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Development of 3D Learning Media Applications on Materials Food Chain Using Augmented Technology Reality

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ABSTRACT

Augmented Reality is a technology that is currently being developed which can combine the virtual world with the real world. With the existence of Augmented Reality (AR) it can function to help the perception and interaction of its users with the real world. In the world of education not many have used Augmented Reality technology and many still use books as learning media. So that the material obtained by students is only in the form of text and 2D images. Therefore, researchers took the initiative to design a learning media in the form of a Food Chain learning application that displays 3D material and living things. It aims to be an interactive and interesting food chain learning tool for grade 5 elementary school students packaged in an Android-based application. This application was created and developed using the Unity 2021.3.12f1 software. The methodology used in developing this application uses the method developed by Luther, which is a multimedia software development method based on six stages, namely Concept, Design, Material Collecting, Assembly, Testing (Testing), and Distribution (Distribution). The results of developing this application can make it easier for teachers to convey material about the food chain.

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1. INTRODUCTION

Learning is a process of the relationship between humans and their environment, planned to enhance their physical and spiritual potential, fostering positive attitudes and progress in cognitive, affective, and psychomotor aspects to achieve their life goals (Suardi, 2018). Education is an instrument necessary to effectively develop students' potential, interests, and talents to achieve the desired educational goals (Mulyati, 2019). One way to achieve the expected educational goals is through the appropriate use of learning media in the learning process.

Augmented Reality (AR) itself is a technology that combines the virtual world with the real world. This technology is widely used in fields such as the military, healthcare, navigation, advertising, entertainment, and education (Mustaqim, 2016). Generally, applications that implement AR technology aim to provide information to users clearly, in real-time, and interactively (Ikhwani and Raharjo, 2020). AR technology efficiency of various sectors, e-commerce, health, industry, transportation and other sectors (Hendriyana, et. al, 2022). AR technology, such as computer vision and real-world object recognition, allows interaction in digital or virtual forms (Abdulghani and Sati, 2020). Information about objects and the environment can be added to the AR system, which is then displayed in real-time over the real-world layer as if it were real (Atmaja, 2018).

Every field of study that students learn, especially at the elementary school level, requires the presence of media. Learning media becomes an important component that must always be developed in teaching and learning activities (Junaidi, 2019). One of its uses is in the field of science. Science is a discipline closely related to human life (Ilham, 2019). Therefore, media that can facilitate students' learning is essential in learning science. However, most teachers still struggle to create engaging learning media that can enhance students' motivation to learn. The low intensity of media use in the learning process is influenced by the difficulty teachers face in determining suitable media and their inability to create media related to the material taught in a particular subject, especially digital media, which is still not mastered to its full potential (Kholilah, 2019). One such material is the food chain in an ecosystem. This topic is important and must be taught to students to achieve the planned learning objectives. Therefore, media that can support the learning process is needed.

Based on these issues, we took the initiative to design a learning medium in the form of a Food Chain learning application that features materials and 3D living organism objects. This aims to serve as an interactive and engaging learning tool for fifth-grade elementary school students, packaged in an Android-based application.

2. METHODS

The method used in the development of this application refers to the method developed by Luther, namely the MDLC (Multimedia Development Life Cycle) method or multimedia software development, which is carried out based on six stages: Concept, Design, Material Collecting, Assembly, Testing, and Distribution. According to Luther in Binanto (2010), these six stages do not necessarily have to be performed sequentially. These stages can be interchanged, but the Concept stage remains the initial phase to be worked on.

2.1. Research Stages

a. Concept

At this stage, the researcher conducts a literature study to obtain the appropriate material concepts for developing a learning application at the elementary school level.

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b. Design
In the design stage, the researcher creates a material design using Canva to specify the requirements for the content, style, and appearance of the program that can attract students' attention.

c. Material Collecting
In the material collection stage, the researcher creates 3D object models that align with the relevant material and curriculum.

d. Assembly
At this stage, the application development process uses Unity 3D software, which involves Vuforia, single marker, multi-marker, and Lean Touch.

e. Testing
At this stage, the researcher tests the developed application by displaying several views on the application using a smartphone.

f. Distribution
After the application has been tested, it is saved by converting it into an installer file using Unity 3D software. This allows the compiled files to be packaged neatly and makes it easier for users to install, allowing the application to be distributed to potential users.

2.2. Analysis System

After going through the research method stages, the next step in developing this application is analyzing requirements or system analysis. This stage is carried out to identify and evaluate problems, opportunities, obstacles that occur, and expected needs so that improvements can be proposed. Several things are done at this stage, including functional analysis, user analysis, software requirements analysis, and hardware requirements analysis.

a. Functional Analysis
This stage was carried out to determine the functions provided by the features of the learning media application for natural science material in the discussion of food chains using Augmented Reality.

b. User Analysis
User analysis means determining who the application is intended for. In this case, it means elementary school students and teachers.

c. Software Requirement Analysis
Making this learning media is in the development process. The application requires how much software or software to create applications, 3D models, and marker designs. Some of the software used in this development is:

- Unity 3D as software for application development.
- Blender 3D to create object models in applications. In this case, these are objects that are used or needed in the food chain.
- Canva will design the appearance of the application, which will later be uploaded to the Vuforia Website.
- Vuforia SDK is used to create 3D objects or make markings in markers uploaded to the Vuforia Website.
- Android to run learning media applications.

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d. Hardware Requirement Analysis

This application development process uses Augmented Reality and several other additional devices.

- Laptop or Computer. Laptops or computers are used to develop design applications or learning media applications that are developed using Augmented Reality.
- Android smartphone to run learning media applications. The way to use this is by using a camera aimed at the marker so that the marker will display a 3D image or object.

At this design stage, the flow of the application system will be explained as a process of use by the user or users, as shown in **Figure 1** below (Atmaja, 2018).

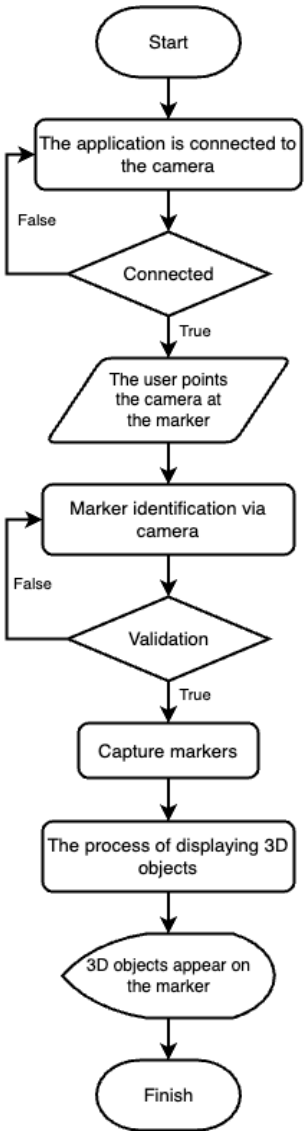

Figure 1. Application Usage Flow

2.3. Use Case Diagram

In the process of developing a design for a food chain learning media application that uses Augmented Reality, a use case diagram was created, the aim of which is to explain how users operate this application. The features that are provided and can be used include Play, Augmented Reality, Menu, Core Competencies, Basic Competencies, Objectives, Materials,

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Home, Exit, Back and Next buttons. The following is **Figure 2**, the flow of behaviour by users (Atmaja, 2018).

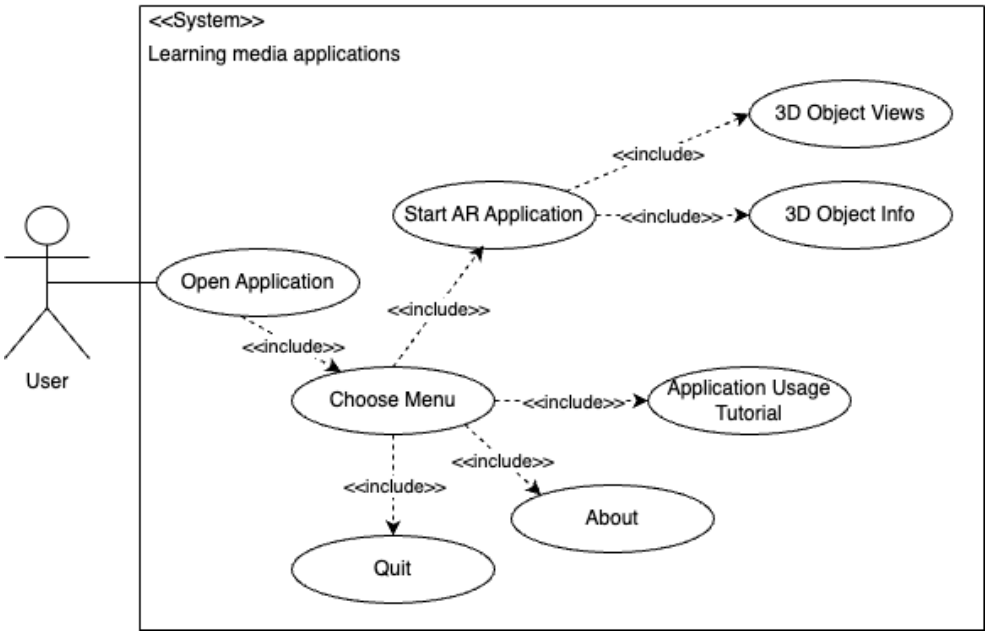

Figure 2. Use Case Diagram

3. RESULTS AND DISCUSSION

3.1. Storyboard Design

This storyboard design describes the application's flow so that you can clearly understand the flow contained in the storyboard learning media. Figures 3 and 4 below are storyboards created on Canva and Google Drive.

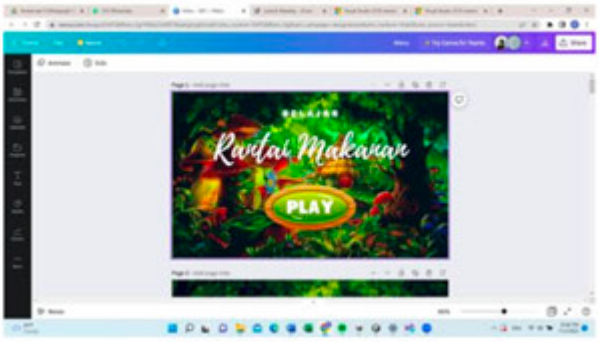

Figure 3. Storyboard of the initial display of the application

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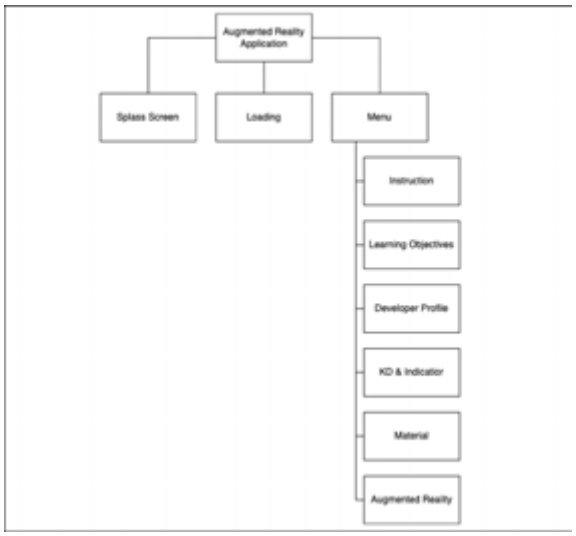
Figure 4. Storyboard display of food chain material

3.2. Program Structure

The design of a food chain learning media application using Augmented Reality has a scene display that is adjusted to the menus in the application. It contains a clearer picture of the application that was created.



3.3. Menu Display Design

In designing this menu display, we used Canva media, which will later be imported into Unity. This menu display is a display that we created previously, and we added an Augmented Reality menu. The display menu includes instructions, learning objectives, basic competency indicators, materials, developer profiles, and Augmented Reality.

Figure 6. Menu display

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3.4. 3D Object Design

The 3D object design we use for AR development uses an asset store to make the import process easier in Unity software.

3.5. Application Design

The design of this food chain application uses Augmented Reality technology, which was built with Unity software. The required 3D *.fbx files are imported into the unity editor, which will later be displayed as Augmented Reality.

Figure 7. 3D object design

3.6. Application Interface Display

The following is a picture of each application display.

Figure 8. Application icon display on Android

a. Splash Screen Display

Figure 9. Application splash screen display on Android

The first appearance the user sees when opening the application is the Play button display menu, so users cannot immediately see it.

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b. Main Menu Display

Figure 10. Main application menu display on Android

This display shows the application's menu options, allowing users to choose which menu to go to. Instructions for viewing explanations of buttons in the application, material for reading about the food chain system, and Augmented Reality to carry out AR functions are also included.

c. Augmented Reality Main Display

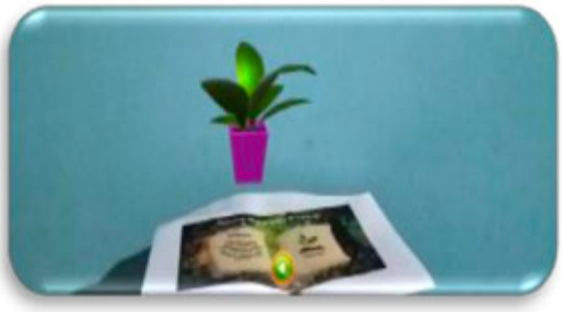

Figure 11. Main Augmented Reality application display on Android

Display image objects on paper that will appear in 3D in the application. Learning media applications using Augmented Reality technology will activate the camera on the user's smartphone if the user presses the Augmented Reality button on the menu and then points the camera at the image on the paper like the image above.

d. Credits Display

Figure 12. Display application credits on Android

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The application creator profile can be seen in the existing developer profile on the main menu.

e. Display Instruction

Figure 13. Application instructions display on Android

In this display, users can see the functions of the buttons in the learning media application using augmented reality technology so that they can use the application correctly.

3.7. Implementation

The following is a picture of the results of implementing AR on Android.

Figure 14a. Manufacturer AR Display

Figure 14b. Consumer AR Display

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4. CONCLUSION

The food chain learning media application uses AR technology developed with Unity software version 2021.3.12f1 and Vuforia SDK from Vuforia Website Developer. The method used is MDLC (Multimedia Development Life Cycle), which has 6 stages: Concept, Design, Material Collecting, Manufacturing, Testing, and Distribution. Hopefully, this application will make it easier for teachers to provide materials because it is supported by the display of 3D food chain objects while teaching using Infocus, which is connected to a smartphone. With this learning media application with AR technology, students can see the forms of producers, consumers, and decomposers in the food chain. With smartphones, students can learn and view 3D objects from the food chain components anywhere and anytime. However, developing learning media applications using Augmented Reality technology still has many shortcomings. It must be further developed in a better direction, namely adding 3D objects with a more realistic appearance and more interesting animations so that the 3D objects of a food chain component look real. and can increase students' enthusiasm for learning food chain material.

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