Interactive Technology in Concept Learning Biology of Human Fetal Development on Augmented Reality Implementation for High School Students

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ABSTRACT

The rapid development of information technology affects the world of education world to create innovations that can support learning activities. One of these technological developments is augmented reality (AR). This study aims to design an interactive technology application in the concept of learning the biology of human fetal development with the implementation of Augmented Reality for high school students. The method used in this research design is card detection. The results in the design of interactive technology learning media applications on the concept of learning the biology of human fetal development using augmented reality use autodesk virtual software to design 3D objects of human fetuses. Unity game engine software used to combine 3D objects from Autodesk virtual software, as well as Photoshop software to design the marker image and Vuforia SDK used to render the image into a target marker. To display the 3D object of human fetus in the application of biology learning media of human fetal growth and development using augmented reality, the thing to do is to detect/scan the marker image that has been specially designed for the application of learning media of human fetal growth and development using augmented reality. The detected marker image will bring up a 3D object of a human fetus along with an explanation according to each marker image.

General Terms

Human Fetuses, Learning, Unity, Vuforia SDK

Keywords

Augmented Reality, Application, Technology, 3D, Biology

1. INTRODUCTION

The rapid development of information technology affects the world of education world to create innovations that can support learning activities. While augmented reality (AR) technology is being considered by educators for its potential to help students visualize abstract concepts, currently there are barriers from the high cost of developing complex AR applications [1]. It is expected that students are more familiar with technological events and can use them as learning aids. Augmented reality is a technology that allows adding virtual elements to a human's real field of view [2].

The problem of learning biology subjects that often become boring. Therefore, a system is needed that is able to explain ssthe process of fertilization and development in the fetus. This research aims to help students in learning biology and especially understanding human fetal growth with different methods, namely displaying three-dimensional (3D) augmented reality objects with a little animation to support student interest visually. This system can be used by applying mobile-based augmented reality (AR) where the operating

system used is Android. The interactive and three-dimensional nature of augmented reality is suitably placed to cater for a higher quality of communication and information exchange in planning processes [3].

AR refers to the augmentation or the conglomeration of virtual objects in the real world scenario which has a distinct but close resemblance to Virtual Reality (VR) systems which are computer simulated environments which render physical presence in imaginary world [4]. This application uses card media as a marker that displays three-dimensional (3D) objects according to the selected card. The application was created using markers. This application is made so that high school students can learn the growth and development of the human fetus with good teaching materials and operations, so that this application can be applied as a learning medium.

2. RESEARCH METHOD

The system to be built is a mobile application as a medium of information about the development and growth of the human fetus using the Android platform with augmented reality technology. In every system creation, a design in the form of an architecture diagram is required. This architecture describes how the system works as a whole.
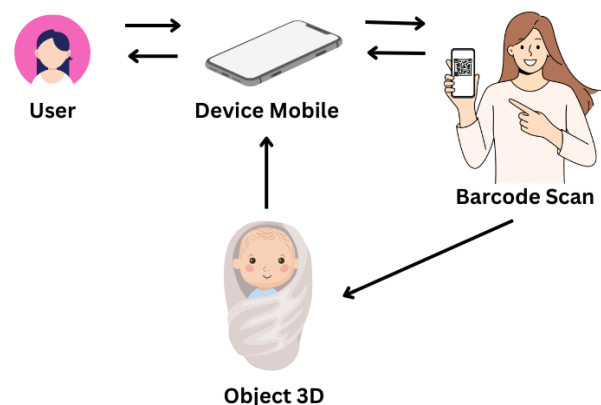

Fig. 1 Architecture Diagram of ARHumanfetus Application

Users can access the application through mobile devices, the installed application can scan barcodes which will then display 3D objects as information providers.

2.1 Data Collection Procedure

2.1.1 Literature Study

Literature study is a stage of searching for some materials and data linkages or comparative journals that have discussed the

same study as the theme of this research. Usually the literature here is more on the development side of the application to be made and the user interface in accordance with the research material. So that when experiencing difficulties in developing a problem, it can be solved with some literature studies about being solved with some of the above literature studies.

2.1.2 Observation
Observation study is data collection by collecting data directly by studying and researching pre-existing data.

2.2 System Design Logic
In the logical design, the user requirements and recorded problem solving begin to be created for implementation. Presentation of the system through diagrams such as flowcharts, use case diagrams, activity diagrams, and data flow diagrams. While physical design is an advanced stage of conceptual design where the design begins to be translated into physical form.

2.2.1 Flowchart
Flowcharts naturally represent the control flow and structure of imperative programs [5]. The flowchart of the system explains the flow of application performance. Users can scan the marker on the application to display 3D objects.
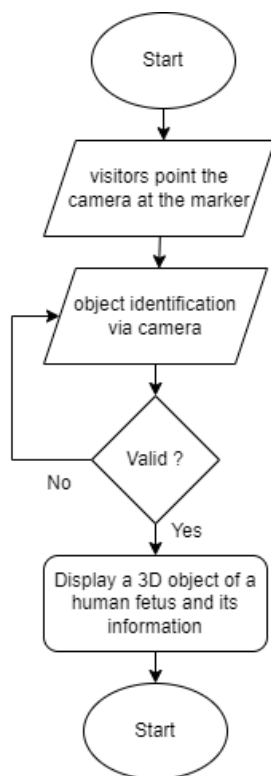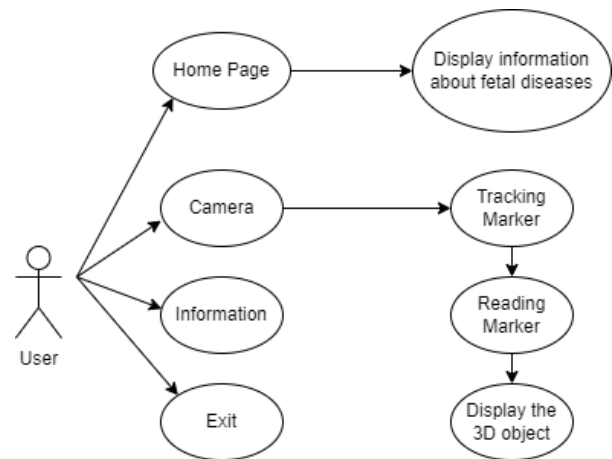

Fig. 2 Flowchart

2.2.2 Use Case Diagram
The use case diagram provides a concise sketch of the application through depicting the usage of the system.

2.2.3 Activity Diagram
Activity diagrams are another important diagram in UML. Such diagrams contain a graphical representation of processing flows of nodes, which represent functions that take inputs and convert them into outputs [6]. Activity diagram explains the flow of the system on the guide menu. With this guide menu, the application will display information about the author's application.
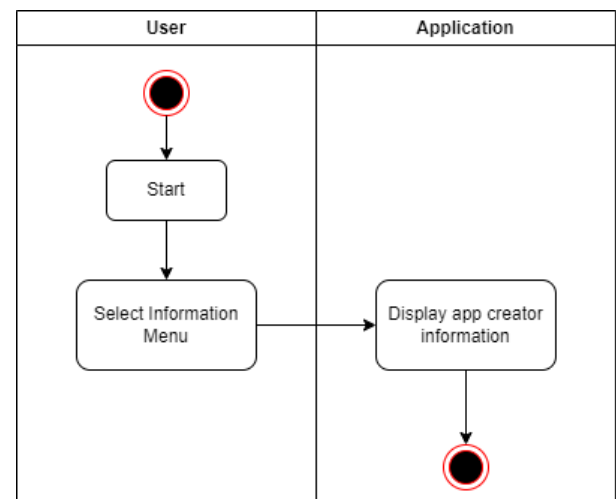

Fig. 3 Menu Activity Diagram

The diagram describes the marker scanning menu. When opening the menu, the application will automatically activate the camera then the user points the camera at the marker, then the application will process the marker and if the marker matches then the application will display a 3D object of a human fetus along with the information.
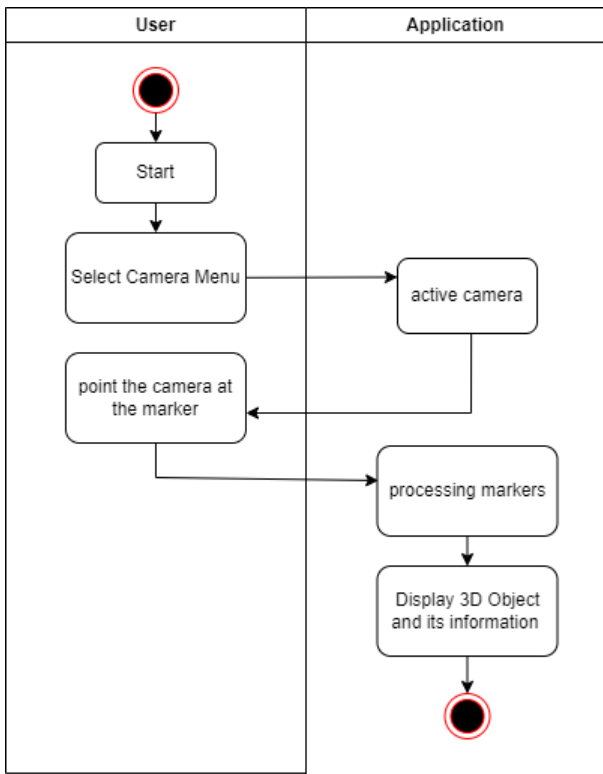
Fig. 4 Marker Scan Activity Diagram

2.2.4 Data Flow Diagram

A Data Flow Diagram (DFD) is a modeling notation, which focuses on essential, functional aspects of such early software designs [7]. A Data flow visualization system allows users to compose a query for system specifications in visualization modules and construct the data flow diagrams [8]. Generating data flow diagrams using traditional techniques is time-consuming and increases overhead, discouraging the user [9]. At DFD level 1, it is explained that there are 4 processes. The first process contains AR Start, the second process contains usage procedures, the third process contains the menu about, and visitors process.
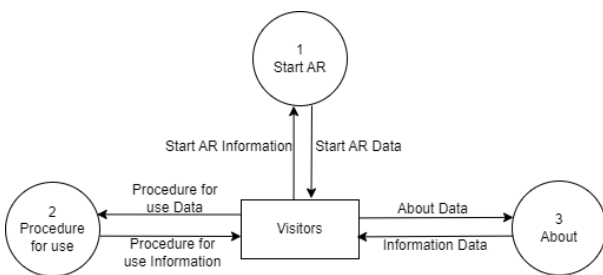

Fig. 5 Data Flow Diagram Level 1

At dfd level 2, there are 10 processes. each data flow in the process will explain the movement of data.
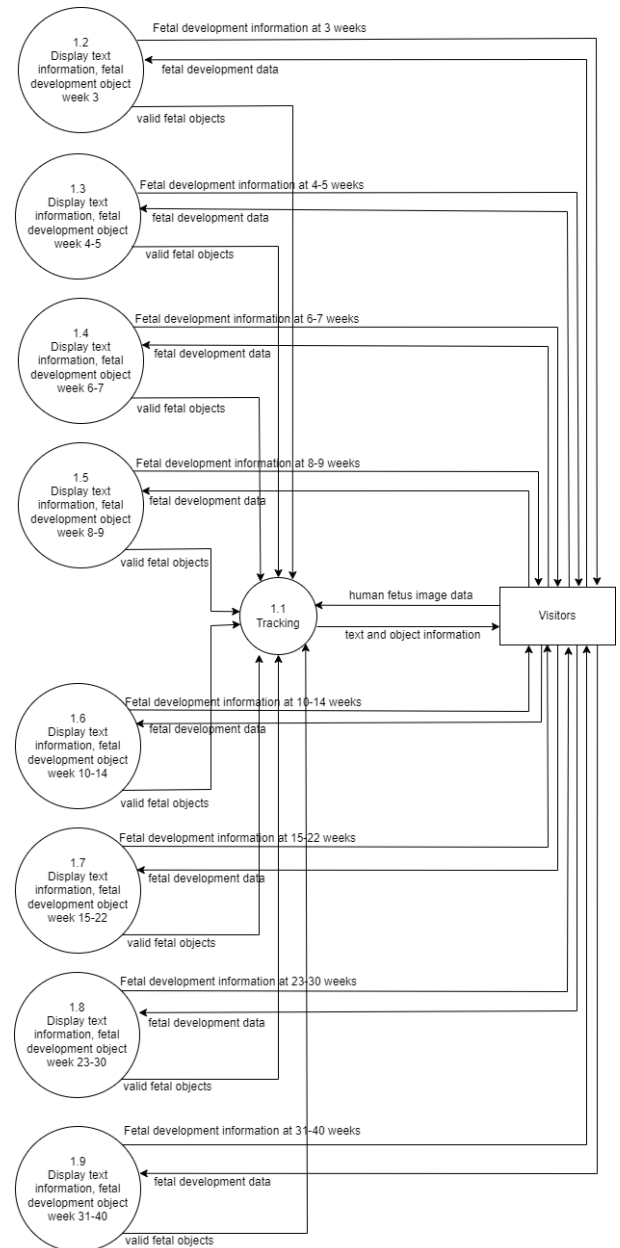

Fig. 6 Data Flow Diagram Level 2

2.3 Interface Design

A user interface is the most eminent aspect in industrial design [10]. The design of this system design is made in the form of wireframes.
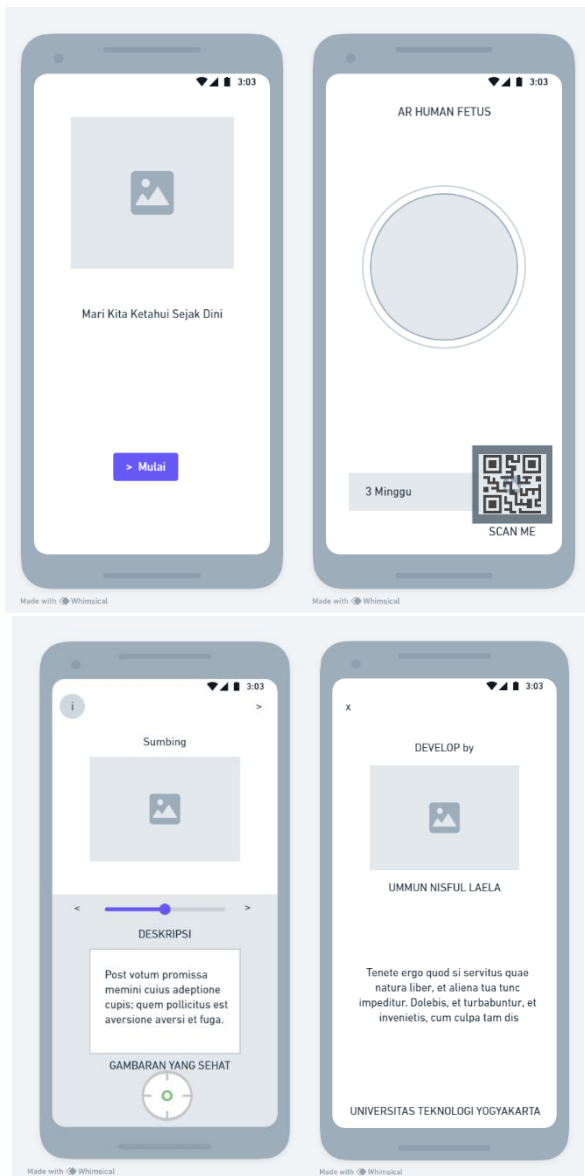
Fig. 7 Wireframe

3. RESULT AND DISCUSSION

3.1 Assumptions

AR Humanfetus application is made as a learning media in high school. this application can be installed using an android smartphone. this learning media makes it easier for students to access information and understand the material because there are clear 3D objects.

3.2 Hypothesis

This hypothesis is based on the existing system design in the study. This research hypothesizes that "Humanfetus AR application can help the learning process to be more effective and efficient, and facilitate students in accessing learning materials optimally"

3.3 Run an Experiment

After making a design in the form of design, the next step is coding. Coding is made using the C language with Unity3D. Unity 3D is a game engine developed by a Danish company, it is not only easy to learn, but also cross-platform, which makes it popular among game developers at home and abroad [11].

3.4 Implementations

3.4.1 Marker Implementation

The application of human fetus recognition in this study uses marker-based augmented reality. Therefore, the application of augmented reality into the application requires a marker or marker to be able to recognize a human fetus. The application of augmented reality into the application requires a marker or marker to be able to bring up 3D objects into the AR Camera. Markers are obtained from search results on the web. Markers that are made are then uploaded to the Target Manager Database available on the Vuforia Developer Portal. In the application of human fetal recognition, there are 8 markers that represent each fetal recognition.
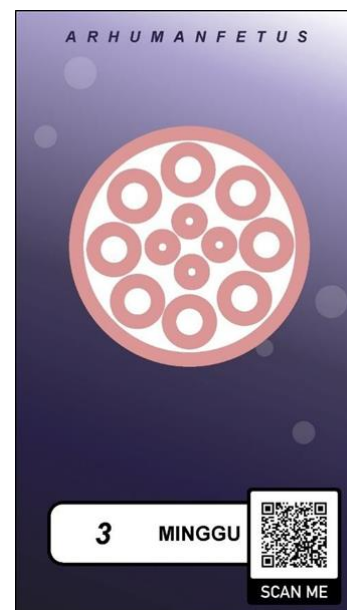

Fig. 8 Three Weeks Marker

3.4.2 3D Object Implementation

3D objects are created using the virtual autodesk application program. The created 3D objects will appear on the AR camera when the marker is recognized. Each 3D object loaded will be different based on the marker processed by vuforia. The results of 3D modeling on virtual autodesk are then saved into *.fbx format for further processing in the unity application.
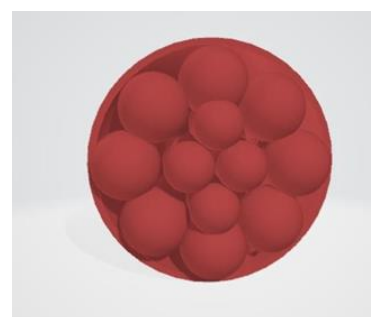

Fig. 9 3D Object

3.4.3 Splash Screen

On the splash screen page there is an image from the beginning of the application which when opening the application will appear in a few seconds.

Fig. 10 Splash Screen

3.4.4 Main Menu

On the main menu page there are three buttons, namely camera, information, exit and how much additional information about abnormalities in the human fetus on the main page. The camera button functions to scan the marker, the information button functions to provide information on how to use the application. While the exit button serves to end the application.

Fig. 11 Main Menu

3.4.5 AR Mode Page

To display a 3D object, point the AR camera towards an available marker, so that the 3D object will appear along with its explanation.

Fig. 12 Display AR

3.4.6 Scan Marker

The 3d object will appear when the marker is successfully scanned.

Fig. 13 Scan Marker

3.4.7 Information Page

On the information page there is information about the AR maker such as photos and information from the maker.

Fig. 14 Information Page

3.5 Discussion of Result

The next step is testing. In this study using the black box testing method. Software testing is the main technology to ensure the quality of the software [12]. One is a white box testing, which is a test design based on the structure, and the other is a black box testing, which is a test design based on the specifications of a software [13]. The black box test results table can be seen as follows.

No	Page	Result	Status
1	Splash Screen	Can display the start page with the start button	Succed
2	Main Menu	Display image information and description	Succed
3	AR Scan Page	Displays a camera to scan barcodes	Succed
4	Information Page	Displays information about the app creator	Succed

4/4 x 100% = 100%

Based on the test table above, it can be concluded that the 4 pages in the system can work perfectly. so it can be produced that the system is 100% "**Successful**".

4. CONCLUSION

Based on the results of existing research, the following conclusions can be drawn

1) In the design of interactive technology learning media applications in the concept of learning the biology of human fetal development using augmented reality by using autodesk software to design 3D objects of human fetuses, virtual software to design 3D objects of human fetuses, Unity game engine software used to combine 3D objects from autodesk virtual software, as well as photoshop software to design marker images and Vuforia SDK which is used to make images into marker targets.

2) To display 3D objects of human fetus in media applications biology learning application of human fetal growth and development using augmented reality, the first thing to do is to detect/scan the marker image that has been specifically designed for the 3D object. Learning media application of human fetal growth and development using augmented reality. The detected marker image will bring up a 3D object of human fetus along with its explanation according to each marker image.

3) System development using augmented reality technology that helps the development of computer science

5. REFERENCES

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