



Augmented Reality-Based Medicine Plants Learning Applications

M Julkarnain^{1,*}, Mohammad Taufan Asri Zaen², Nawassyarif¹, Yudi Pratama¹, Yuliadi¹

¹ Teknik Informatika, Universitas Teknologi Sumbawa, Sumbawa, Indonesia

² Sistem Informasi STMIK Lombok, Lombok Tengah, Indonesia

Email: ^{1,*}m.julkarnain@uts.ac.id, ²opanzain@gmail.com, ³nawassyarif@uts.ac.id, ⁴yudi38761@gmail.com, ⁵yuliadi@uts.ac.id

Coressponding Author: m.julkarnain@uts.ac.id

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Abstract—This study aims to design and build learning applications for medicinal plants based on Augmented reality so that they can be used as interactive learning media. The research methods used are qualitative and quantitative methods. Data collection methods used in this study are observation, interview, documentation, questionnaires and literature study and use the Prototype method as a software development method. This Augmented Reality-based medicinal plant learning application was built using the C# and Blender programming language to create 3-dimensional image designs. The result of developing this application is a learning media that can be run on a Smartphone by utilizing interactive Augmented Reality technology. When this application is opened, the main page will appear containing several menus, namely the play, guide, learning, and quite menus. The features contained in Augmented Reality-Based Medicinal Plant Learning, namely the 3D object scan feature, can find out information about plants with scanned images. This application can help people to get to know medicinal plants and their properties. And it can be an effective learning medium. Based on the results of the questionnaire, the application made by the author received a positive response from the respondents, in many category, such as the display, educational, satisfaction, interactive and music.

Keywords: Application; Interactive; Medicinal Plants; Augmented Reality; Prototype; C#

1. INTRODUCTION

The development of information technology is currently needed by the public to access information so as to increase insight and knowledge. Information technology has also encouraged the improvement of public services so that they can easily access information anywhere. In various fields, including government, the economy, education and health. In this case, the researcher makes applications for learning medicinal plants around the community by taking plant data from the Community Health Center (Puskesmas) Moyo Hilir District.

Community Health Center is the technical implementing unit of the district or city health office that is responsible for health development in an area. The Moyo Hilir District Health Center is one of the health centers located in Sumbawa Regency. This health center has a mandatory program to maintain public health. It also has a development program where not all puskesmas make it. The development program depends on the condition of the community environment. The Moyo Hilir District Health Center has a development program that is about counseling medicinal plants that exist around the community.

Plants are one of the most important resources for maintaining public health. According to the World Health Organization, 80% of the world's population uses traditional medicine, including the use of drugs using plants. A quarter of modern medicines circulating in the world come from active ingredients isolated and developed from plants [1]. Medicinal plants are plants that can be used for purposes that can cure various diseases. Unlike plants that grow naturally, medicinal plants are deliberately planted and cared for in a way to be taken advantage of or harvested when they have reached a certain time. Various types of medicinal plants can be found throughout Indonesia, including Sumbawa Regency, West Nusa Tenggara Province. Many also have medicinal plants that can be planted by the surrounding community, but not all people plant and know the benefits of these medicinal plants. The source of data on medicinal plants comes from the Kec. Moyo Hilir Health Center.

People are still very unfamiliar with medicinal plants. They prefer to use drugs that have high levels of chemicals without knowing what the side effects of these chemical drugs are. Whereas in the environment, we often encounter medicinal plants whose contents can cure various diseases. Not to mention, in this modern era, there is a lack of public interest in reading books, especially for the younger generation. Based on data from the 34 Provinces Reading Literacy Activity Index, it is stated that the level of reading literacy activity in Indonesia is still relatively low [2]. Moreover, getting to know and studying medicinal plants is boring and the data is mostly in books. From this data, it can be concluded that public understanding is still very lacking, especially of medicinal plants. The samples used were 5 medicinal plants, namely: Moringa, Miana, Aloe Vera.

Based on the problems above, it is very necessary to design and build an Augmented Reality-based Medicinal Plant Learning Application. Design is a series of procedures for translating the results of the analysis of a system into a programming language to describe in detail how the components of the system are implemented, while building is an activity that creates a new system or replaces or improves an existing system either as a whole or partially [3]. And then, design is an activity of translating the results of analysis into the form of a software package and then creating the system or improving an existing system. The system is a collection of elements that interact to achieve a certain goal [4].

Furthermore, augmented reality is a technology that combines two-dimensional and three-dimensional virtual objects into a real three-dimensional environment and then projects these virtual objects in real time [5]. Augmented Reality (AR) has advantages on the interactive side because it uses markers to display certain 3-dimensional (3D) objects that are directed at the smartphone camera, so that it can increase one's imagination. According to market intelligence



firm IDC, worldwide spending on AR and VR products and services will increase by 69% next year and will reach a five-year growth rate of nearly 70% from 2017 to 2022, proving that Augmented Reality technology is highly sought after and in demand.

The database used is Vuforia. Vuforia is software for Augmented reality developed by Qualcomm that uses consistent sources of computer vision that focus on image recognition. Vuforia has many features and capabilities that can help developers realize their thoughts without any technical limits [6]. Features in this application only include 3D images, practice questions, and information on substances contained in the medicinal plant.

Applications are made using the C# programming language, using Blender and Unity. Unity 3D is a cross-platform based game engine, so Unity can be used to create games that can be used on computers, Android, iPhone, Playstation and even X-Box. Unity is an integrated tool for creating games, building architecture and simulations. Unity is a great choice for small studios, indie development, and for those who want to make their own games [7]. Whereas, Blender is a three-dimensional modeling and animation application package that has various functions that other three-dimensional applications do not have. Blender is also a kind of program that can perform various functions [8].

C# (pronounced: C sharp) is an object-oriented programming language developed by Microsoft as part of the .NET Framework framework initiative. This programming language is based on the C++ language, which has been influenced by aspects or language features found in other programming languages, such as Java, Delphi, Visual Basic and others with some simplifications. There are several advantages of the C# programming language compared to other programming languages, namely: .NET, so we can use components built with programming languages. Another .NET, the C# Programming Language has a Language Integrated Query (LINQ), which is a query syntax that can be used on any data set [9].

And then, the software development method used is Prototype. The prototype model is a process that allows developers to create a software model. This method is good to use if the client can not provide maximum information about the needs he wants [10].

The system that has been completed is then tested for the system. To determine whether the software is suitable for use or needs to be refined again. In this study, testing of the prototype will be done using the black box testing method. Black box testing focuses on the functional requirements of software that allows engineers to obtain input that will fully implement the functional requirements for a program. Black box testing attempts to find errors in the following categories: Improper functionality or missing functionality, Interface errors, errors in data structures or external database access, Performance errors, Initialization and termination errors [11].

Based on previous research, Kadek Artawan, et al in making learning applications for flowers of the Eka Karya Botanical Gardens Bali based on markerless augmented reality. The purpose of the application is to make it easier for the public to find out detailed information about the flowers in the Eka Karya Bali Botanical Garden. The main function of this application is to detect and display information along with detailed flower information in the Eka Karya Bali Botanical Gardens. The software development method used is the Waterfall method [12]. In this study, having similarities in the object being studied still used plant objects. Research conducted by Diana, et al. also designed an interactive augmented reality learning media that aims to make students more interested and easier to understand herbal plant material equipped with a 2D object through an android-based application. This application is made using Unity software, Vuforia SDK, CorelDraw x7 [13].

The next research is conducted by Muntahanah, et al with the title Application of Augmented Reality Technology in Android-Based Home Catalog Applications (Case Study of PT. Jashando Han Saputra). The purpose of the application is to make it easier for buyers to view homes virtually in the catalog provided before buying a home. The design of this application uses the prototype method. With the Augmented reality application system for housing visual promotion media, it can make it easier for sellers to introduce products and make it easier for buyers to choose the desired house [14]. In this study, it has similarities in the development method used, namely using the Prototype method.

Majeed and Ali conducted a research related to Augmented Reality entitled A review of augmented reality in educational applications. This research has presented a review of educational applications that are based on AR technology. It has reviewed and analyzed 16 articles from three journals and over a period of three years. In education, augmented reality (AR) provides a better user experience due to its features of displaying 3D virtual information and interaction. Thus, many scholars have been attracted to developing this technology in their research [15].

It is hoped that the Application of Introduction to Medicinal Plants Based on Augmented Reality (AR) can facilitate the wider community to introduce, preserve, and study medicinal plants through three dimensional animation, so as to encourage public interest in studying medicinal plants. The purpose of this research is to design and build an Augmented reality-based Medicinal Plant Learning Application that can help people aged 8 to 15 years old learn and understand information about what content is contained in medicinal plants as natural medicines and also as a learning medium. So that, the author proposes the research title "Augmented Reality-Based Medicine Plants Learning Applications".

2. RESEARCH METHODOLOGY

2.1 Research Flow

The research flow of augmented reality-based medicine plants learning applications is shown by the figure 1 below.

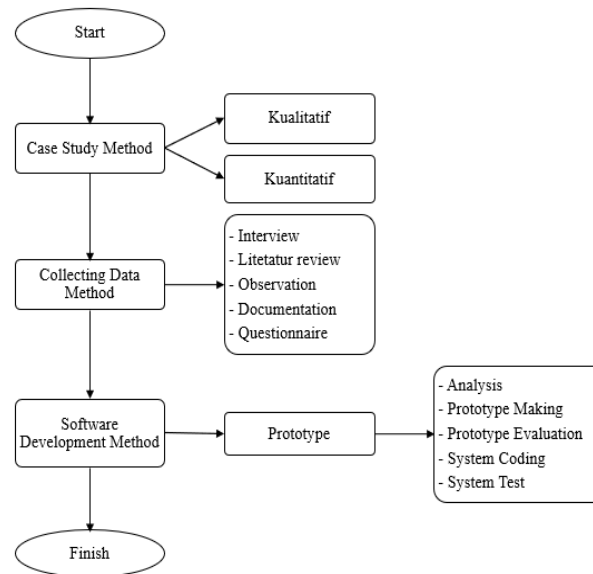


Figure 1. Research Flow of Augmented Reality-Based Medicine Plants Learning Applications

2.2 Method of Collecting Data

To obtain the data needed for the research, the author uses a hybrid research method (qualitative and quantitative) to support the implementation of the research. The qualitative research method of the object under study is natural, not manipulated, as it is based on the facts found in the field and quantitative methods in the form of filling out respondent questionnaires. Some of the data collection techniques are as follows:

a. Observation

In this method, the researchers conducted a site survey to collect plant data in Moyo Hilir District Health Center. This survey was conducted to find out what plants are often found in the community around them. From the results of observations obtained by researchers is data on medicinal plants and data on medicinal plants that often exist in the community.

b. Interview

An interview is a method of collecting data with the process of obtaining information for research purposes by way of questions and answers face to face. Interviews are divided into 2, namely closed and open. From the results of interviews obtained by researchers, it can be concluded that (1) people are still unfamiliar with medicinal plants, (2) people do not maximize existing natural resources, (3) many people use chemical drugs and (4) people's interest in studying medicinal plants is very low.

c. Documentation

The documentation stage is the stage where the researcher takes data in the form of photos or pictures of the staff concerned at the Moyo Hilir District Health Center.

d. Literature Study

Literature study is one of the data collection techniques sourced from books and documents related to the system built on research. Based on the literature study, the researcher obtained a book documentation of medicinal plants, where in the book there are medicinal plants that have many benefits.

e. Questionnaire

Research data collection method uses a list of questions that must be answered by the respondent.

2.3 Software Development Method

The steps in Prototype mode are as follows: [16]

a. Analysis

At this stage, a needs analysis was carried out by collecting data, while the steps taken were using five methods, namely observation, documentation, interviews, library studies and questionnaires.

b. Prototype Making

After getting all the requirements needed to develop the application, the prototype is made. The initial stage is system design using the UML technique. Then the second stage is doing data design. The last stage is interface design.

c. Prototype Evaluation

The evaluation was carried out by holding discussions with the Moyo Hilir District Health Center. Discussion about the feasibility and suitability of the prototype that has been made.

d. System Coding

After the prototype that has been built has been completed and then evaluated, if it is in accordance with what is being studied, the coding process will be carried out. At this stage, the program coding uses the C# programming language, and Unity to build applications.

e. System Test

The system that has been completed is then tested for the system. To determine whether the software is suitable for use or needs to be refined again. In this study, testing of the prototype will be done using the black box testing method.

3. RESULT AND DISCUSSION

3.1 Analysis

At this stage, a needs analysis was carried out by collecting data, while the steps taken were using five methods, namely observation, documentation, interviews, library studies and questionnaires. The results of the analysis in building the application to be built include the needs of hardware (hardware), software (software), users, and data. The hardware requirements used by researchers in the development of this application are Laptops and Smartphones. The software requirements in the development of this application are as follows

Table 1. Software Requirements

Number	Software	Version
1.	Windows	10 Pro
2.	Unity 3D	2018.4.17fl Personal
3.	Blender	2.8
4.	SDK	25
5.	Photoshop	2014CC
6.	Draw.io	V 10.6.5
7.	Corel Draw	X7 64 bit

Then, user needs in using this application are:

- At least the application uses Android version 4.1 JellyBean
- Users play the application without having to use a login account first.
- Users use the application using the android camera kamera
- The initial display of the application displays the play, guide, learning and quit menu
- Users can interact with objects in the application by using the camera on a smartphone to scan 2D images and then move the camera towards the intended object.

In designing applications for the introduction of medicinal plants based on augmented reality, data is needed to create applications. The application needs medicinal plant data and information about medicinal plants.

3.2 Prototype Making

The initial stages of making a prototype introduction of augmented reality-based medicinal plants include the system design stage using the Unified Modeling Language (UML). Based on the results of interviews conducted by researchers at the Moyo Hilir Health Center, the proposed system is the introduction of augmented reality-based medicinal plants as a learning medium.

a. Proposed System

The design of the introduction of augmented reality-based medicinal plants includes Use Case Diagrams, Activity Diagrams, and Sequence Diagrams. Use Case diagrams explain the relationship between system users (actors) and process activities in the introduction of augmented reality-based medicinal plants. In the introduction of augmented reality-based medicinal plants, there is only one actor, namely the user. To explain the use case diagram of the introduction of augmented reality-based medicinal plants, what will be built is described in the use case specifications of each actor. The following is a Usecase diagram for the user. The following use case diagram describes the interaction of the actor with the application.

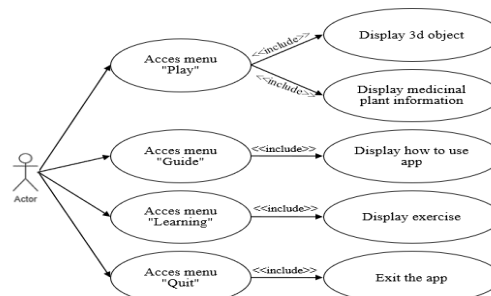


Figure 2. Usecase Diagram for Users

Next there is the Activity Diagram, which includes Activity Diagram Play, Activity Diagram Guide, Activity Diagram Learning. And then, the design using Sequence Diagram describes the process flow of each function contained in the augmented reality-based medicinal plant introduction application. In the sequence diagram play, the process starts when the user opens the application, then the system displays the main menu, then the user selects the play menu, then the user scans the image. After that, the user selects the image according to the object, then the system displays 3D objects, then the user presses the information menu icon, then the system displays crop information after which the user selects the back button to return to the main menu.

b. Database Design

Database design for an augmented reality-based medicinal plant recognition application which includes table structure and uses the Vuforia database with Unity software. There is 1 table in the database, namely the plant table. The database design on the plant table is as follows:

Table 2. Plant Database

Field	Description
Target Name	Option to delete an object
Type	Image
Rating	The image eligibility rating is given a value of 0-5 stars. The more detailed the image and the closer to 5, the faster the scan will be.
Status	Image status is active or not
Date Modified	The date, month and year of the image upload

c. Interface Design

The user interface design when opening the application is as follows:



Figure 3. Main menu interface design

The picture above is the display design when the user opens the application. The image above shows the main menu. There are four menu options, namely the play menu, guide menu, learning menu and quit menu. To select a menu, the user must press the desired button to open it. While the display design of the Augmented Reality-based Introduction to Medicinal Plants application when opening the application is as follows:



Figure 4. Application interface design

The picture above is a display design when the user is in the application. In the picture, above it displays a 3D object when the user has scanned the image of the desired object. The information menu interface design, the guide menu where when the user presses the guide menu it will display how to use the application, and the Learning menu which will display practice questions up to 10 numbers are as follows:

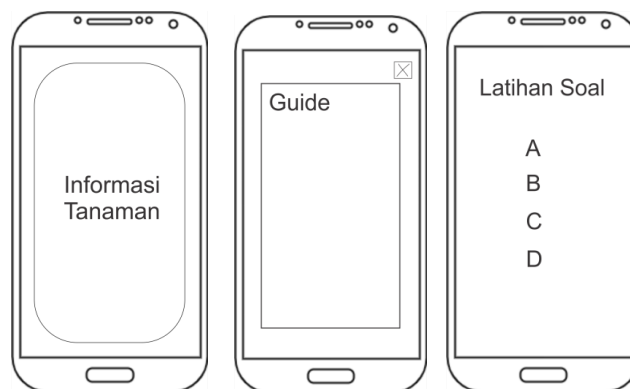


Figure 5. Interface Design of Information, Guide, Learning Menu

3.3 Evaluation of Prototype Design

Evaluation process of Augmented Reality-Based Introduction to Medicinal Plants. To find out what features will be contained in the medicinal plant recognition application so that it is comfortable and easy to understand when used by the user when used to scan images and easily manage the Augmented Reality-based Introduction to Medicinal Plants application.

3.4 Implementation Program

Implementation on the main menu page is before the user plays the application, where there are four menus, namely play, guide, learning and quit. One of these menus can be selected or clicked by the user to play the application. When the user opens the application, it will appear as shown in the following image.



Figure 6. Main menu

In the play menu, when the user scans the specified image, a 3D image will appear. For example, the user has an image of the medicinal plant aloe vera, then the image is scanned as shown in the following example.



Figure 7. Play Menu

If the information icon menu is pressed, a plant information page will appear according to the icon pressed. The information that appears is about a detailed explanation of medicinal plants, including the substances contained in plants and their benefits. Information menu display as shown in the following figure.



Figure 8. Information Menu

The display when the user selects the menu guide is a page on how to use the application. In addition, there is information about augmented reality. Display menu guide as shown in the following figure.

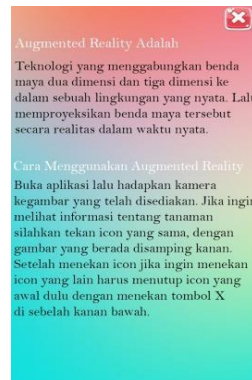


Figure 9. Guide Menu

When the user selects the learning menu, questions about medicinal plants will appear. There are 10 questions that can be done by the user. This question is a multiple choice question with four answer choices. This question will make the user more interested in using the application. The learning menu is designed with an attractive and communicative display, as shown in the following figure.



Figure 10. Learning Menu

3.5 System Testing

The results of software testing conducted by researchers using the black box testing method, namely testing the user system. Tests were carried out on the main menu, the play menu, the information icon menu, the guide menu, and the learning menu. The results of the functionality of all these items successfully passed the test and were in line with expectations. According to the implementation of program it can be conclude that the main menu is suitable for displaying

all existing menus. Then, the play menu, the information menu, the guide menu, and the learning menu shown in the table 3.

Table 3. Menu Testing

Cases and Test Results				
Menu	Actor Action	Which are Expected	Observation	Conclusion
Main menu	Starting system	Display main page	Figure 6	Suitable
Play menu	Opening the play menu	Display 3D object that match to the scanned image	Figure 7	Suitable
Information menu	Opening the information menu	Display information about the plant	Figure 8	Suitable
Guide menu	Opening the guide menu	Display how to use the application	Figure 9	Suitable
Learning menu	Opening the learning menu	Display questions about the medicinal plant	Figure 10	Suitable

In addition, data in the form of a questionnaire was also obtained to get feedback from users. The results are shown in the following table.

Table 4. Questionnaire Results

Category	Very bad	Bad	Medium	Good	Very good	Number of respondents
Display	0	1	5	3	1	10
Educative	0	0	3	5	2	10
Satisfaction	0	0	6	2	2	10
Interactive	0	0	3	5	2	10
Music	0	2	4	3	2	10

Based on the results of the questionnaire in table 4, the application made by the author received a positive response from the respondents. In the display category, the majority of respondents chose moderate as much as 5 (50%), in the educational category, the majority of respondents chose good as much as 5 (50%), in the satisfaction category, the majority of respondents chose moderate as much as 6 (60%), in the interactive category, the majority of respondents chose good as much as 5 (50%), and in the music category, the majority of respondents chose moderate as much as 4 (40%).

4. CONCLUSION

According to the results of the analysis and system processes that have been carried out previously, the author can conclude that the Augmented reality-based Medicinal Plant Learning Applications was successfully created using the C# (C Sharp) programming language, Photoshop Blender, Unity and Vuforia to create applications. The features contained in Augmented Reality-Based Medicinal Plant Learning, namely the 3D object scan feature, so that can find out information about plants with scanned images, which that will useful for direct identification from an android mobile phone. With several features and technology used, this application can be an effective learning way especially for Medicinal Plant identification. The authors suggest that in the next stage in other research, for anyone that interest to develop advanced level of this research, the author recommend that the future project will be developed including: (1) added animation when 3D objects appear, that will improve user experience, (2) graphics of 3D objects are further improved to make them look more attractive, such as by using another software to render or the higher level of hardware, (3) adding features on how to use and dosage of medicinal plants, and (4) added other medicinal plant object from other region and country.

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