Design of Computer Assembly Learning Media Using Augmented Reality

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Abstract. Augmented reality is considered an essential technology in the education sector. It employs sensory immersion, navigation, and information manipulation to promote emotional mediators for improving the learning process and learning outcomes. Augmented reality has two categories for displaying 3D images, namely using markers and not using markers (markerless augmented reality). Markerless Augmented Reality utilizes pop code to place data into the created image. This research utilise waterfall method to develop an augmented reality application in android smartphone. Testing is done by the black box method. The results show the application runs well on the android operating system above android 4.0 (KitKat).

Keywords: Augmented Reality, Markerless Augmented Reality, Android Application

1 Introduction

Augmented Reality (AR) is a new technology that has emerged from virtual reality. This method primarily improves the user's perception of the real world by using information provided by the computer system, and reality can be "augmented" by superimposing computer-generated virtual objects, scenarios, and system prompts on the real scene[1]. It primarily assists humans in displaying inaccessible scenes in the real world[2]. Augmented reality is considered an essential technology in the education sector. It employs sensory immersion, navigation, and information manipulation to promote emotional mediators for improving the learning process and learning outcomes[3][4]. The most appealing aspect of this concept of augmented reality is the incorporation of the real world as an environment, without the need to abstract to an unreal world, allowing us to become more immersed in the experience of that reality[5]. Augmented Reality encourages people to experience enhanced artificial reality to represent real objects by using technology devices such as smartphones, tablets, and personal computers with cameras[6][7].

Augmented reality has two categories for displaying 3D images, namely using markers and not using markers (markerless augmented reality). Markers are computer graphics symbols that are created and printed on paper to serve as a bridge between 3D models and

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smartphones[8]. The marker has a specific shape that will be identified to determine the compatibility and position, which is then visualized into a sound, image, or 3D model[9]. The form of marker can be 2D or 3D object. Markers must be registered before use because the application considers markers as the identity of the place to display virtual objects [10]. Markerless Augmented Reality does not rely on fiducial markers; however, systems rely on natural features for tracking execution[11][12]. Markerless Augmented Reality utilizes pop code to place data into the created image[13].

This paper examines the construction of computer assembly learning media using augmented reality technology. The application will be develop using Waterfall method. This research will produce an augmented reality application that can be run on an android smartphone without using a marker.

2 Methods

This reasearch used waterfall methods to develop the application. Waterfall is a one-way method starting from the analysis stage to maintanance[14]. The research begins by conducting an analysis to determine the requirements specification in the application. Determination of requirements begins with conducting interviews with lecturers and students, reviewing semester learning plans and searching for computer assembly teaching materials. Based on the requirement that have been obtained, application design is made according to the user's needs. The application design is made in the form of activity diagrams to make it easier for programmers to translate user needs into programs. At this stage the application building components are collected, such as 3D drawings of computer components and application software builders. Furthermore, the application is built using the Unity software and the Java programming language. The final product is in the form of an apk extension that can be installed on an Android smartphone. This research ends in the blackbox testing phase to ensure all functions and features in the application run well.

3 Results and Discussion

3.1 Application Development

Requirements analysis is the first stage in the development of this application. The analysis that carried out got the results that students of information technology education had difficulty understanding the shape and function of the components in the computer. The lecturer complained about disassembling the computer to see the components in the computer causing some damage to the components. Therefore, an android application with augmented reality was made to describe computer components more realistically with 3D images without disassembling the computer. Applications are made using Figma, Unity, and Vuforia software. The storyboard and user interface design of the application were made using Figma, the development of the Android application was made with Unity, and Vuforia was used as an augmented reality extension in Unity.

Based on the analysis, a design is made according to the needs of students and lecturers. At this stage an activity diagram is made to understand the flow of application usage and understand process activities in the application[15].

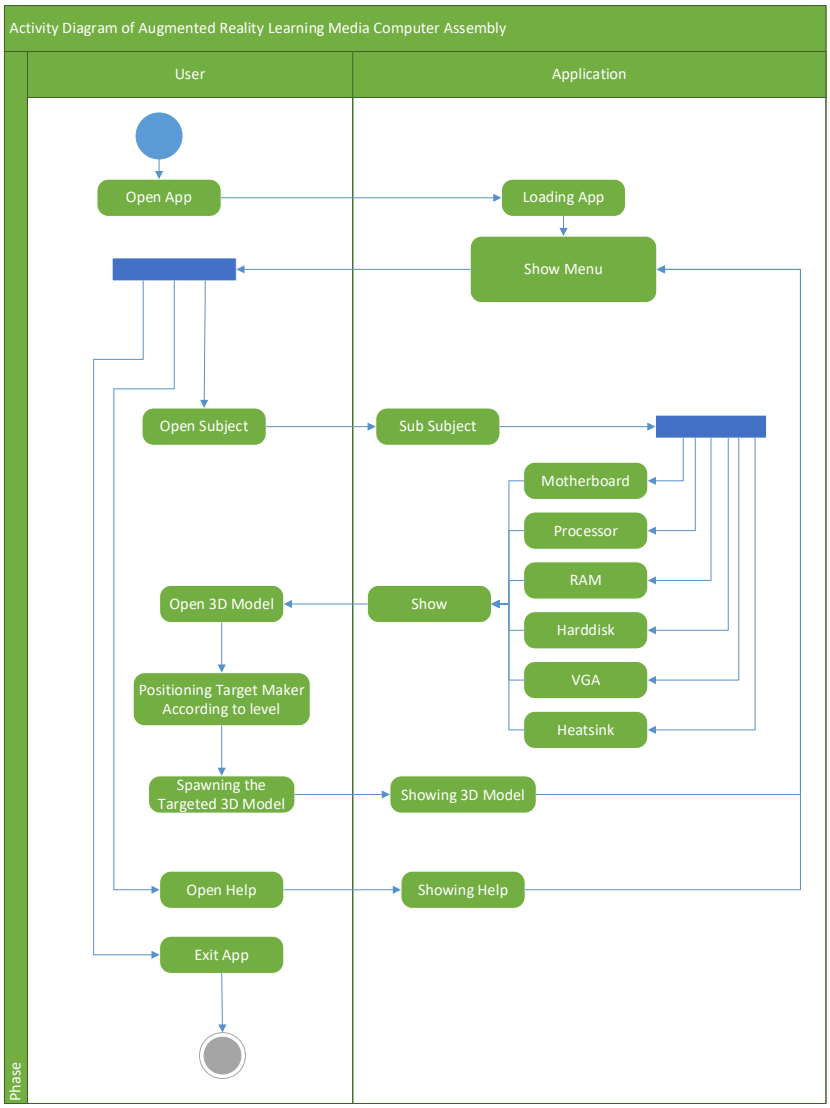

Fig. 1. Activity Diagram

Furthermore, the 3D component images, learning materials, and user interface designs that will be used are collected. From the activity diagram it can be seen that the user can do several things in this application. If user wants to learn the subject, user must open the subject, after that there will be sub- subject that can be studied. To view 3D objects, user can open the 3D model and then position the smartphone so that the 3D object can be seen. In this application there is also a help menu to help users understand the use of the application.

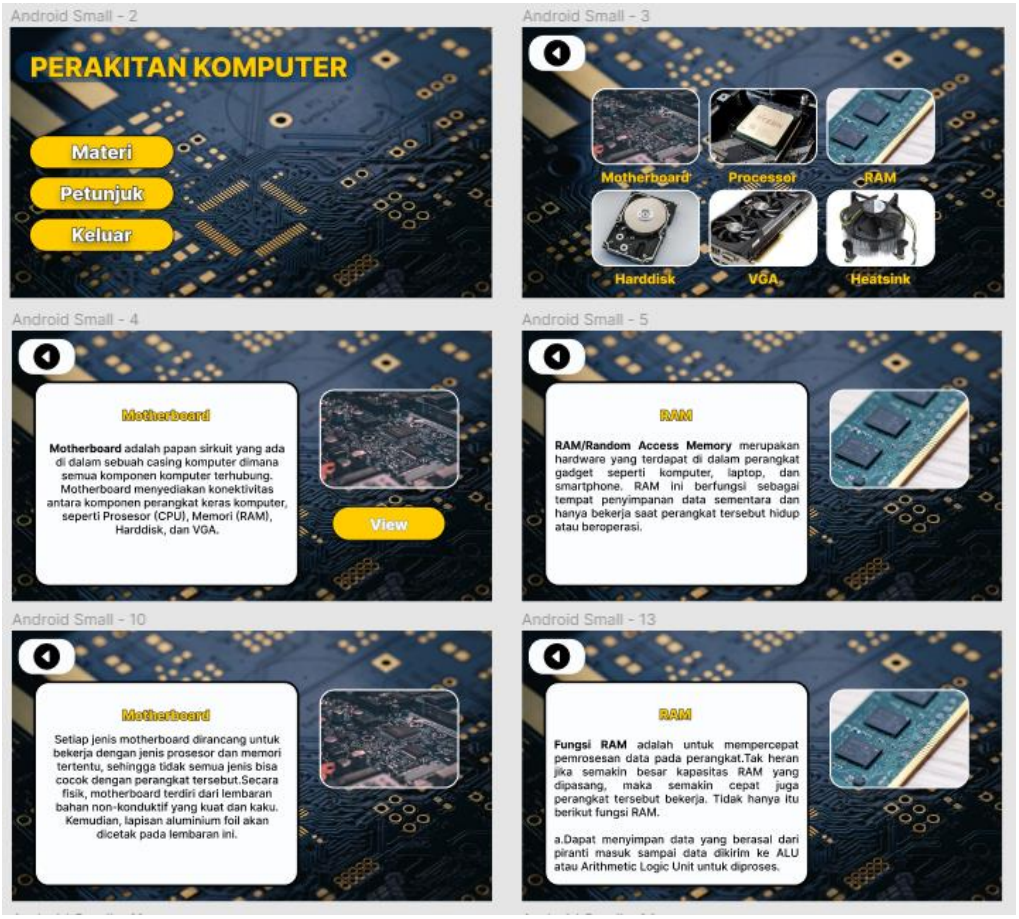

Fig. 2. User Interface Application

Next, the application development begins according to the needs and designs that have been made in stage two. Application development begins with uploading the design to the vuforia software as a database. Then change the user interface component such as button, background, menu, material, etc, and Covert UI become jpg/png data type. After all the needs for making the application are done, the application is built to get the .apk file that will be installed on the android smartphone.

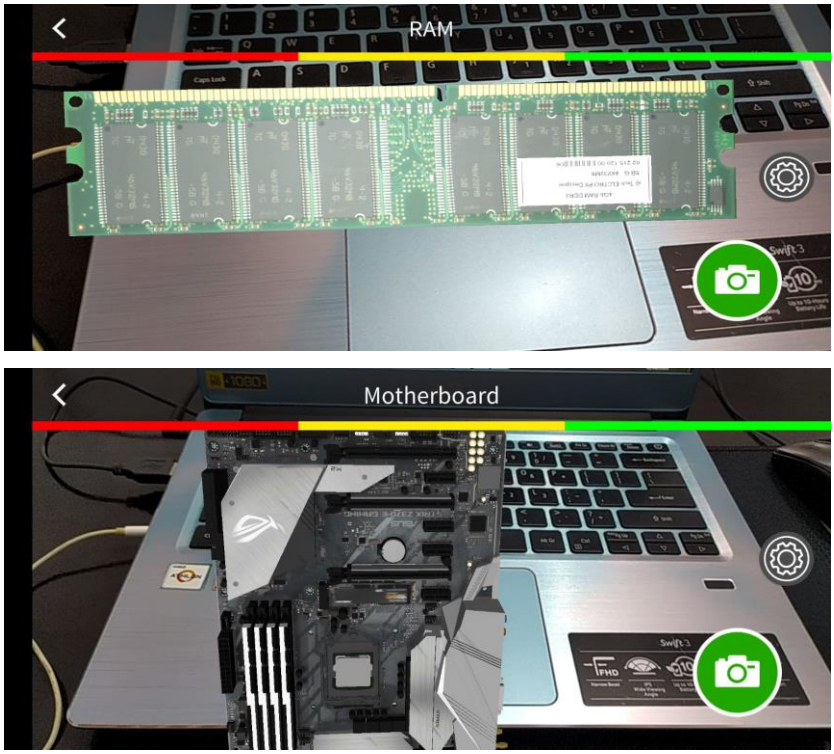

Fig. 3. 3D object on Application

3.2 Application Testing

The next stage is application testing. In this paper, we use black box testing to determine whether this application can be used as needed. Testing applications using blackbox serves to test all features in the application to function properly. This test looks at the results of input and output from the application without knowing the code of the application[16].

Table 1. Blackbox Test Results

No	Page	Test Element	Results obtained	
			Working	Not Working
1	Main Page	1. Main Menu Interface	✓	
		2. Button (Mulai, Petunjuk, dan keluar)	✓	
2	Subject Menu	1. Subject (Materi) Interface	✓	
		2. Button (Materi, Back)	✓	
3	Motherboard Menu	1. Motherboard Menu Interface	✓	
		2. Button (View, Back)	✓	
		3. Content Slider	✓	
4	Processor Menu	1. Processor Menu Interface	✓	
		2. Button (View, Back)	✓	

		3. Content Slider	✓
5	RAM Menu	1. RAM Menu Interface	✓
		2. Button (View, Back)	✓
		3. Content Slider	✓
6	Hard disk Menu	1. Hard disk Menu Interface	✓
		2. Button (View, Back)	✓
		3. Content Slider	✓
7	VGA Menu	1. VGA Menu Interface	✓
		2. Button (View, Back)	✓
		3. Content Slider	✓
8	Heatsink Menu	1. Menu Interface Heatsink	✓
		2. Button (View, Back)	✓
		3. Content Slider	✓
9	3D Object Motherboard	1. Motherboard Menu Interface	✓
		2. Level Target Maker	✓
		3. Button (Device Options, Target Maker, Back)	✓
		4. Touch Learn (Size Object, Position Object)	✓
10	3D Object Processor	1. Processor Menu Interface	✓
		2. Level Target Maker	✓
		3. Button (Device Options, Target Maker, Back)	✓
		4. Touch Learn (Size Object, Position Object)	✓
11	3D Object RAM	1. RAM Menu Interface	✓
		2. Level Target Maker	✓
		3. Button (Device Options, Target Maker, Back)	✓
		4. Touch Learn (Size Object, Position Object)	✓
12	3D Object Hard disk	1. Hard disk Menu Interface	✓
		2. Level Target Maker	✓
		3. Button (Device Options, Target Maker, Back)	✓
		4. Touch Learn (Size Object, Position Object)	✓
13	3D Object VGA	1. VGA Menu Interface	✓
		2. Level Target Maker	✓
		3. (Device Options, Target Maker, Back)	✓
		4. Touch Learn (Size Object, Position Object)	✓
14	3D Object Heatsink	1. Heatsink Menu Interface	✓
		2. Level Target Maker	✓
		3. Button (Device Options, Target Maker, Back)	✓
		4. Touch Learn (Size Object, Position Object)	✓

Based on the results of the blackbox test the application runs properly. All buttons and menus can run according to the function. The 3D display is clearly visible according to the input given wich is selected menu. Oleh karena itu aplikasi ini dapat digunakan

4 Conclusion

Computer assembly learning applications with augmented reality can be made using the waterfall system development method. This application can run well on android smartphones and display 3D images of computer components without using markers. Tests using blackbox testing show the application is running well and displays output that matches the input given.

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