Augmented Reality on Android for Identifying and Learning about Orchids

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Abstract

Indonesia, as an agricultural country, has a wealth of various plants which are often used as ornamental plants because of their beauty, including the popular orchids. The diversity of orchids offers various opportunities for development, both for cut flowers and decoration. However, orchids are sensitive plants, requiring special care depending on the type, including growing media, water requirements, and proper temperature. Therefore, accurate information is very important for orchid fans. To answer this need, an Android-based application that utilizes Augmented Reality technology has been developed to make the delivery of information about orchid plants more interactive. Augmented Reality is a technology that combines 2D or 3D virtual objects with the real three-dimensional world, which then displays these virtual objects in real-time. With this technology, users can see 3D representations of orchids and get information through integrated video. The Multimedia Development Life Cycle method was used in developing this application, which aims to make it easier for users to understand various types of orchids and how to care for them. The Information Orchid Type Application (IJA) allows users to zoom and rotate 3D virtual objects of five types of orchid plants.

Keywords*: 3D Objects; Augmented Reality; Orchid; Orchid Plant Identification*

Abstrak

Indonesia, sebagai negara agraris, memiliki kekayaan beragam tumbuhan yang seringkali digunakan sebagai tanaman hias karena keindahan mereka, termasuk anggrek yang populer. Keanekaragaman anggrek menawarkan berbagai peluang untuk pengembangan, baik untuk bunga potong maupun hiasan. Namun, anggrek adalah tumbuhan yang sensitif, memerlukan perawatan khusus tergantung pada jenisnya, termasuk media tanam, kebutuhan air, dan suhu yang tepat. Oleh karena itu, informasi yang akurat menjadi sangat penting bagi para penggemar anggrek. Untuk menjawab kebutuhan ini, sebuah aplikasi berbasis Android yang memanfaatkan teknologi Augmented Reality telah dikembangkan untuk membuat penyampaian informasi tentang tanaman anggrek menjadi lebih interaktif. Augmented Reality adalah teknologi yang menyatukan objek virtual 2D atau 3D dengan dunia nyata tiga dimensi, yang kemudian menampilkan objek virtual ini secara real-time. Dengan teknologi ini, pengguna dapat melihat representasi 3D dari anggrek dan mendapatkan informasi melalui video yang terintegrasi. Metode Multimedia Development Life Cycle digunakan dalam pengembangan aplikasi ini, yang bertujuan

untuk memudahkan pengguna dalam memahami berbagai jenis anggrek dan cara merawatnya. Aplikasi Jenis Anggrek Informasi (IJA) memungkinkan pengguna untuk memperbesar dan memutar objek virtual 3D dari lima jenis tanaman anggrek.

Kata kunci*: Augmented Reality; Anggrek; Identifikasi Tanaman Anggrek; Objek 3D*

1. INTRODUCTION

Indonesia is an agricultural country that is rich in various types of plants. Indonesia has approximately twenty-five percent of the world's flowering plant species and is the seventh largest country with a total of 20,000 species. Forty percent are endemic to Indonesia [1]. This variety is why numerous flowering plants, possessing attractive forms, are utilized as decorative plants.

Ornamental plants provide vast resources that can be utilized as business opportunities. These resources are supported by several potentials, namely Indonesia is a tropical and subtropical agro-climate region, almost all ornamental plant agribusiness commodities in the world can be developed in Indonesia. Indonesia also has a relatively large area of land so that there is still quite a large space for the development of land based agribusiness, like ornamental plants in general. Technology and human resources for developing ornamental plants are relatively available in Indonesia [2]. One of the most popular ornamental plants is the orchid plant. According to botanists, in the world Indonesia has the most species of orchids (*Orchidaceae*), reaching 5,000 species. This high diversity of orchid species provides the possibility for the development of various types of orchids, both as cut flowers and as flowering ornamental plants [3]. Orchids are also known as eternal flowers, meaning that their existence knows no season and is liked by many people throughout the ages. Therefore, it is not surprising that scientists and orchid hobbyists continue to crossbreed various species of orchids with the aim of producing new, more attractive and more beautiful orchids [4]. Orchids are ornamental flower plants that have beautiful flowers. Orchids have been known since 200 years ago and since the last 50 years have been widely cultivated in Indonesia [5]. The largest orchid diversity in Indonesia is found in Papua, around 2,000 species. The statement was also reported by Solihah that the number of orchids in Papua is 2,000 species, as well as in Java as many as 731 species, Maluku as many as 820 species, Sulawesi as many as 548 species, and 1,118 species in Sumatra. [6]

A prevalent issue is the sensitivity of orchid plants to their growth environment, requiring proper water, temperature, and specific growing mediums, with each orchid variety necessitating unique care. Consequently, information becomes crucial for enthusiasts of orchids. It is necessary to enhance the way information is presented to make it more engaging, for instance, by employing augmented reality technology. In the field of agriculture, especially ornamental plants, augmented reality can be utilized as a learning tool in the maintenance of ornamental orchid plants.

Augmented reality is a technology that combines 2D or 3D virtual objects into a 3D real environment, then projects these virtual objects in real time [7]. Virtual objects can be displayed into real objects through markers. A marker is a pattern designed in the form of black dots that can be recognized by a webcam. Markers are the key to AR. Marker information will be used to display 3D objects [8]. Marker detection is known for two methods, namely one marker (single marker) and many markers (multi marker). Single marker method is a method of camera tracking objects captured only one means, when the smartphone camera scans, one marker will issue a 3D object [9]. Multiple marker is a development method of single marker. In single marker AR the camera can track objects captured by only one marker. While multiple marker AR cameras can track objects captured by more than one object. At the time of implementation, angle recognition with various forms of markers can be done using several approach methods that can be done, such as component labeling and angle detection [10]. 3D modeling is a process of creating 3D objects that want to be expressed in real visual form through certain tools. Rendering is the final process of the modeling process where all data that has been entered in the process of modeling, animation, texturing, lighting will be translated in the form of a final display output on the model and animation [11]. There are two methods developed in augmented reality, namely.

a. Marker Augmented Reality (Marker based Tracking) This method performs object detection on a marker which is usually illustrated as a black and white square with thick black borders and a white background. The computer will recognize the position and orientation of the marker and create a virtual world in 3D in the form of points (0,0,0) and 3 axes (X, Y, Z) [12].

b. Markerless Augmented Reality With this method, users do not need to use a marker to display digital elements, but with the tools provided by Qualcom for mobile device-based AR development, it is easier for developers to create markerless applications [13].

This study develops an application utilizing Augmented Reality technology for introducing orchid species (*Orchidaceae*) through Android. The creation of this application will follow the multimedia development life cycle methodology. The application will feature details about various orchid types and will include 3D models and YouTube links for additional video information, enhancing engagement and comprehension. The aim of this application is to assist in delivering knowledge about different plant species and their maintenance.

2. RESEARCH METHODS
2.1. Types of research

This research uses the development method multimedia development life cycle [MDLC] which has been modified by Sutopo in 2009 has 6 (six) stages, namely concept, design, material collecting, assembly, testing and distribution [14]. The MDLC diagram can be seen in Figure 1.
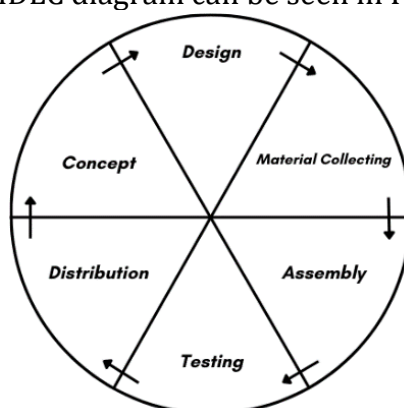

Figure 1. Multimedia Development Life Cycle [14]

The stages of the MDLC referred to in this research are as follows [14]:

a. Concept

At the concept stage, it starts with determining the purpose of making the application and determining the user of the application. In this research, the purpose of making an application to detect an object using augmented reality technology. augmented reality technology

b. Design

The purpose of the design stage is to create a detailed specification of the project's architecture, style, and material requirements. the project architecture, style, and material requirements for the project. for the project.

c. Material Collecting

At this stage, the collection of materials such as clipart images, animations, audio, along with the creation of graphic images, photos, audio, and others needed for the next stage. Materials that materials needed in multimedia can be obtained from sources such as libraries, existing materials from other parties, or special creation. libraries, materials that already exist in other parties, or special preparations made by outsiders. done by an outside party.

d. Assembly

The assembly stage is the stage where all multimedia objects are created. multimedia objects are made. System creation is based on storyboard, flowchart view, navigation structure, or object diagram derived from the design stage.

e. Testing

This is done after the manufacturing stage is complete and all data has been entered. First, modular testing is carried out to ensure that the results are as desired.

f. Distribution

When the multimedia system will be used with different machines, duplication using a flash disk, or CD-ROM. A system or application usually requires many different files, and sometimes they are very large. Files are best when they are placed in an adequate storage medium.

2.2. Research Target

The purpose of this research is to implement augmented reality on the introduction system of orchid plants to create an application that is more interactive and can interact with 3-dimensional objects such as zoom and rotate functions in realtime. Creating 3D virtual objects of ornamental orchid plants equipped with related information from each type of ornamental orchid plant. Get good User Acceptance Testing results on each statement tested.

2.3. Procedure

The research stages are divided into several parts, namely literature study, data collection, system development, and report writing. The stages in the research can be seen in the flow chart in Figure 2.
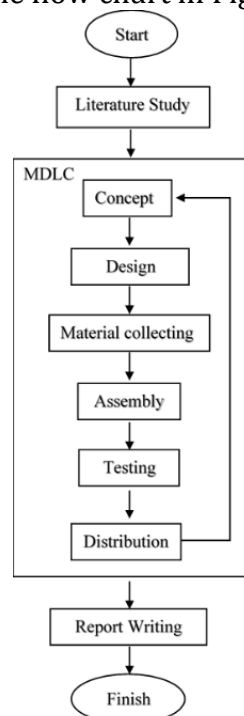

Figure 2. Research Flow

a. Literature study

Literature study is a stage that is carried out to understand the concept of Augmented Reality and find references for the development of an orchid flower type recognition system using Android based augmented reality.

b. Concept

The Concept stage determines the goal, which is to create an introduction system to orchid plants with Android-based augmented reality technology, the target user (audience) is an orchid hobbyist and people who are interested in orchid plants, determining the specifications of the devices used in making products and the ability of product users.

c. Design

The design stage is carried out by designing a simple application business process using CRC Cards, Storyboards, designing application interfaces, designing markers, and designing functions in the application.

d. Material Collecting

Material Collecting is collecting materials needed to support the development of this application. The materials needed are Markers, photos of orchids that match the type of orchid and its source, videos explaining the maintenance of orchids that come from the Youtube platform, software and hardware devices needed in the process of making Augmented Reality applications.

e. Assembly

The next step is realized in the form of program code. Implementation is done starting from giving the function of each button. Implementation is done using Unity3D with C# programming language and Vuforia SDK to connect the marker with AR Camera.

f. Testing

In this study, two stages of testing were carried out, namely initial testing and final testing. Initial testing using the Black Box Testing Equivalence Partitioning method using test scenarios, expected results and test results to see whether the system runs accordingly or not [15]. The final test uses the User Acceptance Testing method using a Likert scale which contains questions about the system and answers in the form of strongly agree (SS), agree (S), neutral (N), disagree (TS), strongly disagree(STS) as in Table 1[16].

Table 1. Skala Likert [16]

Satisfaction Levels	Code	Scale
Strongly Agree	SS	5
Agree	S	4
Neutral	C	3
disagree	TS	2
strongly disagree	TST	1

The following is the calculation carried out to get the results of UAT testing, which can be seen in the following equation [16].

$$P = \frac{S}{ideal\ score} \times 100\%$$

Description:

P = Presentation value searched

S = The number of frequencies multiplied by the score that each answer has

Ideal Score = The highest score multiplied by the number of samples

g. Distribution

Furthermore, at this stage the finished application is then stored in a storage medium such as a hard drive, a memory card of some kind or can be downloaded on the Google Drive link.

3. RESULTS AND DISCUSSION

Application Informasi Jenis Anggrek (IJA) is an augmented reality application that can display 5 types of orchid plants in the form of 3-dimensional objects equipped with detailed information about each type of ornamental orchid plant. The information provided is in the form of a description of the type of orchid, photos of orchids and maintenance videos based on the type of orchid. Interaction that can be done by users is to rotate the position and zoom 3D objects directly using the touch screen of an Android smartphone. This IJA application also provides a marker download feature so that users can easily get markers to display orchid plants. In addition, this application is also equipped with a guide feature that contains how to use the application, and an about application feature that contains information about this application. Figure 3 is a view of the IJA application.

Figure 3. Main Menu Page Display

Figure 3 is the display of the main menu page which is the display after the splash screen. In the main menu there are 5 (five) menu options, namely select AR Camera (Kamera AR), About Application (Tentang Aplikasi), Guide (Panduan), Download Marker (Unduh Marker), and exit (Keluar).

Figure 4. AR Camera Page and Dendrobium Orchid Description Page

Figure 4 is the AR Camera display when scanning the dendrobium orchid marker and the dendrobium orchid description page display.

Figure 5. About App Page Display

Figure 5 is a display of the menu page about the application that contains information about the application and a back button that functions to the main menu.

Figure 6. App Guide Page Display

Figure 6 contains a guide to the use of the application as well as an arrow button that functions to the next guide slide.

3.1. BlackBox Testing

This test was conducted by 4 (four) testers using Android smartphones with different specifications. The results of all functional testing from the 4 testers were successful for each test scenario of various features according to their functions using smartphones with different specifications.

3.2. User Acceptance Testing

This test involves testing the software based on the non-functional requirements that have been defined at the concept stage. The next stage respondents give an assessment by filling out a questionnaire on the Google Form page that has been given. This non-functional test has 5 (five) interpretations of the assessment with criteria, namely strongly agree (SS), agree (S), usually (B), disagree (TS), and strongly disagree (STS) Non-functional testing involves 33 (thirty-three) respondents to get an assessment of the application that has been developed. Figure 7-9 is the

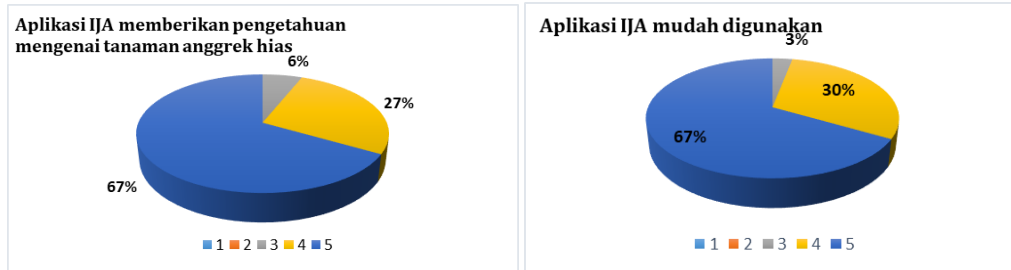result of respondents' assessment of this application from several statements given:

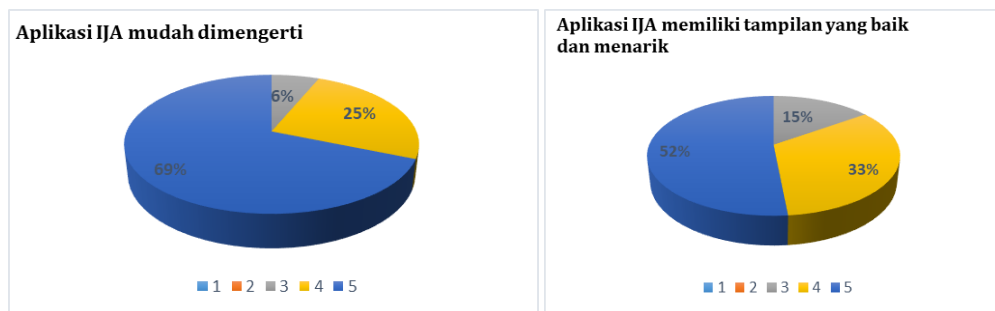Figure 7. Results of Respondent Research on Statement 1 & 2

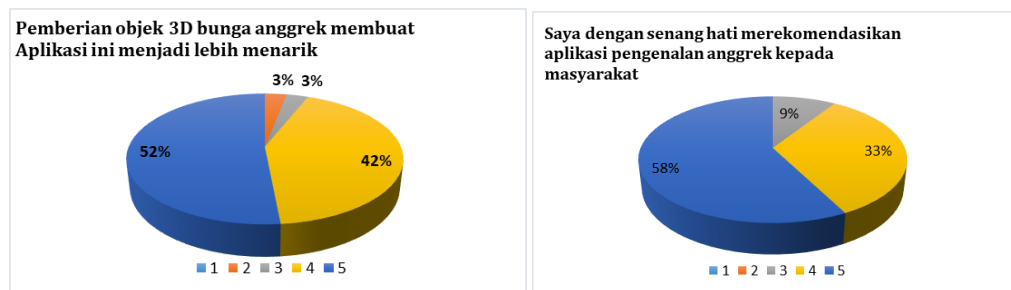Figure 8. Results of Respondent Research on Statement 3 & 4

Figure 9. Results of Respondent Research on Statement 5 & 17

4. CONCLUSIONS

The conclusion of the research indicates that the Orchid Type Information Application (IJA) was successfully developed using Augmented Reality technology, incorporating features such as zoom and rotate on 3D virtual models of five different orchid types. These models are accompanied by informational and maintenance videos for each orchid type. Recommendations for future development include enhancing the 3D model quality and user interface, developing a website version, integrating videos directly into the app, and expanding the range of 3D orchid types available for interactive engagement.

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