

Implementation of Augmented Reality with Markerless Location Method: Building and Space Recognition Application of UTY Campus 1

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ABSTRACT: Yogyakarta University of Technology is one of the private universities in Yogyakarta. The university, which is located in the Special Region of Yogyakarta (DIY), has 27 types of study programs, one of which is Informatics Engineering located on campus 1 which is located at Jalan Siliwangi (North Ringroad), Jombor, Sleman, Yogyakarta. This year the learning process carried out by students and lecturers does not use online methods but uses face-to-face methods as a whole. For new students this certainly makes it difficult for them if they want to get information related to buildings or rooms in the UTY campus 1 area, but not contained in visual information or maps. Buildings & spaces located at UTY campus 1 are used for the teaching and learning process of students every day. Based on the description of these problems, this research was conducted with the aim of building a 3D Building & Room Information Introduction application using the Markerless Location - Based (AR) method in making applications using the C# programming language and Unity 3D tools to help new students find out information related to buildings & rooms using Android-based smartphones.

KEYWORDS: Augmented Reality, Markerless Location Based, Application, Android

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I. INTRODUCTION

The visualization of reality view produced by amalgamating the virtual objects with the real scenes is an Augmented Reality (AR) technology[1]. To use AR in the educational environment, four resources are necessary[2]. An electronic device with a camera[3]. Software capable of integrating virtual content into the real world[4]. A “trigger” that can run AR content, which is often a QR code but can also be an image or object[5]. A server to store the virtual information you want to project in the real world[6].

Augmented reality technology is applied in this system to help students know the layout of the campus. System development using location-based methods without markers. POI markers will be placed in every location on campus. The existence of POI markers can help new students get information related to buildings and rooms in the UTY campus 1 area through the perspective of their respective smartphone cameras.

The purpose of this research is the application of Augmented Reality Technology using the markerless location-based method, in the application of the introduction of UTY Campus 1 Building & Room information to make it more interesting. System created using Unity3d and Vuforia SDK. For the development of the environment the Unity 3D Engine as well as freely available models and plugins for Unity are leveraged[7]. The programming languages used are PHP and C#. Data storage using MySQL. Later the application can be used on android.

II. RESEARCH METHOD

The system design is made using AR Core which implements Augmented Reality technology. With this, the system can display a 3D model on an android smartphone device using the location point.

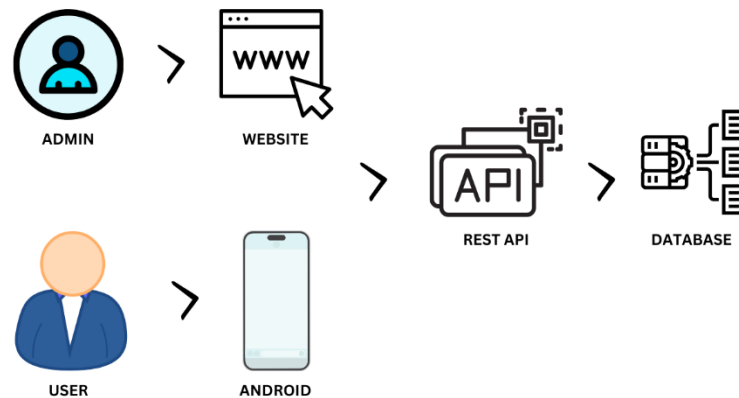


Fig. 1. Architecture Diagram

Based on the picture, it can be explained the steps taken by admin in processing databases and websites to present data in the form of information about the University and related applications. While users use the building & space introduction application within the scope of UTY campus 1 by utilizing Augmented Reality technology with location - based markerless method based on android. Users need a smartphone that has multiple sensors including GPS, Accelerometer, Gyroscope, and supports ARCore services. In addition to sensors, an internet connection is also required when running the application, then the system will perform the rendering process or environmental scanning. After successfully rendering, the system will display 3D objects related to the name of the building or room along with the information.

2.1 Data Collection Procedure

The way researchers get data is by direct observation to UTY Campus 1. Observation is a data collection technique by going directly to the field where the case study will be taken. The data taken is in the form of building names, room names, and also the longitude and latitude of each location point that will appear 3D objects.

2.2 System Design Logic

The system design in this application uses a model (UML) that describes an object-oriented design analysis process. UML diagrams are used in the analysis, construction, and maintenance of software systems[8]. UML diagrams are formal representations of various software components and their stockholders; therefore, they play an important role in creating software[9].

2.2.1 User Flowchart

Reversible flowcharts are intended as a model of reversible programming languages in much the same way that classic flowcharts are a model of many widely used programming languages[10].

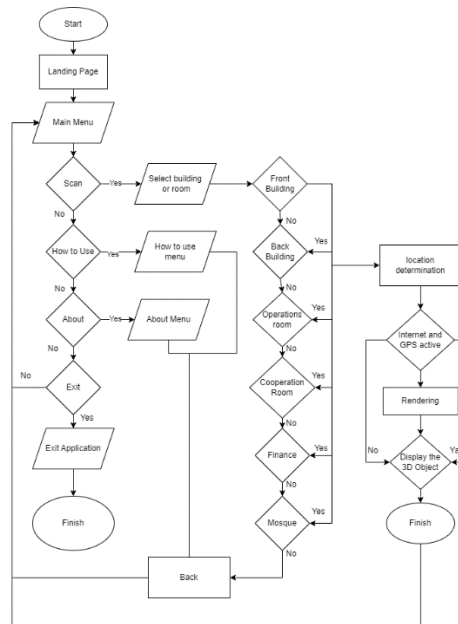


Fig. 2. User Flowchart

When starting the application, the first display that will appear is the splashscreen on the main page of the application. Then when the user presses the Start button, it will be directed to the second page, which is a menu containing the scan menu, usage, about and exit button. If the user selects the Scan menu, it will go to the building or room select page and will start scanning the environment by allowing the use of the camera feature and GPS feature, if the user does not activate the feature then it will not be able to see the 3D object display.

2.2.2 Admin Flowchart

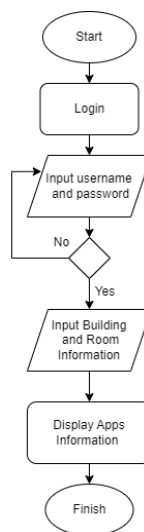


Fig. 3. Admin Flowchart

Based on the picture, it can be explained that the first thing the admin does is enter or log into the website by entering a username and password. If the admin enters the wrong username and password, it is automatically still on the login page and there will be a sentence that the username or password is wrong. And if the admin successfully enters the username and password, it will enter the next page to add or change building or room information data. After that the admin will save the data and display information on the application.

2.2.3 Use Case Diagram

A use case diagram depicts the interaction between the user and the system. The image shows that the user is running the application.

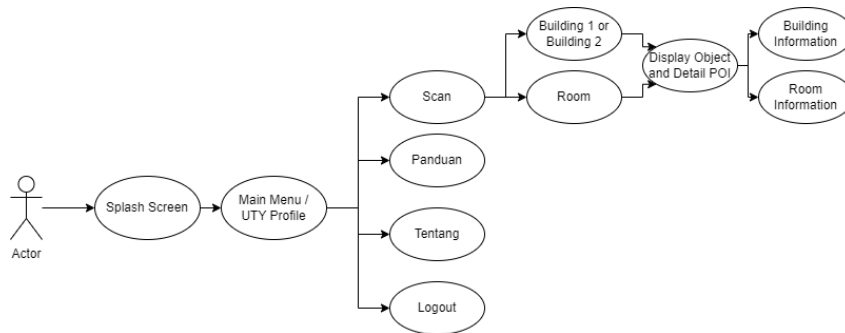


Fig. 4. Use Case Diagram

A. Start Menu

On the main menu, the user will be given a button in the form of a Start button that will go to a page that displays the Yogyakarta University of Technology profile. And if the user presses the Next button, it will automatically be directed to the next page which contains the scan menu, usage guide menu, about application menu, and exit application menu.

B. Scan Menu

This menu will go to the main part of the application, which is through a camera directed to the location point that has been determined by the application designer. By using the rear camera and location enabled on the user's smartphone, the 3D object will automatically appear.

C. Help Menu

In this menu there are steps or how users use the Building & Space Recognition Application at UTY Campus 1.

D. About Menu

This menu contains general information related to the application and the designer of the Building & Space Recognition Application at UTY Campus 1.

E. Exit Menu

In this menu, if the user presses it, it will complete the application process or stop processing the application.

2.2.4 Activity Diagram Scan Camera Menu

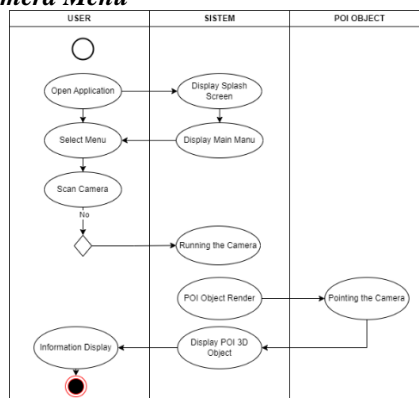


Fig. 5. Activity Diagram Scan Camera Menu

Based on Figure 4.4 Activity Diagram of the scan menu shows that the user is running the application. The explanation in Activity Diagram 4.4 above is as follows:

- A. At this stage begins with the user entering the application and there is a splash screen display which is the first display that will appear.
- B. After the splash screen appears, the user presses the 'start' button and the main menu display appears which displays information related to the Yogyakarta University of Technology. Then the user presses the 'next' button, the user will be directed to the scan menu and the user selects the list menu in the form of buildings & rooms that will be scanned and obtained information.
- C. The next step, the user starts scanning the location that has been determined.
- D. The application will display 3D objects regarding building & room name information.
- E. Done

2.2.5 Activity Diagram About Menu

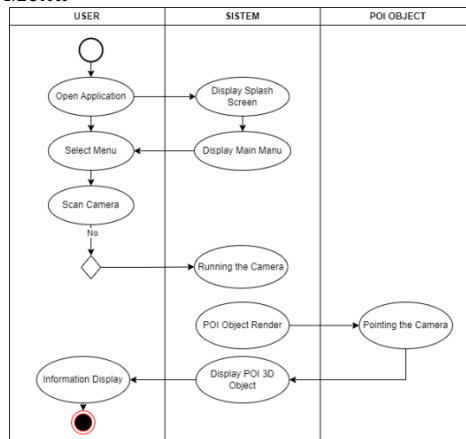


Fig. 6. Activity Diagram About Menu

Based on the Activity Diagram of the about menu shows that the user is running the application. The explanation in the Activity Diagram picture above is as follows:

- A. The user is on the main menu display.
- B. Then when the user selects the 'about' button, the Building & Space introduction application will display information related to the application and application designer.
- C. Done

2.2.6 Activity Diagram Application Guide Menu

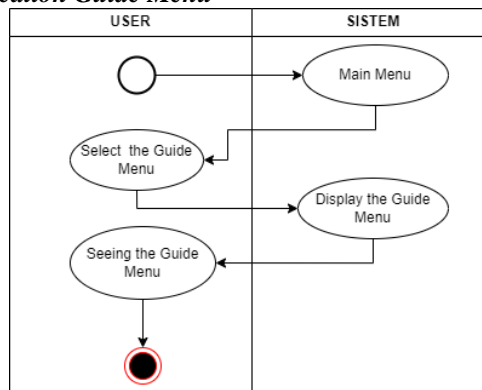


Fig. 7. Activity Diagram Application Guide Menu

Based on the Activity Diagram of the guide menu, it shows that the user runs the application. The explanation in the Activity Diagram picture above is as follows:

- A. The user is on the main menu display.

- B. Then when the user selects the 'guide' button, the application will automatically direct the user to the alloy display which contains information about the steps of using the application.
- C. Done.

2.2.7 Activity Diagram Exit Menu

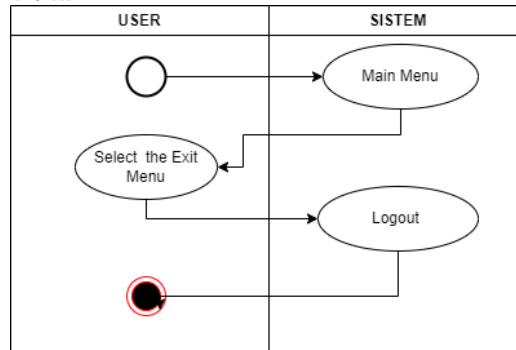


Fig. 8. Activity Diagram Exit Menu

Based on the Activity Diagram image of the exit menu shows that the user is running the application. The explanation in the Activity diagram picture above is as follows:

- A. When the user will start running the application on the main menu, there will be an 'exit' menu button.
- B. If the user presses the 'exit' button, the application will automatically exit which means the user has ended the use of the application.
- C. Done

2.2.8 Sequence Diagram Scan Camera Menu

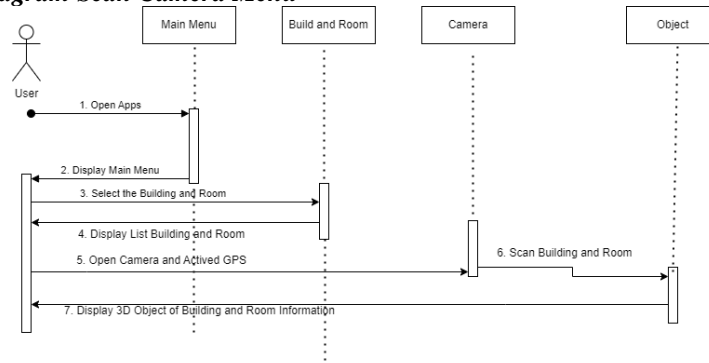


Fig. 9. Sequence Diagram Scan Camera Menu

Based on the picture, it can be explained that when the user opens and selects the scan menu which contains a list of Buildings & Rooms. Then the user will select the list, and if they have chosen, the user will be directed to the camera and activate the GPS to render the building & room. If the user has activated the camera and GPS and is already at the specified point, then the user can scan and see 3D objects related to building & room name information on campus 1 UTY.

2.2.9 Sequence Diagram About Menu

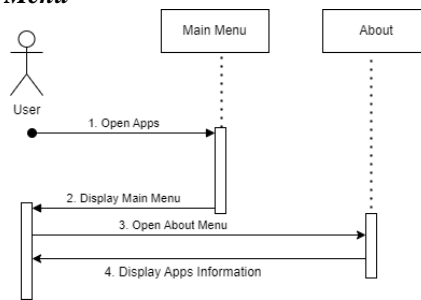


Fig. 10. Sequence Diagram About Menu

Based on this picture, it can be explained that, when the user opens the application and the next page appears, namely the main menu. Then when the user selects the About menu, the user will automatically be directed to the contents page of the about menu. The about menu contains application information that contains the designer, and also related information from the application.

2.2.10 Sequence Diagram Guide Menu

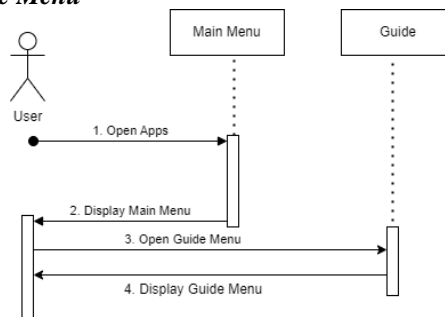


Fig. 11. Sequence Diagram Guide Menu

Based on the picture it can be explained that, when the user opens the application and the next page appears, namely the main menu. Then the user selects the Guide menu, then the user will automatically be directed to the contents page of the Guide menu. The guide menu contains information about the steps in using the application.

2.2.11 Sequence Diagram Exit Menu

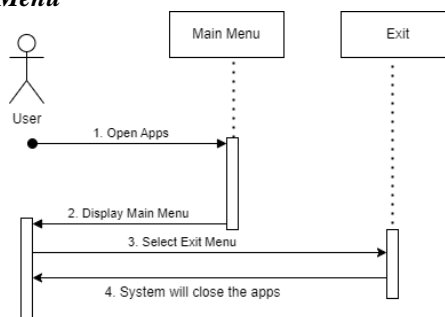


Fig. 12, Sequence Diagram Exit Menu

Based on the picture it can be explained that, when the user opens the application and the next page appears, namely the main menu. Then when the user selects the Exit button, the application will automatically stop the work process. Which means the user is no longer operating it.

2.2.12 Class Diagram

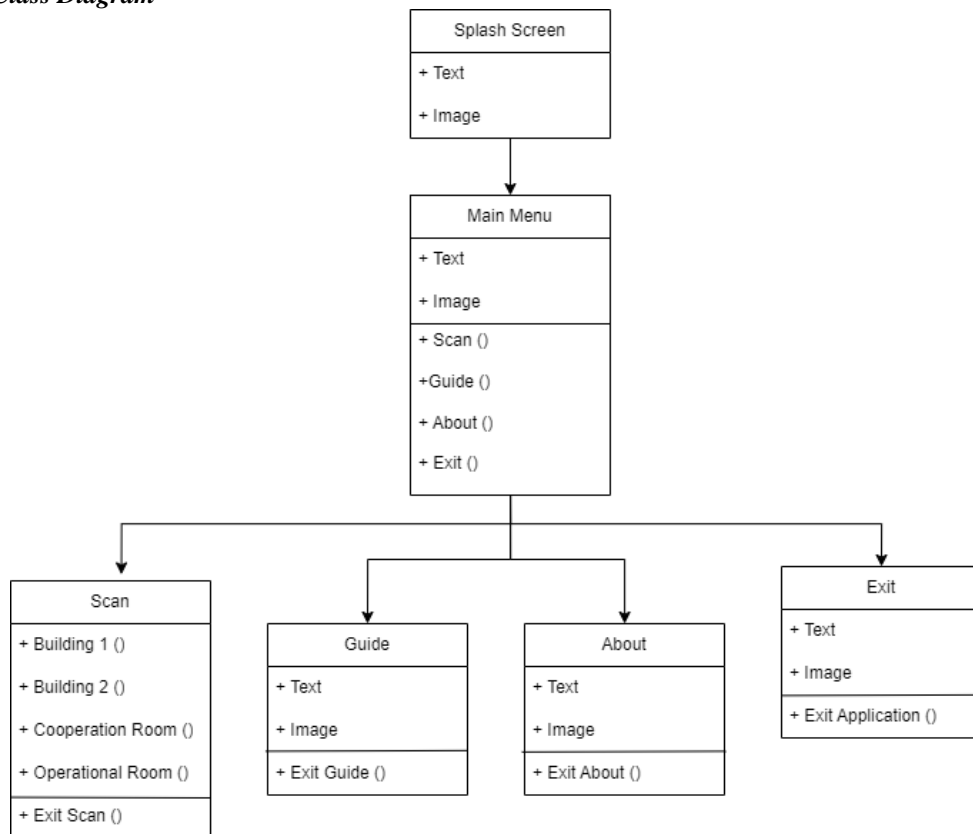


Fig. 13. Class Diagram

Based on this picture, it can be explained that in the design of the application and its appearance using text and images. Where in the class diagram in this application contains several class names such as splash screen, main menu, scan, guide, about, and application. With attributes as in the picture, each class has an output process or output generated from the class name.

2.3 Markerless System Development

Markerless motion capturing has the potential to provide a low-cost and accessible alternative to traditional marker-based systems for real-world biomechanical assessment[11]. Although commercial multi-camera markerless systems have shown acceptable accuracy in determining 3D joint kinematics[12]. The system works by capturing objects and then using GPS tracking technology.

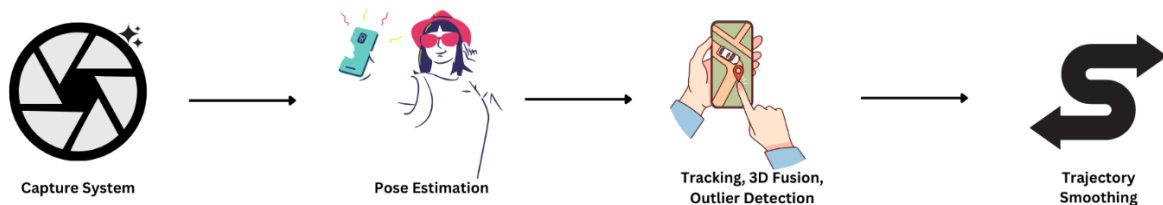


Fig. 14. Markerless System Development

2.4 Interface Design

Since AR interfaces differ from traditional UIs, the standard UI design guidelines should be tuned for the development of AR interfaces[13]. The UI design of this system is made in the form of a wireframe which consists of several contents in it.

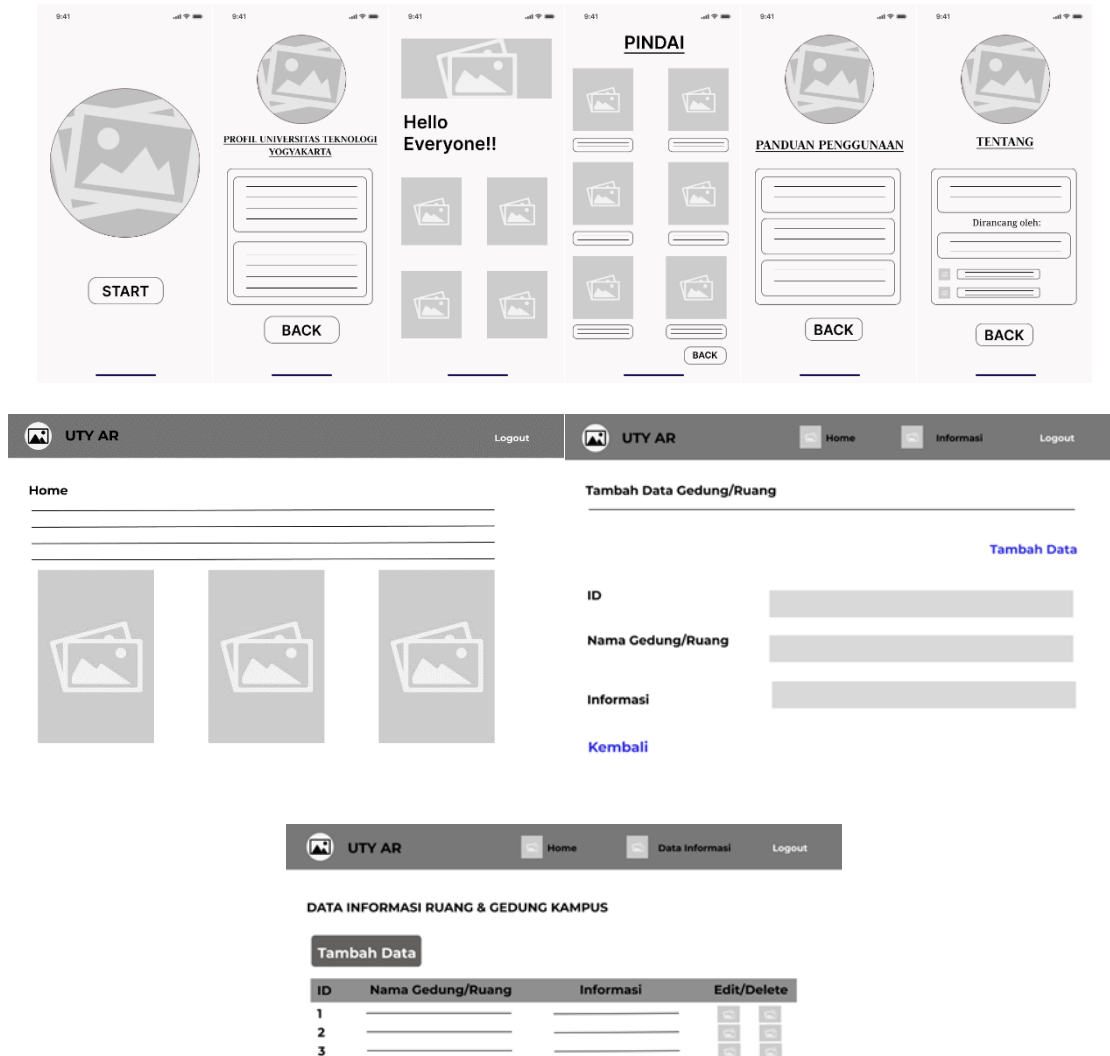


Fig. 15. User Interface

III. RESULTS AND DISCUSSION

3.1 Implementation

3.1.1. Login Page Admin

There are several components on the Login page, namely the admin Username and Password, if dmin enters one of them incorrectly, there will automatically be a command to check and re-enter the username or password.

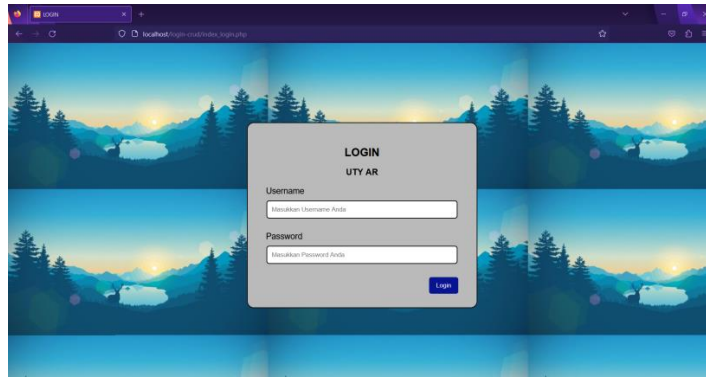


Fig. 16. Login Page Admin

3.1.2. Home Page Admin

On the Home page, the admin provides information that explains about the application, the usefulness of the application, and the smartphone specifications that support running the application.

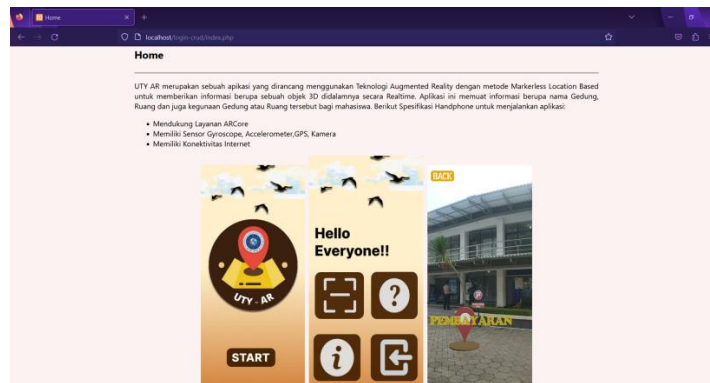




Fig. 17. Home Page Admin

3.1.3. Design Object 3D Page

The 3D objects are designed in a way that makes it easier for users to find the location they are looking for. Here is the design.

Table 1. Design 3D Object

Name of Object 3D	Picture
Back Building	
Front Building	

Operational Room	
Mosque	
Cooperation	
Payment	

3.1.4. Start Menu Page

This initial display serves as the first display to start the application if the user presses the Start button on the screen.



Fig. 18. Start Menu Page

3.1.5. UTY Profile Page

This profile view displays information related to Yogyakarta University of Technology which contains information on the establishment of the University, address, and study programs at the University.

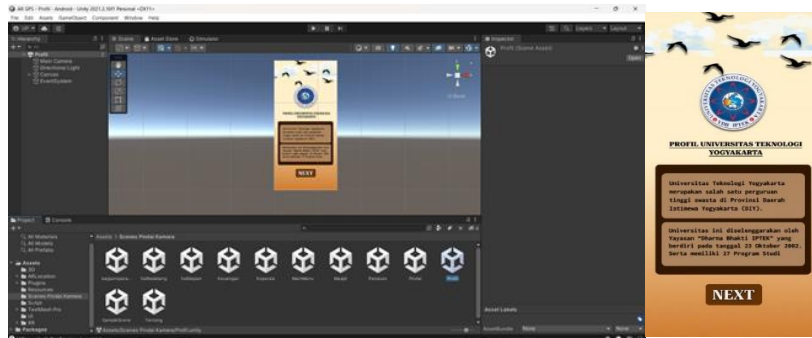


Fig. 19. UTU Profile Page

3.1.6. Main Menu Page

After the user presses Next, it will automatically be directed to the next display, which is the main menu containing several button icons. These button icons include the scan icon, how to use icon, about icon, and exit icon.



Fig. 20. Main Menu Page

3.1.7. Scan List

In the scan menu display contains several lists related to the name of buildings & rooms on UTU campus 1. Which later if the user presses 1 menu it will be directed to the camera to render 3D objects.



Fig. 21. Scan List

3.1.8. Camera Page

Once the user presses the building or room menu, it will automatically switch to the camera menu to start scanning.

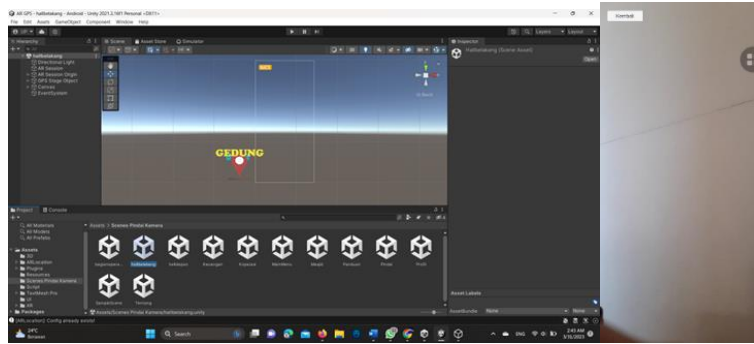


Fig. 22. Camera Page

3.1.9. Guide Menu Page

When the user presses the Guide button icon, it will automatically be directed to the contents of the guide menu page. This menu displays the steps on how to use the application.



Fig. 23. Guide Menu Page

3.1.10. About Menu Page





When the user selects the About button icon, it will automatically be directed to the About menu content page. This menu contains information related to information and application designers, along with the names of their social media accounts.



Fig. 24. About Menu Page

3.2 Discussion of Result

The next step is testing. Software testing is the main technology to ensure the quality of the software[14]. The testing method used in this system is the blackbox testing method. In black box testing we do not have information on the internal structure of the system under test (SUT) [15]. The resulting test table is as follows.

No	Menu	Expected Results	Application Display	Description
1.	Splash Screen	Display the main page of the application		Success
2.	Profile Menu	Display information related to Yogyakarta University of Technology		Success
3.	Main Menu	Display the application menu		Success
4.	Scan Menu	Display the list on the scanning menu		Success

IV. CONCLUSION

Based on the results of the discussion of the Augmented Reality application Introduction to Building Information & Space UTY campus 1 based on Android, the authors draw the conclusion that this Augmented Reality application system uses the GPS feature in displaying 3D objects according to a predetermined point. And this application displays object output regarding the name of the building & indoor and outdoor parts.

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