| RESEARCH ARTICLE

Augmented Reality as a Tool in Plant Research for Medicinal Purposes

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| ABSTRACT

Plants are organisms that grow by utilizing photosynthesis to convert light into food energy. The structure of plants includes roots that absorb nutrients and water, stems that transport them, and leaves that capture light for the photosynthesis process. Additionally, plants have flowers and fruits that function in reproduction. Examples of plants that are often studied and utilized include Aloe Vera, Celandine, and Betel Leaf. However, public understanding of information about medicinal plants remains limited. To address this issue, Augmented Reality (AR) technology can be utilized to provide education on the importance of medicinal plant information. Augmented Reality is a technology that integrates the virtual world with the real world. In this context, the Marker-based Tracking method is applied, which is an AR technique using two-dimensional markers with specific patterns that can be read by a mobile device camera. With this technology, people will find it easier to learn about various plants that can be used as medicine.

| KEYWORDS

Augmented Reality; Marker-Based; Plants; Technology; Medicines.

| ARTICLE INFORMATION

1. Introduction

The Indonesian society still struggles to recognize plants that can be used as medicine. As a result, many people opt to use medications prescribed by doctors or purchased from pharmacies. Medications obtained from doctors or pharmacies are often quite expensive, prompting people to seek alternatives such as traditional medicinal plants (Yazid & Hidayat, 2020). However, public knowledge about medicinal plants is very limited, so they typically learn about medicinal plants through images and written materials.

Augmented Reality (AR) is a technology that integrates digital elements with the real world, creating a more interactive and immersive experience (Kamińska et al., 2023). AR has now become a necessity in various sectors. This technology is rapidly evolving and has a significant impact on many aspects of life. In today's technological era, people heavily rely on technology that allows them to experience Augmented Reality. It enhances the ability to access interactive and engaging informational media, making it easier to understand. Currently, the development of information technology, particularly AR, has reached an excellent level. With AR, information delivery and visualization can be carried out in more diverse ways using various digital media, including 3D objects.

The public's need for information tends to favor visually displayed objects on smartphone screens(Hendriyana et al., 2022).Therefore, the author believes that it is essential to provide information that can be easily understood by the public about the introduction of medicinal plants, presented in a form resembling their real appearance through smartphones. Hence, this issue can be addressed through Augmented Reality technology, enabling the medicinal plant information to be presented in a form similar to its actual appearance, specifically as 3D objects, which will later be realized in an Android-based application.

2. Literature Review

2.1 Plants

Plants are organisms that grow and develop by using photosynthesis to convert light energy into food. Plants have roots that function to absorb nutrients and water from the soil, stems that function to transport food and water upwards, and leaves that function to capture light and convert it into food through the photosynthesis process (Pironon et al., 2024). Plants also have flowers and fruits that serve as parts of reproduction. Plants are an essential part of the world's ecosystem as they help maintain natural balance and provide a food source for animals and humans.

2.1.1 Aloevera

Aloe vera (Aloevera) is a species of plant with thick, fleshy leaves from the Aloe genus. This plant is perennial, originates from the Arabian Peninsula, and its wild varieties have spread to tropical, semi-tropical, and dry climate regions across various parts of the world.

Figure 1 Aloevera

2.1.2 Celandine

Celandine flowers have been used for centuries to treat digestive disorders such as stomach ulcers (dyspepsia) and gallbladder diseases. Celandine also serves to treat asthma, bronchitis, and whooping cough. Meanwhile, celandine roots are widely used to address irregular menstruation and to reduce pain from toothaches or after tooth extraction.

Figure 2 Celandine

2.1.3 Piper Betel
Betel leaf is a plant native to Indonesia that grows as a creeper or climber on other tree trunks. In different languages, betel leaf is known by various names such as suruh, lu'at, sireh, bido, base, and amo. In cultural contexts, betel leaves and fruits are often chewed together with gambier, areca nut, tobacco, and lime.

Figure 3 Piper Betel

2.2 Augmented Reality
Augmented Reality (AR) is a technology that integrates digital content in real-time and applies it to the physical world. With AR, users can view virtual 2D or 3D objects that appear within the context of the real environment (Arena et al., 2022). Augmented Reality is a technology that incorporates 2D or 3D virtual elements into the surrounding environment and then projects those elements onto the physical world.

2.3 Android Studio
Android Studio is the official integrated development environment (IDE) for Android app development, developed by Google. The platform provides complete tools for designing, building, testing, and deploying Android applications. Android Studio is based on IntelliJ IDEA and includes features such as a powerful code editor, code analysis tools, and a Gradle-based build system. In addition, Android Studio supports various tools for visually designing user interfaces, Android emulators for app testing, and integration with Google Cloud (Nur Laila. et al., 2023). As a key tool in Android app development, Android Studio makes it easy for developers to create responsive, compatible, and high-quality apps for various Android devices.

2.4 Flowchart
A flowchart is a graphical tool used to illustrate the steps in a process or system. Each step in the flowchart is represented by specific symbols, such as rectangles for processes, diamonds for decision-making, and arrows to indicate the flow direction. Using these symbols, a flowchart presents the program or process flow in an easily understandable manner, making it easier for researchers to follow and analyze the steps involved (Khesya, 2021).

2.5 DFD (Data Flow Diagram)
DFD (Data Flow Diagram) is a visual tool used to depict the flow of data within an information system. In the context of academic system design, DFD is used to illustrate how data flows between various processes within the system (Irfan et al., 2024). This method helps model the system's functions and shows how data is processed, stored, and transferred between processes or system components.
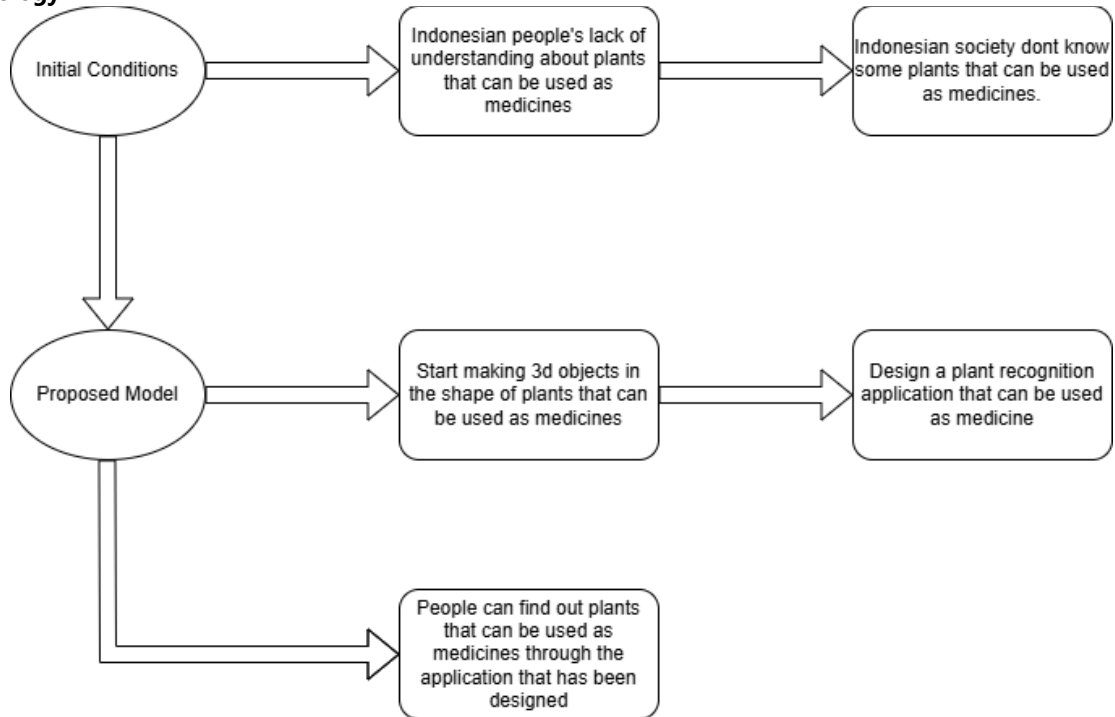
3. Methodology

Figure 4 research framework structure

3.1 System Requirements Analysis

The analysis of system requirements for Augmented Reality applications on the introduction of medicinal plants on mobile devices includes two main aspects, namely: functional analysis and non-functional analysis.

1. Functional Analysis

The functional analysis for this Augmented Reality application on medicinal plant recognition on mobile devices includes several processes on the main page. In the input part, the application requires scanning using AR which relies on markers to recognize objects. Next, in the process section, the application will process the marker to generate 3D objects that match the scan results. In addition, the app also processes text and audio as object descriptions. In the output section, the application will display the 3D object of the plant, present text information regarding the description of the plant, and provide an explanation through audio about the recognized plant.

2. Non-Functional Analysis

Non-functional analysis aims to determine the tools and specifications needed in making and testing applications. In the development of Augmented Reality applications, several applications are used to support development in this study. Blender 3D is open-source software used to create 3D animations and visual effects, giving users the flexibility to develop them further (Zebua et al., 2020). Vuforia is an SDK that makes it easy for developers to create Augmented Reality (AR) applications (Wijaya, 2022), while Unity is a game engine used to develop AR and VR-based games that can run on various platforms (cross-platform) (Alvendri et al., 2023).
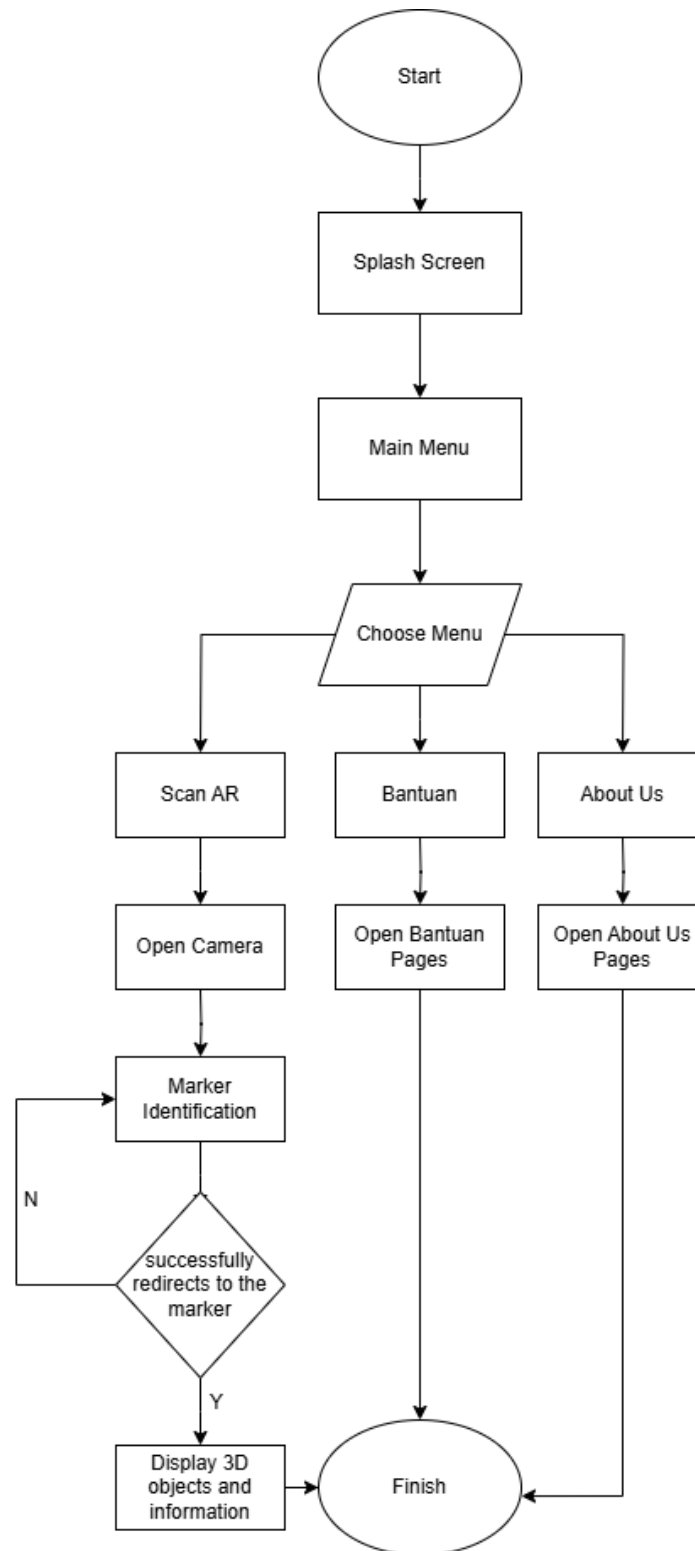
3.2 Flowchart

Figure 5 Flowchart

The flowchart illustrates the process of a system that begins with a splash screen, followed by the main menu where the user can choose between options such as Scan AR, Bantuan (Help), or About Us. If the user selects Scan AR, the system opens the camera for marker scanning and checks for marker identification. If the marker is successfully identified, the system displays 3D objects and related information. Alternatively, selecting Bantuan opens a help page, and choosing About Us opens a page with details

about the app or organization. The process ends once the user accesses any of these features, either through AR content display or by navigating to the other available pages.
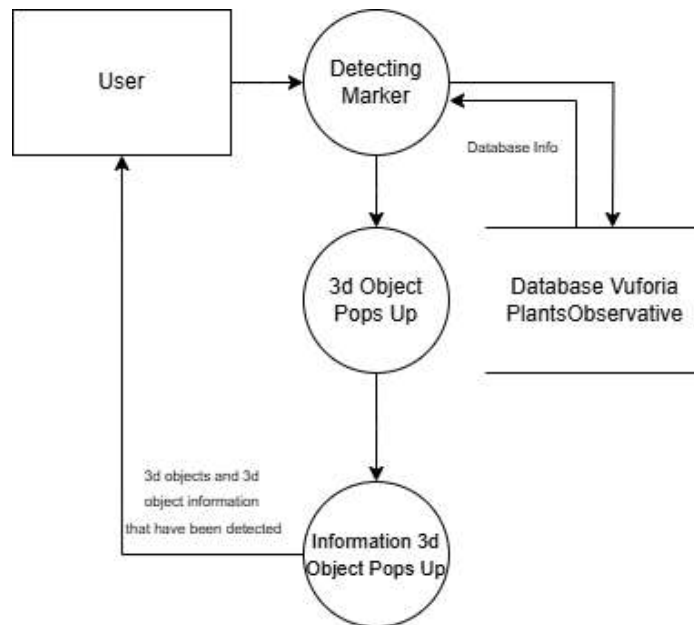
3.3 DFD (Data Flow Diagram)

Figure 6 DFD (Data Flow Diagram)

The diagram is a simple Data Flow Diagram (DFD) that describes the process in an augmented reality (AR) based application for plant observation using the Vuforia database. The process starts with the user interacting with the system to detect the marker. Once the marker is recognized, the system retrieves relevant information from the database (Vuforia PlantsObservative). Based on the data, the relevant 3D object will appear on the screen. Furthermore, additional information related to the 3D object will also be displayed to the user. All this information is then presented back to the user for a more interactive experience**.**

4. Results and Discussion
1. Splash Screen: The Splash Screen page is the first page that users will find when opening this augmented reality application.

Figure 7 Splash Screen

2. Main Menu: The menu page is the second page that will be found by users when loading is complete, on the menu page users can find several buttons such as : SCAN AR, Help, About Us.

Figure 8 Main Menu

3. Scan AR: The scan AR page is a page that will be used to scan the marker. On this page there is a description panel that contains information about the 3D object.
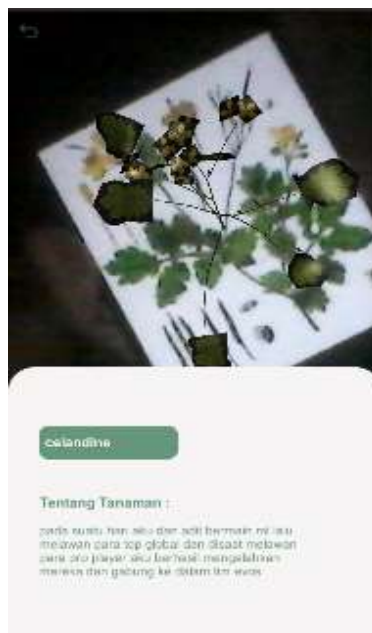

Figure 9 Scan AR

4. About Apps: The page contains application information along with the author of the application.

Figure 10 About Us

5. Black-Box Testing: Black-Box Testing is a testing method that assesses the functionality or usability of an application. This test focuses on verifying the functionality of the application. The process is done by running the application and observing whether the application operates properly or not.

No	Unit	System Testing	System Reaction	Result	Tested By
1	Scan AR	Pointing camera at the marker	Displaying 3d objects	Success	User
2	Description Text	Pointing the camera at the marker, whether the description displays the information according to what is in the database	Display the corresponding information from the database	Success	User
3	Rotate and Move 3D Objects	Rotating and Moving 3D objects	3D objects are successfully rotated and moved	Success	User
4	Zoom in and Zoom out 3D Objects	Zoom in and Zoom Out 3D objects using 2 fingers	3D objects get bigger and smaller according to user interactions	Success	User

5. Conclusion

With the construction of Augmented Reality Applications on Plants That Can Be Used As Medicines is expected to be an alternative media as reading material to recognize and find out information about medicinal plants and their properties in curing diseases traditionally. The results of the development of Augmented Reality Applications on Plants That Can Be Made as Medicines provide convenience to users in a search for information needed about the types of plants that can be used as medicines effectively and efficiently.

Based on unit testing (Black Box) this application has a high successful presentation, besides that there are system confirmation features (popup), sliding, rotation, zoom in and zoom out which can add more interaction between users and the application. It is hoped that this application can help the community in recognizing any unknown plant plants that can be used as medicines

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