

Gedhe Kauman Mosque Introduction Application Based On Mobile Augmented Reality

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ABSTRACT

Keywords:

augmented reality; gedhe kauman mosque; yogyakarta

The Great Mosque of Yogyakarta, or better known as the Greatness of the Grand Mosque, is an integral part of the Yogyakarta Sultanate. The existence of this mosque confirms the existence in Yogyakarta as an Islamic kingdom. The gedhe mosque was built on the west side of the north square and southwest of the Beringharjo market, not far from the palace buildings. The Gedhe Mosque was founded on Sunday, May 29, 1773 M. or 6 Rabi'ul Akhir 1187 H. This research aims to design an Augmented Reality-based application that can make it easier for tourists to recognize history and objects in the Gedhe Kauman mosque. The application was built using the Unity 3D application. The Gedhe Kauman Mosque Introduction Application is used as an introduction and learning medium for the Gedhe Kauman mosque for tourists and the surrounding community. The use of this application is recommended to use android with version 8.1 (Oreo) and above.



Introduction

The city of Yogyakarta has a variety of popular tourist destinations to be visited by tourists ranging from natural attractions that are mostly located in the southern part of the Yogyakarta region such as beaches and hills, then Mount Merapi tours in the north of the city, but in the city itself there are also many tourist attractions that are no less interesting to visit, one of which is the Great Mosque of Yogyakarta, The mosque attracts tourists who are in the middle of the city to perform prayers and get to know more closely about the history of the Great Mosque of Yogyakarta (Brata, Brata, & Pramana, 2018). The Great Mosque of Yogyakarta or better known as Kagungan Dalem Masjid Gedhe Kauman, is an inseparable part of the Yogyakarta Sultanate. The existence of the Gedhe Mosque confirms the existence in Yogyakarta as an Islamic kingdom. The Gedhe Mosque was built on the west side of North Square and southwest of Pasar Beringharjo, not far from the palace building. The Gedhe Mosque was founded on Sunday Wage, May 29, 1773 AD, or 6 Rabi'ul Akhir 1187 Hijri (Riskiono, Susanto, & Kristianto, 2020). The Gedhe Mosque was established on the initiative of Sri Sultan Hamengku Buwono I and Kyai Fakhri Ibrahim Diponegoro as the head of the palace. The design of the building was done by Kyai Wiryokusumo (Fiaji, Brata, & Zulvarina, 2021). The Gedhe Kauman

Mosque has a past building architecture although several renovations have been carried out but have never changed the original form so that people want to know how the shape of the mosque building made in the 18th century. From the results of previous research, it was explained that the introduction of mosques is still manual and historical information is not widely known to tourists, causing a lack of interest in visiting (Achlisson, 2020).

Based on the problems found, this study aims to design an Augmented Reality (AR)-based application that can make it easier for tourists to recognize history and objects in the Gedhe Kauman Mosque (Organization & Canada, 2015).

Based on previous research and solutions to the problems they raised, the author proposes the title of research on the Mobile Augmented Reality-Based Gedhe Kauman Mosque Introduction Application to help overcome tourist problems in recognizing the Gedhe Kauman Mosque (Mubarak, 2019).

In this study only discusses the history of the introduction of the Gedhe Kauman Mosque, the application made is Augmented Reality which will be designed using Unity 3D and SDK Library.

The purpose of this study is to create an Augmented Reality application for the introduction of the Gedhe Kauman Mosque that can make it easier for tourists to recognize the history of the mosque, and make it easier for the mosque to explain it (Muhammad, Wardhono, & Afirianto, 2018).

The benefits of this research are expected to make it easier for users to recognize about the Gedhe Kauman Mosque in the form of 3D visual objects, increase the attraction of tourists and the surrounding community to visit the Gedhe Kauman Mosque, and provide knowledge about the Gedhe Kauman Mosque to tourists (Nurbaita, Fathda, Nurjayadi, & Efendi, 2021).

The source of information in this study is based on several previous studies used to compare existing advantages and disadvantages. This research seeks various information from journals, theses, and theories that can be used as a reference in completing this report (Pakaya, Tapate, & Suleman, 2020).

Research conducted by this study aims to create an application for the recognition of objects at the Great Mosque Islamic Center using android-based Augmented reality that can be useful for the mosque in the process of introducing the mosque to tourists. The method in this study uses MDLC (Multimedia Development Life Cycle). The results of this study include mosque recognition applications with android-based augmented reality that can be used to recognize mosque objects (Nurbaita et al., 2021).

Research conducted by (Makhasi & Fakhurrifqi, 2020). This research aims to develop a QR code-based digital tourism path in Kauman village that can help tourists explore Kauman village without dependence on the existence of a tour guide. This research method uses qualitative with a research and development approach. The results of this study include, history and explanation of the Kauman mosque and Kauman village with a page-based QR code pictographic hyperlink (Pirmansyah & Pramono, 2021).

Research Methods

Data is all facts and figures that can be used as material in compiling information, information itself is the result of data processing used for the benefit of (Arikunto, 2021). Research data is a collection of information obtained from observations where the data can be in the form of numbers (Slamet Riyadi). In a study, data is always needed. Because through data can process it into a trusted source of information. The requirements for valid research data are, actual, representative, objective, relevant, timely, and useful. In

this study, researchers used one type of data used, namely, qualitative data. Qualitative data is a type of data in research that focuses on the description and in-depth understanding of a phenomenon. This data is not numerically measurable and describes social perspectives, experiences, or contexts. Qualitative data collection methods involve direct interaction with participants through interviews, observation, or document analysis. Qualitative data analysis involves interpreting and extracting meaning from the collected data.

The Gedhe Mosque was built on Sunday Wage, May 29, 1773. The mosque was built on the initiative of Sri Sultan Hamengkubuwono 1 and kiai Fakhri Ibrahim Diponegoro and designed by Kiai Wiriyokusumo. The architectural style of the Gedhe Mosque inherits the style of the Demak Mosque. Gedhe Mosque has the characteristics of 4 main pillars or known as saka guru. There are 48 (forty-eight) pillars in this mosque building, while the roof consists of 16 (sixteen) sides with three levels.

Results and Discussion

System Analysis

System requirements analysis is carried out to study and understand the needs needed in designing application systems. At this stage, all requirements will be identified and described in detail, including ongoing system analysis, proposed system analysis, input needs, process requirements, output requirements, hardware requirements and specifications, and software requirements. In this needs analysis, each aspect will be explained in detail to ensure a comprehensive understanding of the needs required (Siregar & Permana, 2016).

Analysis of Running Systems

Analysis of the system that runs in this study, it has been written how to make an application that can make it easier or help tourists recognize the Gedhe Kauman mosque, researchers analyze solutions to solve existing problems by making applications that utilize mobile augmented reality technology as a medium of introduction, with the existence of augmented reality technology it is very easy to recognize and understand objects that we want to know with 3-dimensional visuals like real without limited time and place (Syani, 2019).

Along with the development of the era, technology is increasingly sophisticated and helps humans, one of which is a smartphone or mobile. Smartphones are very useful for all of us because there are now many technologies that we can access through smartphones that are owned to be more efficient. From the data we get, smartphone users in Indonesia are getting more and more and the average Indonesian citizen has a smartphone to work and communicate. More than half of the population in Indonesia or 56.2% have used smartphones in 2018. A year later, as many as 63.3% of people used smartphones (Soesilo, 2018).

Based on the problems found, the author wants to create a mobile or android-based augmented reality application so that it can be used on users' smartphones easily without bothering when they want to know more about the Gedhe Kauman Mosque.

In the first step, researchers identify the problems found at this point. This is used as a basis for designing the system to achieve perfect goals and results. Due to the limitations of the introduction media that only relies on tour guides and just descriptions on the QR code, tourists do not understand the history of the Gedhe Kauman Mosque.

The second step, the researcher proposes a model to solve the problems found. Researchers found a solution by making visualizations of the Gedhe Kauman Mosque in

3-dimensional form that can make it easier for tourists to recognize the mosque without the help of a tour guide. The first stage in this step is that researchers collect data about the Gedhe Kauman Mosque so that the application made can provide an accurate explanation. The next stage researchers design applications from the data obtained and make 3-dimensional objects as precise as possible as the original so that later tourists more clearly recognize in detail the objects in the mosque building (Makhasi & Fakhurrifqi, 2020).

The third step, the final condition in the design that is made and has become a ready-to-use application. Researchers hope that the application made can greatly help tourists recognize mosques with the features in the application that can spoil tourists.

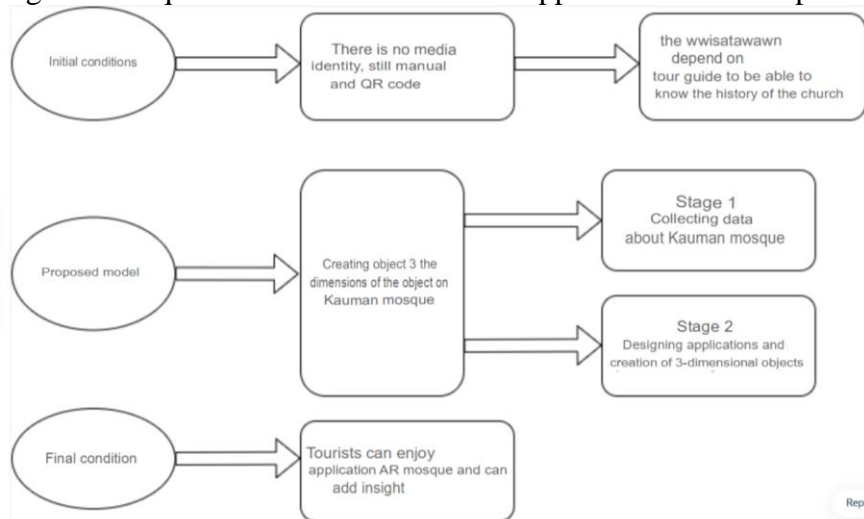


Figure 1 Research Framework

Analysis of the Proposed System

The system analysis proposed in this study uses system architecture. The architecture of the system can be seen in figure 2.

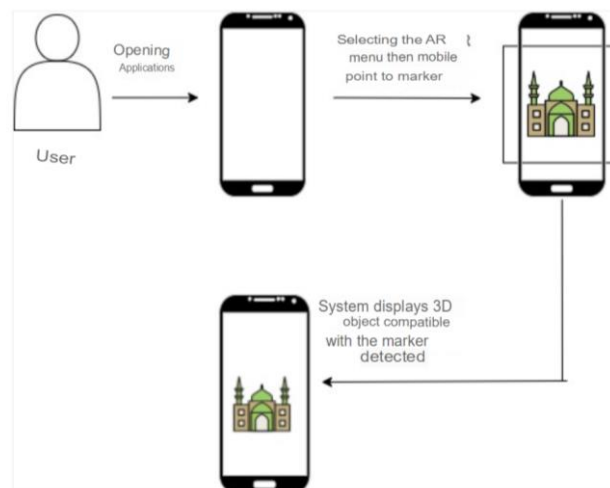


Figure 2 System Architecture

The description of the system architecture in figure 2 is as follows:

1. User opens or accesses applications on the smartphone
2. The user selects the Augmented Reality menu, then the system asks for permission to turn on the user's smartphone camera to detect the marker that has been provided

3. The system will read the intended marker and then bring up a 3-dimensional object of the Gedhe Kauman Mosque

a. Functional Analysis

Functional needs are needs that contain processes that will be needed by the application. There are three needs in the functional needs of this application, namely input needs, process needs, external needs.

1. Input needs
 - 1) User Interface
 - 2) Required markers
 - 3) Description of the history of the mosque
 - 4) Sound explanation description
 - 5) Mosque floor plan
2. Process requirements
 - 1) The system can display objects from scanned markers
 - 2) All menus can display accordingly
 - 3) The application can run properly
 - 4) No *bugs* on the app
3. External needs
 - 1) Information about mosques
 - 2) Mosque objects
 - 3) Explanatory voice

b. Non Functional Analysis

Non-functional requirements analysis contains what software and hardware components are used in the manufacture and testing of the system to be created.

1. Software Requirements
Here are some of the needs that will be used:
 - 1) Windows 11 Operating System Version 22H2
 - 2) Unity 3D 2021.3.1f1
 - 3) Blender 3.2
 - 4) Canva
 - 5) Figma
 - 6) Mockflow
2. Hardware Requirements
 - 1) Laptop

The hardware used in designing and creating applications is as follows.

Table 1 Designer Device Specifications

System Model	Asus VivoBook 14
Processor	Intel Core i5 11th Gen
OS	Windows 11 Home
RAM	8 GB DDR 4
GPU	NVIDIA GeForce MX 330
SSD	512 GB
Battery	2 Cell Battery

2) Android Smartphones

The next hardware is a smartphone that helps this application in the testing process so that the application can run perfectly as desired. Here are the specifications of the smartphone used.

Table 2 Tester Device Specifications

System Model	Samsung Galaxy A50s
Size	6.4 Inches
OS	Android 11
Chipset	Exynos 9611
Network	LTE
CPU	Octa-core (4x2.3 GHz Cortex-A73 & 4x1.7 GHz Cortex-A53)
Memory	128 GB 6 GB RAM
Battery	Li-Po 4000 mAh

System Design

Logical Design

The logical design in this study uses flowcharts and Unified Modeling Language (UML).

Flowchart

Flowcharts are used to show the entire workflow of the system, flowcharts can be seen in figure 3.

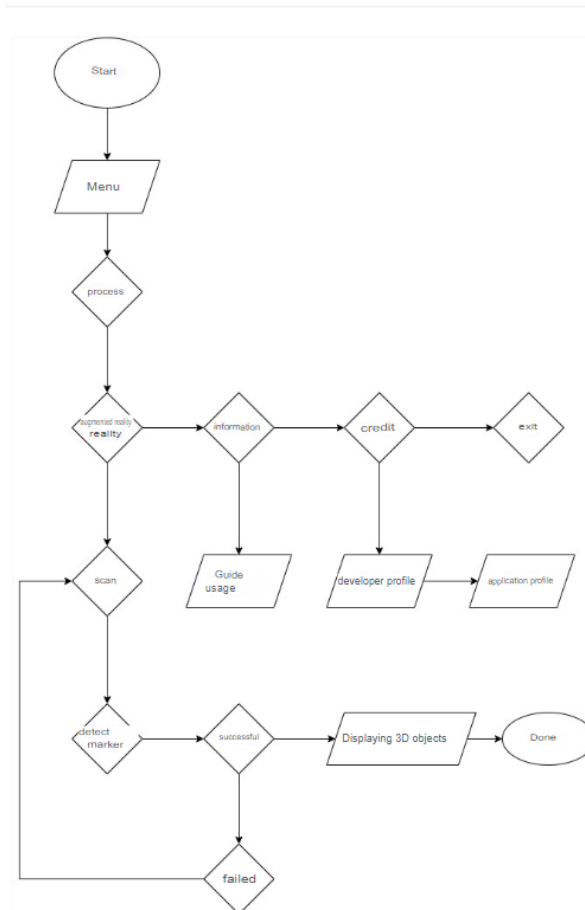


Figure 3 Flowchart

Unified Modeling Language (UML)

In logical design, researchers use UML diagrams where these diagrams function as visuals of system design to be created and modeling or images to users. This design uses three UML diagram models consisting of, *use case diagram*, *activity diagram*, *class diagram*

Use Case Diagram

Use case diagrams contain users and activities that users can perform when using the application system, as figure 4.

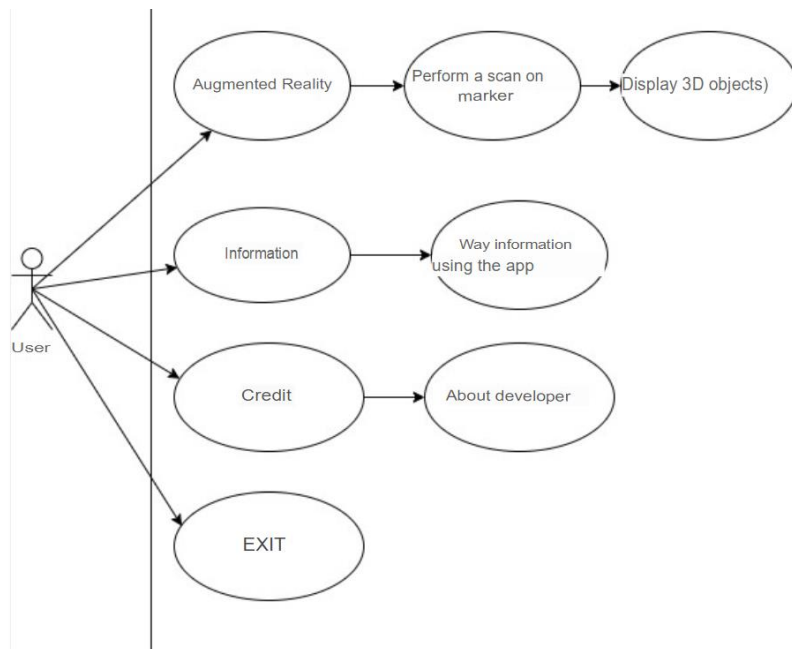


Figure 4 Use Case Diagram

There is one actor involved in the diagram above. Users can select several menus on the system when using it.

1. Activity Diagram

Activity diagrams contain a sequence of user activities and processes performed by the system. In application design, there are four activity diagrams as follows.

1) Activity diagram augmented reality

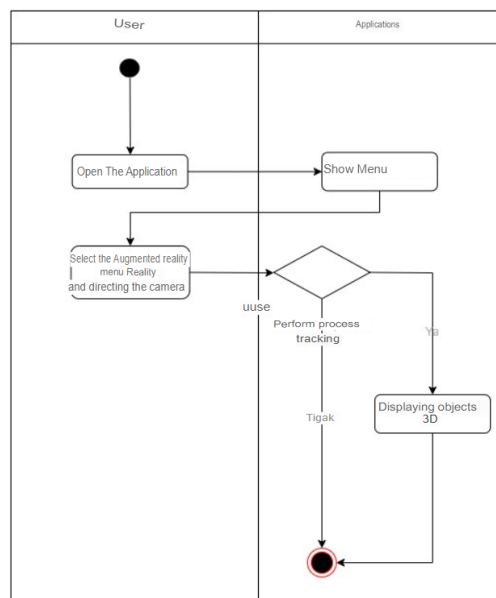


Figure 5 Activity diagram augmented reality

Process activity diagram in figure 5 The user opens the application then the system displays a menu, the user selects the augmented reality menu, the system will ask permission to turn on the user's camera, then scan the marker provided, if the system reads the marker it will display a 3-dimensional object, otherwise the system will continue to detect the marker.

2) Activity diagram Information

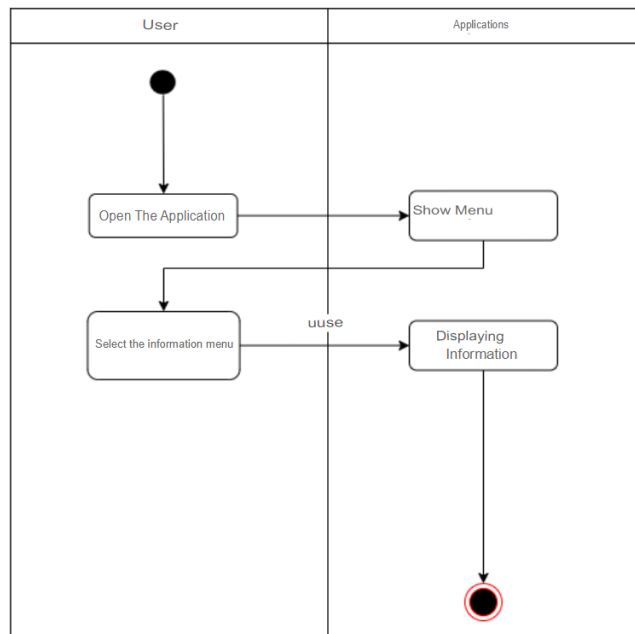


Figure 6 Activity diagram Information

Based on the process in figure 6, when the user opens the application and opens the information menu, the system will display information about the use of the application.

3) Activity diagram Credit

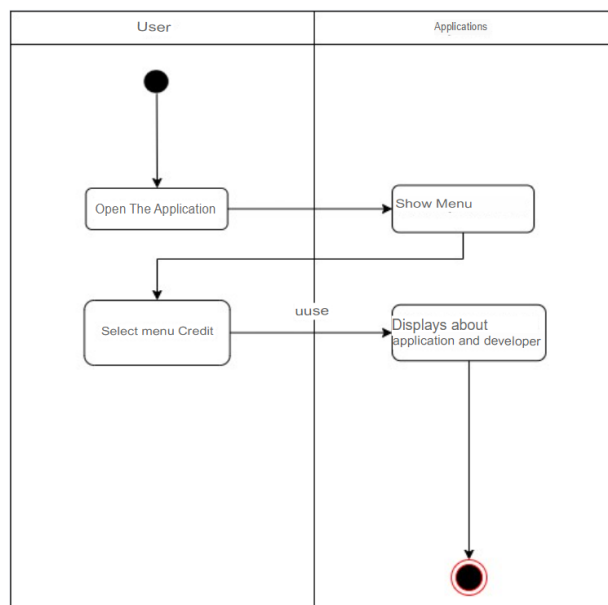


Figure 7 Aactivity diagram Credit

Based on the process in figure 7 When the user is shown a menu, then selects the credit menu, the system will display a profile about *the developer* and about the augmented reality application of Masjid Gedhe Kauman.

4) Activity diagram exit

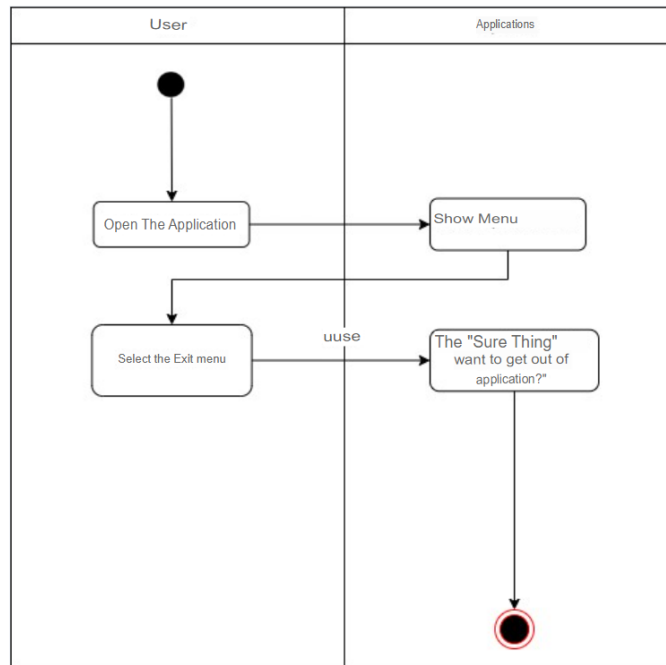


Figure 8 Activity diagram Exit

Regarding the process in figure 8. If the user wants to exit the application then select the exit menu, the application will not exit immediately, the system displays "Are you sure you want to exit the application?" and will be provided with the option "YES or NO".

Class Diagram

Class diagram is a modeling that functions as a logical *model* of a system. The class diagram will show the schematic of the architecture and the relationship of each object of the designed system, can be seen in figure 9.

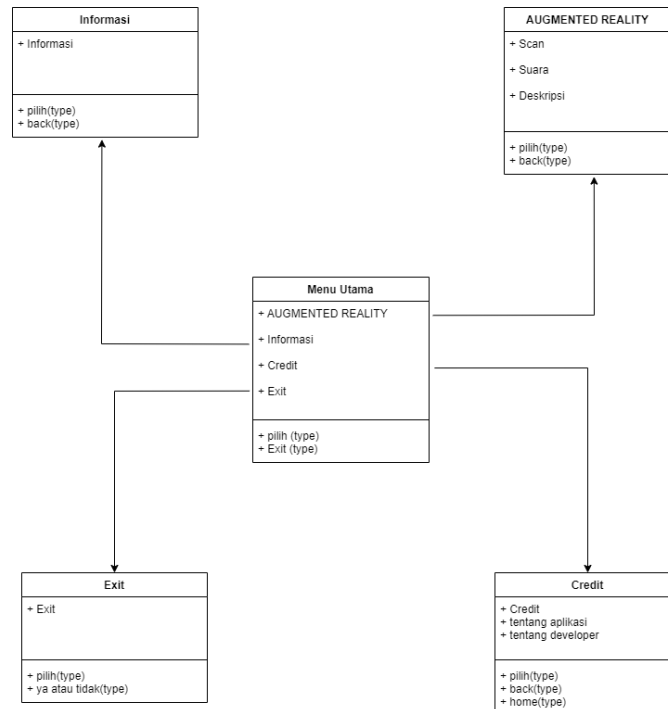


Figure 9 Class diagram

Physical Design

Physical design aims to design the system user interface in the form of a prototype to facilitate the creation of applications. The following is the prototype of the Kauman Mosque Introduction Application interface.

Menu page

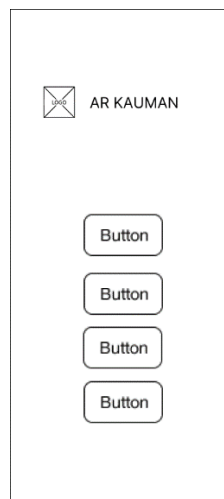


Figure 10 Menu Page Design

Description of application menu buttons can be seen in table 4.3 below.

Table 3 Menu Page Description

Button	function
1	The first button is a button to open 3D objects or scan
2	The second button is an information button about how to use the application
3	The third button is a credit button that contains the developer's profile and about the application
4	The last button is an exit button that functions to exit the application

Augmented Reality Page

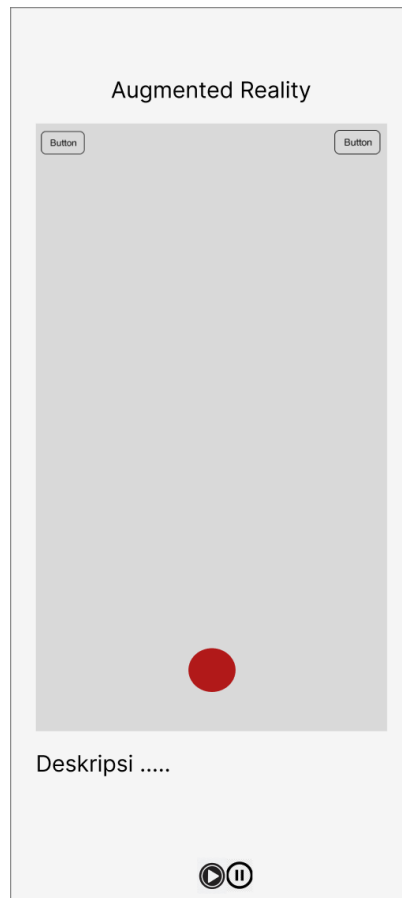


Figure 11 AR Page Design

There are several buttons in figure 11, along with a table description on the augmented reality page.

Table 4 Augmented Reality Page Description

Button	Function
1	The first button in the upper left corner is a button to return to the menu
2	The second button in the upper right corner is the mute button for sound
3	The red circle is a button for scanning
4	Description is a story about the history and explanation of the object displayed
5	The play button serves as an explanation start using voice
6	The pause button serves as an explanatory sound pause

Credit Page

The credit pages have two pages which can be seen carefully in figures 12 and 13.

1) Developer profile page

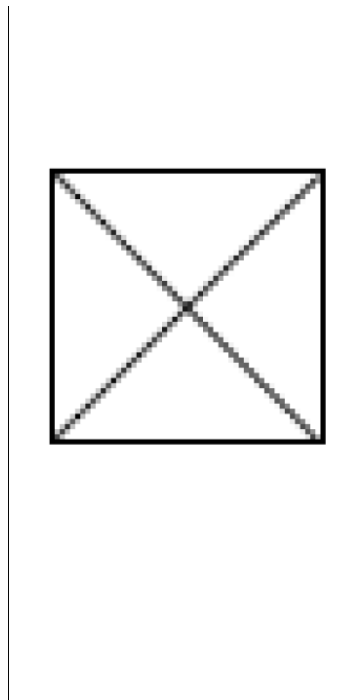


Figure 12 Credit Developer Page Design

On the developer credits page there is a brief profile about the application developer and the button returns to the main menu page, the slide can be shifted to the application credits page.

2) About app page

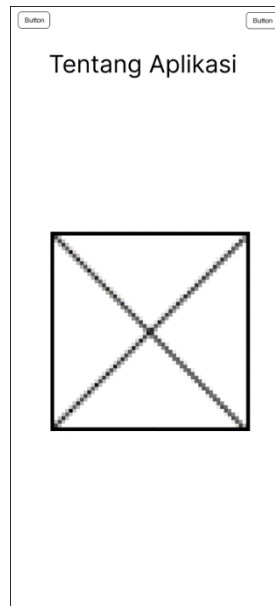


Figure 13 Credit Application Page Design

On the application credit page there is a brief profile about the Gedhe Kauman Mosque augmented reality application, the back button serves to return to the developer profile page and the home button serves to return to the main menu page.

1. Information Page

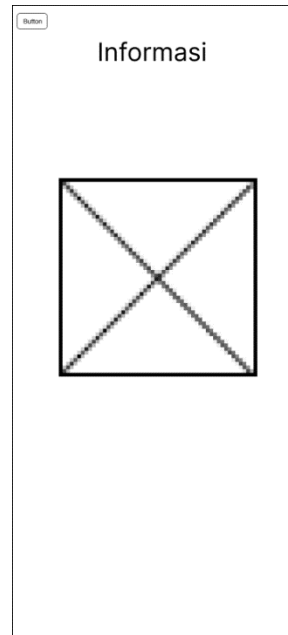


Figure 14 Information Page Design

On the information page there is information on the guide to using the Gedhe Kauman Mosque augmented reality application, if users are confused when using the application, the information menu has provided a user guide.

Conclusion

Research and design of the Mobile Augmented Reality-Based Introduction to the Gedhe Kauman Mosque application has been successfully carried out and testing has been carried out to test the application and obtained the following results:

The Gedhe Kauman Mosque Introduction Application is used as an introduction and learning medium for the Gedhe Kauman mosque for tourists and the surrounding community.

The use of this application is recommended to use android with version 8.1 (Oreo) and above.

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