Augmented reality as a media for Reog Ponorogo art figure introduction

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Augmented Reality as a Media for Reog Ponorogo Art Figure Introduction

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Abstract. Technology has currently been developing, from various sectors or fields, technology is inarguably required to support human activities. One of which is the use of augmented reality technology in education as a learning medium. Augmented Reality contains a combination of virtual objects and real objects that previously went through a computerized process, simulating a-nearly-real look of an object. By using augmented reality technology, this study aims to introduce characters from the android-based Reog Ponorogo art, including the art and the character or figures. Development has been conducted through the waterfall method, which consists of needs analysis, system design, implementation, testing and maintenance. The process is initiated with creating 3-dimensional (3D) characters using blender software. The user interface (UI) and the detection system is conducted by using the Unity Game Engine software. The testing is conducted by testing white box testing and black box testing. Meanwhile, the result of the tests indicates that the Reog Ponorogo character recognition application using augmented reality technology displays the smooth operation of application. Judging from the white box testing results obtained, which include: Cyclomatic Complexity (CC), Region (R), and independent path. In addition, the obtained results present similar values from the calculations according to the formula. In addition, the black box testing the application runs smoothly on the 3 android devices, which are: Xiaomi Mi 9, Google Pixel XL, Sony XZ1.

INTRODUCTION

Technology has been currently expanding, from various sectors or fields, in which technology is required to support human activities. In the field of education, technology plays a vital role in assisting the teaching process and providing information on learning materials, ranging from books, physical teaching aids and modern ones using augmented reality (AR) technology.

Augmented Reality refers to a combination of virtual objects and real objects that previously went through a computerized process [1][2]. To date, the role of technology is widely applied for augmented reality, such as in the field of product marketing, health, and education. Additionally, augmented reality provides real visuals in the form of 3 dimensions in presenting the information, thereby presenting clearer and more interactive information to users and at the same time users can obtain the information [3]. AR was previously selected as the technology to develop Reog recognition applications in this study.

Reog Ponorogo is an open art dance that is used as people's entertainment. In the diary written by KH. Mujab Tohir, the art of Reog was originally called "Barongan" [4]. Reog itself is an art that comes from the city of Ponorogo, East Java. In the Reog dance, there are several roles of figures involved in this artistic dance, namely barongan (dadak merak), jathil, warok, prabu klono Sewandono, bujang ganong. Each of these figures has a different role in the dance arts. This Reog character application aims to introduce the characters who play a role in the Ponorogo Reog dance. Thus, wider community can recognize the art of Reog not only from its outward appearance, originating from the city of Ponorogo, but also understands the actors or characters who play the Reog dance. In addition, in the introduction of media, augmented reality media could additionally provide interest in learning history.

Based on the aforementioned review, it is emphasized that *augmented reality* in the world of education has been useful in providing information in the form of a real picture of the material to be delivered [5]. In addition, using this technology offers a more interactive media in the introduction of the art figures of Reog Ponorogo, as the world of education is only based on using books which only display the 2-dimensional (2D) images or visualizations.

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METHODS

System Development Life Cycle (SDLC) Waterfall model contains a method of developing a system sequentially starting from the top step to the bottom, which is similar to the structure of a waterfall. Initially, the Waterfall model was proposed by Winston W. Royce in 1970 to illustrate the concept in developing software engineering systems [6]. Several stages are required when using the Waterfall model, completed one by one and moved to the next stage. The overview of the Waterfall model is visualized in Figure 1.

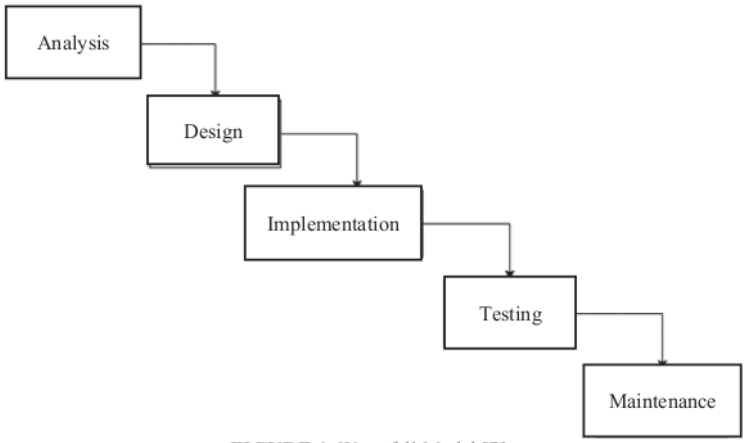


FIGURE 1. Waterfall Model [7]

1. **System Analysis**

   In attempt to resolve the problem in the system, the first step is conducted to define a problem and then re-evaluate it. The created system serves as an information system based on augmented reality, as a medium for introducing the art figure of Reog Ponorogo (case study: S*anggar Reog Singo Hamengkudjoyo*). In this case, the developer analyzes the running of the system by utilizing use case diagrams, consisting of the interaction between one or more actors of a system. In general, use cases are employed to understand a system and its features [9]. The following chart depicts an image of a use case diagram of an augmented reality system for the introduction of the Reog Ponorogo character.

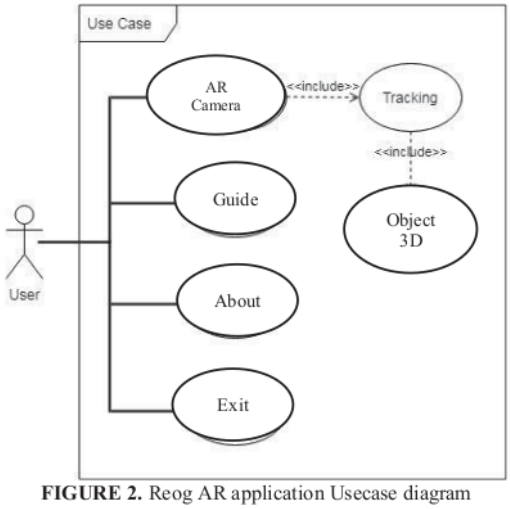


FIGURE 2. Reog AR application Usecase diagram

Figure 2 from the use case above, the user is an actor who runs an augmented reality (AR) based application. Further, the user opens the application, offered by several menus in the application, including: Start (AR camera), guide, about, and exit.

2. System Design

At the system design stage, the author uses the system architecture to design the application system that will be created. The system architecture model of the application is visualized as Figure 3.

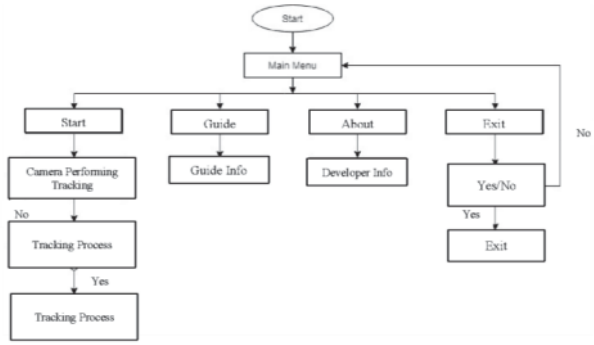


FIGURE 3. Reog Ponorogo AR system architecture

Figure 3 describes the flow of how the application works. From the description of the system architecture above, there are several menus, which are: the start menu, guide, about, exit.

3. Implementation

At the implementation stage, the developer uses several supporting software in making Augmented Reality applications as a Reog Ponorogo Character Recognition Media. The software to create 3D objects is Blender. In addition to developing Augmented Reality technology, both Unity Game Engine and Easy AR are also included.

4. Testing

In conducting testing, the developer uses the 2 types of tests, which are Black Box and White Box testing. White Box testing contains a test of the algorithm flow and graph matrix, often used in Cyclomatic Complexity (CC), using a software matrix that determines the complexity of the program logic that can guarantee that all independent paths in the module are conducted at least in one time. Meanwhile, Black Box testing refers to a test that focuses on the appearance and function of each menu and also the existing features, which are in accordance with the previous planning in building the application [8].

RESULTS AND DISCUSSION

The results and discussion of the augmented reality-based Reog Ponorogo introduction application are explained according to the manufacturing flow.

1. User Interface Implementation

The following description presents the result of the application Augmented Reality as a Media to introduce Reog Ponorogo Art Figures (Case Study: *Sanggar Reog Singo Hamengkudjoyo*). This application is installed on android devices with a resolution of 16:9 (1440 x 2560) px. In the display menu, there are several menus having their respective processes and functions. The following Figure 4 visualizes a menu display of the Reog Ponorogo character introduction application, employing augmented reality.

FIGURE 4. Application menu display

There is a start menu that has the function of starting to display a 3D model of the Reog Ponorogo character using AR. Guide menu has the function of providing information on how to use the application. About menu contains the function of displaying developer information. Exit menu serves to exit the AR application.

2. System Test

After the Reog character recognition application using augmented reality was successfully created, the system was tested. The tests used were white box testing and black box testing.

A. White Box Test

The White Box test is a software test to determine the complexity of the program logic [10]. In white box testing, two tools are used, which include: a flowgraph which is useful for describing the flow of the algorithm and a graph matrix that is used to generate a flowgraph. In this test, testing of the entire system and testing of the AR detection feature was conducted.

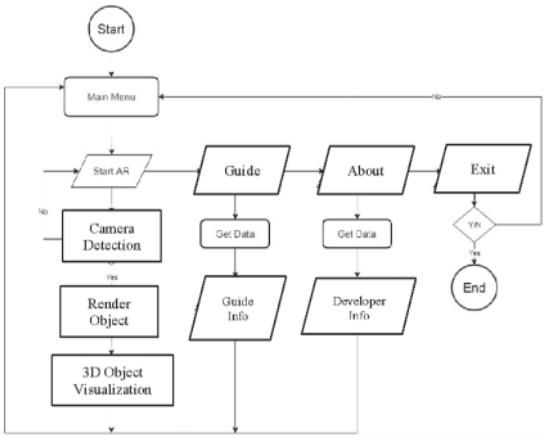


FIGURE 5. Flowchart of AR Reog Ponorogo

Figure 5 presents a flowchart of the entire course of the AR Reog Ponorogo introduction application. Further, the flowchart is converted into a flowgraph to make quantitative calculations easier on the complexity of the program. Thus, the flowgraph application flow is displayed as Figure 6.

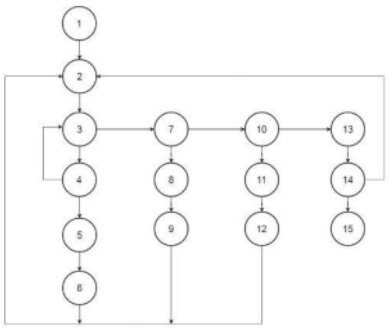


FIGURE 6. Flowgraph of AR Reog Ponorogo

Cyclomatic Complexity (CC): a quantitative measurement of the complexity of a program from a flowchart can be calculated by the following Equation 1 and Equation 2.

$$V(G) = E - N + 2 \tag{1}$$

$$V(G) = R \tag{2}$$

In which:
V(G) = *Cyclomatic complexity graph*
R = Number of regions in flowgraph
E = Number of edges
IP = *Independent Path*
N = Number of nodes (dots)

Thus, Cyclomatic Complexity obtained the following results:

$$V(G) = 19 - 15 + 2 = 6$$

$$V(G) = R = 6$$

The basis set generated by the independent path linearly is illustrated in Table 1 and Table 2.

TABLE 1. Independent Path base set

Number	*Independent Path*
1	1 – 2 – 3 – 4 – 5 – 6 – 2
2	1 – 2 – 3 – 4 – 3
3	1 – 2 – 3 – 4 – 7 – 8 – 9 – 2
4	1 – 2 – 3 – 7 – 10 – 11 – 12 – 2
5	1 – 2 – 3 – 7 – 10 – 13 – 14 – 15
6	1 – 2 – 3 – 7 – 10 – 13 – 14 – 2

TABLE 2. White Box test results

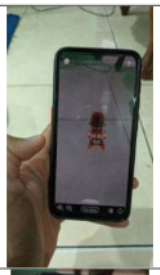
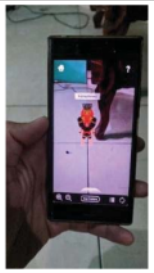
App Name	Expected results		
	CC	Region	IP
AR Reog Ponorogo App	6	6	6

In glance, the white box testing indicates that if the number of cyclomatic complexity, region, and independent paths presents similar value, which is for the Reog Ponorogo AR application on the independent path (1 – 2 – 3 – 7 – 10 – 13 – 14 – 15), it is concluded that the logic of the application runs correctly without any errors, conversely if the value is not similar, then there is an error from the application.

B. Black Box Test

Black Box testing is focused on the appearance and function of each button and feature in the AR Reog Ponorogo application. Prior to the program operation, if appearing *en masse*, the program is thus ready for use. The following presents a Table 3 of application test results, conducted through different mobile devices:

TABLE 3. Display on Multiple Mobile Devices

Number	*Device*	Results	
		Display 1	Display 2
1.	Xiaomi Mi 9		
2.	Google Pixel XL		
3.	Sony XZ 1		

It is acknowledged that the application runs normally when installed on multiple device versions, and the system will run on an android device of at least OS version 4.4 (KitKat).

CONCLUSIONS

From the process of developing augmented reality applications as a medium for introducing the Reog Ponorogo character, the following conclusions are withdrawn:

1. Based on the results of the implementation, the development of the Reog Ponorogo character recognition application using augmented reality technology was successfully built and can display 3-dimensional (3D) Reog Ponorogo objects or characters as presented in Table 3 when tested on 3 android smartphones with different specifications.
2. In white box testing, there are 2 ways, including the independent path basis test and the graph matrix test. The independent path basis test is conducted by testing the flowgraph of the entire application. Thus, the results of the independent path basis of the entire application are 1 - 2 - 3 - 7 – 10 – 13 – 14 – 15, and for AR detection obtaining independent path basis of 1 – 2 – 3 – 4 – 5 – 6 – 7. White box test results are obtained when Cyclomatic Complexity, Region, and Base Independent Path are equal, and logic of the application runs correctly.

3. In black box testing, this augmented reality application runs smoothly where from the appearance and usage test, this application has met the requirements.

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