

Design of Augmented Reality Based on Learning Media on The Subject of Computer Networking Fundamentals

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INTISARI

Pandemi Covid-19 menyebabkan seluruh proses belajar mengajar dialihkan menjadi online, termasuk mata pelajaran praktik. Namun demikian, metode pembelajaran online tidak efektif diterapkan untuk mata pelajaran praktikum. Kondisi ini tentunya merugikan siswa Sekolah Menengah Kejuruan (SMK) Negeri 1 Bukittinggi khususnya siswa TKJ kelas 10 yang mempelajari praktikum perakitan dan perawatan komputer. Penelitian ini bertujuan untuk mengembangkan media pembelajaran berbasis Augmented Reality untuk materi perakitan dan perawatan komputer. Media pembelajaran ini menampilkan perangkat keras dan peroses perakitannya dalam bentuk 3D. Metode yang digunakan dalam perancangan media pembelajaran ini adalah Research and Development (R&D). Hasil perancangan media pembelajaran ini adalah terkembangnya media pembelajaran berbasis AR. Untuk membuktikan aplikasi dapat berjalan dengan baik, maka dilakukan pengujian dengan metode black box. Dengan begitu, diharapkan siswa kelas X Jurusan Teknik Komputer dan Jaringan dapat melaksanakan praktikum secara virtual.

Kata kunci: Media Pembelajaran, Komputer, Augmented Reality.

ABSTRACT

The Covid-19 pandemic caused the entire teaching and learning process to change online, including practical subjects. Unfortunately, online learning is not effectively applied to practicum subjects. Based on a google form survey. 83% of tenth-grader of Computer and Network Engineering major students at the State Vocational High School 1 Bukittinggi have difficulty understanding online practicum materials. One of the materials that must be studied is the assembly and maintenance of computers. The purpose of this research is to develop an Augmented Reality based on learning media for computer assembly and maintenance materials. This learning media display 3D models, 3D animation, and videos about assembling computer hardware, along with an explanation of its functions and maintenance. The method of this media development uses Research and Development (R & D). The result is the development of AR-based learning media. To prove the application can run properly, then tested with the black-box method. By doing so, it is hoped that grade-tenth students of the Computer and Network Engineering Department can carry out virtual practicums.

Keywords: Learning Media, Computer, Augmented Reality.



INTRODUCTION

The Covid-19 pandemic has hampered all activities outside the home. To reduce the number of positive cases, the government of Indonesia implemented various ways to limit physical contact between individuals. The impact of this policy has forced public places to be temporarily closed, including schools. Because of that, the face-to-face

teaching and learning process in school turn into online teaching-learning at home.

However, Online learning method also has disadvantages. The most common problems with online learning are internet interference and the availability of devices for students. Moreover, this method is also ineffective if applied to practicum subjects due to limited tools and materials for students at home. So, online learning is ineffective

for vocational school students who have a 70% practicum curriculum.

Computer and Networking Fundamentals is one of the required practicums for tenth-grade Computer and Network Engineering students. Computer assembly and Hardware Maintenance practicum is one of the topics in this subject. This topic is difficult to learn online due to unavailable tools and materials for students at home. It is proven based on a google form survey for tenth-grade students at State Vocational High school 1 Bukittinggi. 83.3% of respondents could not understand this material on online studying, the problems faced by respondents include poor internet connections and the unavailability of tools and practicum materials at home. One of the solutions to this problem is by using learning media[1]. The model of learning media that can be applied in this situation is Mobile-learning. This model is carried out between places or environments using mobile phone technology that has learning applications in it[2]. Then, the type of mobile application that can be implemented in this mobile-learning is an Augmented Reality-based application.

1. Augmented Reality

Augmented Reality is a technology that combines digital data and human senses to appear integrated.[3]. In other words, this technology can mix digital objects (2D or 3D objects) and the real-world with real-time interaction capabilities[4]. It means that AR can simulate practical tools and materials in 3D by using devices[11][12].

2. Marker

Augmented Reality technology uses a marker to show 3D objects inside the application[5]. There are two kinds of markers: the marker method and the marker-less method. Augmented reality usually uses a 2D marker method in the form of paper containing programmed images.

3. Vuforia

Vuforia is an augmented reality technology used as a tool by developers to make their applications run on mobile devices[6]. Without this tool, developers can not access the AR camera or make a marker.

4. Unity

Developing an Augmented Reality application requires software. Currently, most developers use Unity. This software is a cross-platform IDE for developing three-dimensional (3D) and two-dimensional (2D) games, but focuses more on developing 3D[7]. Therefore, most developers use Unity to make an Augmented Reality application.

With AR technology, this research develops an Augmented Reality-based learning media. More precisely, the developed learning media can visualize objects that are difficult to have in 3D[8]. This media will visualize the animation of the computer assembly process in 3D. The 3D object will appear via the scan marker. Marker is an image target that has been programmed so that AR can display 3D objects[9].

Previously, some research on this theme has been developed. However, in this study, several features and materials were developed, such as 3D animation videos for each computer component assembly. In addition to each hardware 3D object, there is information about the device. 3D objects can be rotated and enlarged. Then, for computer hardware maintenance materials, it is designed in the form of slide information that can be shifted.

METHOD

1. Research Method

The method used in this media learning is research and development (R & D). This method is used to produce the product [10]. Then, the R & D model used in this method is 4D. The 4-D model has 4 stages, which consist of: define, design, develop, and disseminate.

a. Define

At this stage, the problems faced by TKJ students who study online in practical subjects are defined. From this problem, the concept of problem solving has developed by developing learning media.

b. Design

The second stage will be determined by the type of learning media developed. Learning media is made with AR technology. After that, the initial interface display and digital components needed for the development of AR learning media were designed.

c. Development

The development stage will begin after the design stage. At this stage, the learning media will be developed and produced. After development, the learning media is ready to be used.

d. Disseminate

After the learning media has been successfully developed, at this stage, the media will be disseminated so that it can be used by students of the TKJ Department. The dissemination method used in this research is uploading learning media applications to the Google Playstore.

2. User Analysis

Table 1. User Analysis

No	User	Function/Role
1	Tenth-grade students of Computer and Networking Engineering and others	- Access the AR menu of various hardware in 3D - Using learning media as an alternative to learning computer assembly and maintenance online practicum. - Access the explanation menu of each hardware device and learn how to maintain it.
2	Teacher or Intern Teacher	- Introduce learning media and how to use them and provide instructions for students to study independently - Access all the menus in the learning media.
3	Public	- Access all the menus contained in the learning media media - Utilizing learning media to learn

3. Problem and Solution Analysis

Table 2. Problem and Solution Analysis

No	Problem	Solution
1	83.3% of tenth-grade students do not understand the materials for computer assembly and maintenance in online practicum learning.	One of the solutions that can be used is to develop interesting learning media to make students learn independently.
2	The common problem faced by students in the online class is internet connection access.	Most of the features of this learning media do not require an internet connection, except for the module download process and learning outcomes. This media can be accessed with an android smartphone.
3	Students cannot do practical work directly on the subject of introducing hardware components and how to assemble them. This	There is a digital 3D model in this learning media that can be enlarged as well as an explanation of the function and how to

makes learning outcomes less than optimal

maintain each of the hardware components.

4. Flowchart

This learning media flowchart consists of 9 decisions. 4 of these 9 decisions are buttons on the main menu. The core decision in this flowchart is the AR Camera menu. This core decision consists of 2 more sub decisions (3D Object button and 3D animation button). Each of these decisions has a process called marker tracking. After the process, there is one more decision. If the process is successful, the flowchart will display the process of 3d objects or 3d animation, if it fails the flowchart will repeat back to the marker process. The other 3 decisions in the main menu have one process each, the process is about downloading or just displaying.

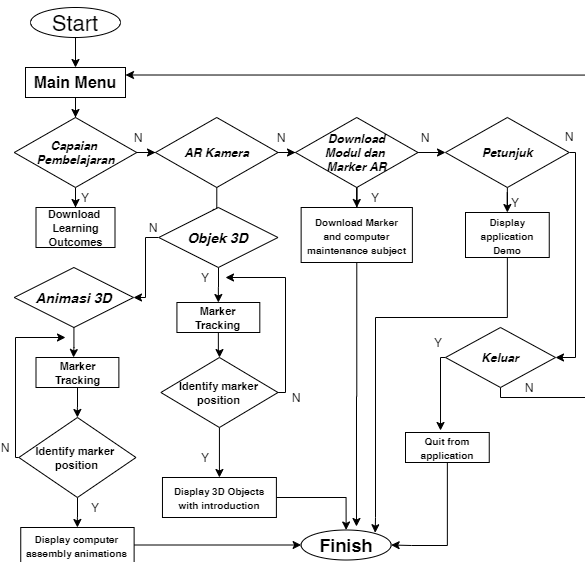


Figure 1. Flowchart of Computer Learning Media and Basic Network Based on Augmented Reality

5. Use Case Diagram

Use case diagram of Augmented Reality-Based Computer Learning Media and Basic Network consists of: Main Menu, Learning Outcomes, Camera AR, Hardware Maintenance, and Instructions.

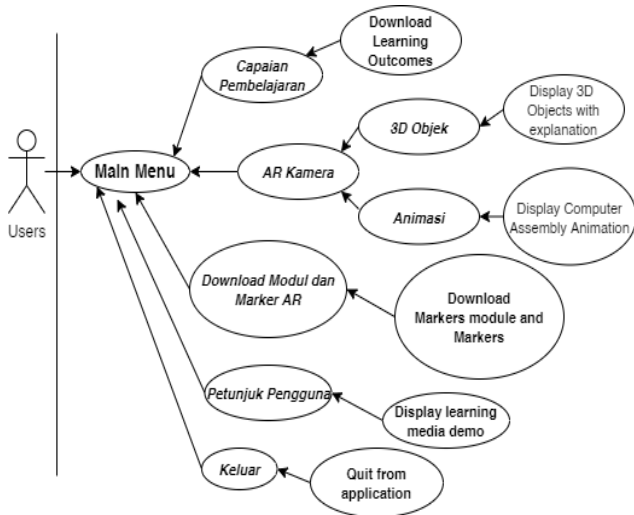


Figure 2. Use Case of Computer Learning Media and Basic Network Based on Augmented Reality

6. Activity Diagram

The activity diagram shows that this learning media has 4 menus in the main menu, the core menu of the 4 menus is the AR Camera menu, in AR Camera there is an AR scan activity so that 3D objects and 3D animations appear. Other menus only contain information according to the name of the menu.

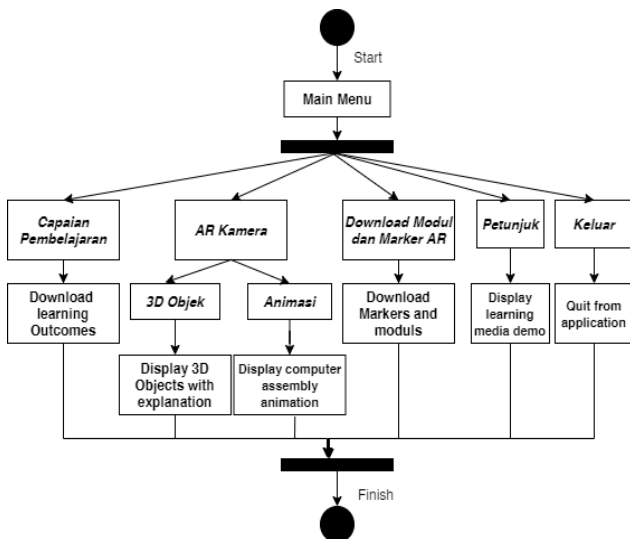


Figure 3. Activity Diagram of Computer Learning Media and Basic Network Based on Augmented Reality

RESULTS AND DISCUSSION

1. Interface Design

Interface design is the initial stage for designing user-interface menu displays. The design made is only a rough design of the layout of each menu on the learning media that will be developed. The designed menus consist of 4 menus, namely:

a. Main Menu Design

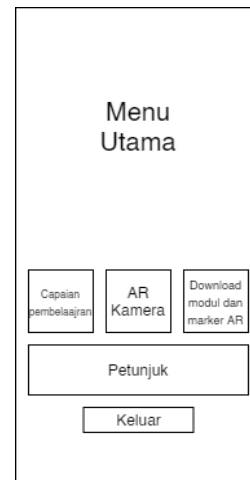


Figure 4. Main Menu Design

b. AR camera Menu Design



Figure 5. AR Camera Menu Design

c. Instruction Menu Design

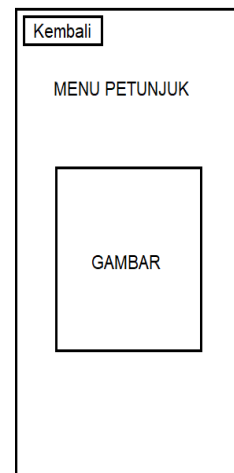


Figure 6. Instruction Menu Design

2. Splash Screen

The splash screen is the image that is displayed the first time the user opens the application. Made with unity on the splash screen learning media. This indicates that this application was made using the unity engine.



Figure 7. Splash Screen

3. Main Menu

The main menu is the initial interface after the splash screen. There are five buttons, each of which will display a sub-menu. In this application. There are four sub-menu and one exit button.

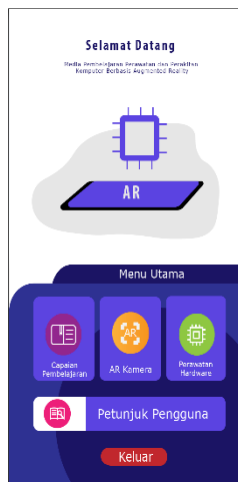


Figure 8. Main Menu

4. Learning Outcomes

The Learning outcomes button in the main menu is a download button that will download the learning outcomes file automatically. The

downloaded file is in the form of a syllabus in .pdf format. In the syllabus, there are Basic competencies and core competencies on the assembly and maintenance of computer equipment.

5. AR Camera

The AR Camera button in the main menu is the core button of this learning media. In the AR Camera menu, there are two buttons to enter the AR Camera. Each AR Camera button has a different function.



Figure 9. AR Camera Menu



Figure 10. Object 3D button

6. User Manual

The Instructions button is a support button that displays information on how to use this learning media, especially the AR camera. This menu explains how to scan, zoom, and rotate AR 3D objects.



Figure 11. User Manual Menu

7. Marker

A Marker is an image that is designed in such a way. The image is then entered into the AR learning media program so that the image can be scanned and display 3D objects on the smartphone screen that scans it.

The design of the marker in this application uses the module concept. That is, in the module, there are markers that can be scanned to bring up AR objects.

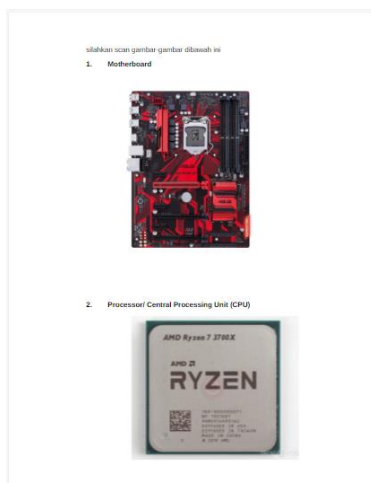


Figure 12. Module Marker

8. Black Box Testing

This learning media was tested using black-box testing. The method used is alpha testing. Alpha testing aims to identify and eliminate problems before the application reaches the user.

Table 3. Application Testing

Testing	Result
Application Installation	Succeed
Application Operation	Succeed
Download Marker Module File	Succeed
Download Learning Outcomes File	Succeed
Scanning Processor Marker	Succeed
Scanning RAM Marker	Succeed
Scanning Motherboard Marker	Succeed
Scanning VGA Marker	Succeed
Scanning Hard-disk Marker	Succeed
Scanning CPU Fan Marker	Succeed
Scanning Power Supply Marker	Succeed
Scanning LAN Card Marker	Succeed
Scanning CPU & CPU Fan Assembly Marker	Succeed
Scanning RAM Assembly Marker	Succeed
Scanning VGA Assembly Marker	Succeed
Scanning LAN Assembly Marker	Succeed
Scanning Power Supply Assembly Marker	Succeed
Scanning Hard-disk Assembly Marker	Succeed

CONCLUSION

Based on the problems and solutions in the process of learning media development, the conclusions are:

- 83% of grade-tenth Computer and Networking Engineering students in Vocational High school 1 Bukittinggi faced difficulty in learning computer assembly and maintenance in online practicum during the Covid-19 pandemic.
- The obstacles faced by students are internet connection problems and the unavailability of tools and practicum materials at home.
- The solution for the problems mentioned is to develop augmented reality-based learning media.
- 3D objects and 3D simulation of computer assembly in this learning media can be an alternative to overcome the problem of the availability of practical tools and materials for students at home.

SUGGESTION

1. The design of this learning media is expected to be developed further by adding features that can move and install each hardware virtually, so that this learning media is more interactive.
2. Further developers can add a quiz feature to test student learning outcomes.
3. Published learning media can be used by students as an alternative to online practicum. In addition, it can also be used by schools that lack practical tools and materials.

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