problem. AR Office Design also provides some interesting quizzes in various forms, such as 'Drag and Drop', 'Test', and 'Match'. In order to strengthen the user's mastery of the office, users can answer the provided quiz.

However, there are some disadvantages to this application. iOS users cannot use this application because it is only suitable for Android. For improvement, this project must be built on a Macbook compatible with the iOS operating system. For card users for the target image, the card needs to be well taken care of because if the card is lost, the user cannot use AR for the target image. However, users can still use AR detection by ground plane because it does not require any image or card to see AR. For some Android users, this app is quite heavy and may experience lag. Sometimes the lag will be severe. To overcome this problem, this project may be able to minimize background processes while AR is running to free up resources.

6.2 Conclusion

In conclusion, based on the AR Office Design project created, there are numerous advantages that can assist students in identifying and differentiating the types of offices and office layouts. By including AR 3D models, students will be able to see the office layout physically without using their eyes. In every layout and type of office available, the project uses AR 3D models. The AR method is divided into two types: AR using a scan from the card and AR design office, which will appear in 3D on the card. In addition, scan the AR camera on a flat surface. Then, by adding a quiz section to this application, users can test their knowledge of office design, reinforce their knowledge, and measure their level of understanding. These interactive features enhance learning by encouraging users to actively engage with the material.

The main advantage of the AR OFFICE DESIGN application lies in its ability to stimulate the user's imagination and improve their understanding of the office layout. Traditional methods, such as video or static images, may fail to provide a comprehensive understanding of the design. However, through Augmented Reality, users can gain a more detailed and realistic perspective, leading to enhanced knowledge retention and a deeper level of understanding.

Overall, the AR OFFICE DESIGN application offers a user-friendly and interactive platform for students to explore and learn about office layouts. By utilising augmented reality technology, it brings visual clarity, engagement, and a practical evaluation component, ultimately enriching the educational experience and facilitating a better understanding of design concepts.

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