Design of Learning Media for Fish Classification with Augmented Reality Technology

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Design of Learning Media for Fish Classification with Augmented Reality Technology

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***Abstract*— The learning process is currently experiencing significant changes, various methods are used to make learning more interesting. The development of computer technology also affects changes in the learning process. The use of multimedia technology, the improvement of the interaction system between human and computer becomes one of the factors in the change of learning process. The use of multimedia technologies such as animation, video or by using slide shows can affect students or students in the learning process**

Augmented reality is one of the technologies that can be developed in the design of learning media. In this research, the learning media design process using augmented reality technology is used. Learning topics taken are the introduction of fish species. The system design method used is to use waterfall.

The result of this research is the application of Augmented reality-based learning media has been successfully implemented by using ARToolkit library. The minimum distance for 3D object can be displayed is at 10 Cm and the minimum angle is 300 to 900 and to see 3D objects. The result of rotation the marker successfully displays every part of the 3D object.

Keywords—Learning; Augmented Reality; ARToolKit;

I. INTRODUCTION

The learning process is currently experiencing significant changes, various methods are used to make learning more interesting. The development of computer technology also affects changes in the learning process. The use of multimedia technology, the improvement of the interaction system between human and computer becomes one of the factors in the change of learning process. The use of multimedia technologies such as animation, video or slide shows could improve the learning process.

Natural Science (IPA) is one of the subjects delivered from elementary to upper secondary level. One part of the learning material from IPA is a knowing the types of fish species. Introduction of fish species itself has a level of difficulty that is enough due to the writing the fish name in Latin. With the development of computer graphics technology such an introduction process can be made more interactively.

One type of computer graphics technology that can be used to provide interactive learning process is Augmented Reality (AR). Application users can experience new experiences in the learning process. AR technology is a computer graphics technology that developed very rapidly at this time, many of industry or academic community who do research in this field. Applications from AR technology can be run on mobile devices or on desktop computers.

Based on the above study then in this paper will be discussed about the design of learning media using AR technology on the introduction of species of freshwater fish. The system to be built is to use a marker detection process that runs on a desktop computer. Applications intended for elementary school children from level 6 to junior high school.

II. RELATED WORK

The influence of multimedia-based multimedia learning media is enormous. The result of research of application of multimedia technology in learning process got the average gain of experiment group score of 4,73 which is bigger than the average gain of control group score 3,12. Experiential group is a group that is given treatment in the form of multimedia-based learning media and control group is group that is not given treatment [1]. Based on the results obtained then the use of multimedia in the learning process can influence the students in receiving the subject of learning. Students can directly interact with the material taught through text, images, sound or video. In another study the use of multimedia in learning is used to measure student satisfaction through instructional in E-learning. The use of instructional using the media makes E-learning application users more satisfied and confident in learning [2].

Augmented reality becomes one of the solutions in the improvement of the interaction process. The use of AR technology has targeted various fields of discipline. One use of AR technology is in the field of military that is implemented in shoot simulators. AR technology can reduce the costs incurred in shooting practice. The environment used can be a room that has been modified with computer equipment. The target shoot system uses virtual objects generated by computer graphs [3]. Other research related to AR technology is designed as a learning tool for teaching basic principles of electricity to ninth-grade students. The results of obtained from this study is students understanding of the material given by using AR-based learning media has a very good impact. Students become more familiar with the material given [4].

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III. Literature Review

A. Learning Media

Learning media is one of the models used in conveying information relating to teaching and learning process. Many media used in the learning process are as follows:

- Visual Media: is only visible media, such as: photos, images, posters, cartoons, graphics etc.
- Audio Media: media that can only be heard only, such as: audio tapes, mp3, radio.
- Audio Visual Media: media that can be heard at once viewed, such as: sound movies, video, television, sound slide.
- Multimedia: media that can present elements of media in full, such as: animation. Multimedia is often identified with computers, the Internet and computer-based learning.
- Media Reality: the real media that exist in the natural environment, whether used in living conditions or already preserved, such as: animals, specimens, herbarium etc. [5].

The development of learning media goes hand in hand with the development of computer technology. To make the learning process interesting and easy to understand, much developed interactive learning media. Interactive learning media is used to convey material to students effectively and efficiently. The benefits of using instructional media are as follows:

- Can clarify the presentation of messages to learners
- Overcoming the limitations of space, time and sense power possessed by schools, teachers and students
- Can reduce the passivity of students
- Be able to overcome difficulties and clarify difficult subject matter
- Stimulate the child to work and move the instincts and generate the willpower to learn something.

B. Augmented Reality

Augmented reality (AR) is a development of computer graphics technology that combines interaction technology with visualization technology. The use of AR technology aims to provide new experiences to application users in order to experience the sensation of interacting, Fig 2 depict of Reality and virtual Continuum (Milgram and Kishino 1994). The use of AR technology can be found in various fields such as healthcare, education, manufacturing, industry, military and machine repair center. For example in the field of health technology AR is used in learning organs bodies conducted by medical students. Body organs can be replaced by using 3-dimensional objects. Fig 1 display of augmented reality on application medical surgery. Use of AR technology can save costs to be incurred. This is because the object used can be replaced by using 3 Dimensional virtual object [3].

Fig.1. Medical Surgery AR-based System [6]

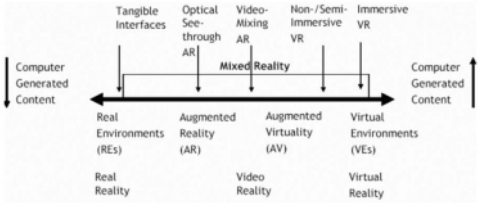

Fig.2. Reality-virtual Continuum [7]

The design of AR technology system is divided into two models: optical and video based. Optical technique is the process of displaying the results of AR applications by using the optical lenses in this case the application users can see directly the outside world using the eyes. Fig 3 shows the design of AR technique by using optical see through display.

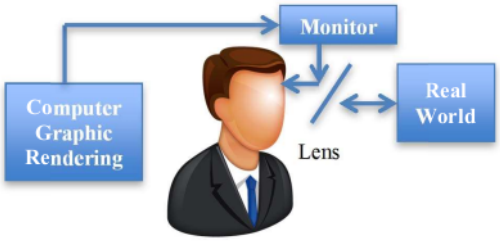

Fig.3. Optical System Design See Through

By using this model the user can feel instantly in seeing the conditions in the real world. To see objects that have been built by the computer graph rendering then on the front of the monitor will be given a lens that aims to reflect objects that have been built and to see the outside world directly. As for the technical model Video see through is to use additional components such as Image Composition, and Camera. Fig 4 display the video model design see through.

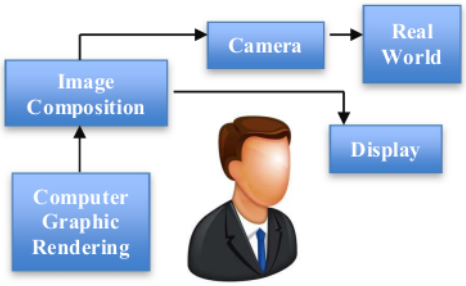

Fig.4. See Through Video System Design

The camera on this system is used to see the condition of the outside world. So that application users can know the state of the environment. To see the results capture by the camera then the user using the display that has been installed in front of the eye. The differences of these two technologies are shown in Table 1.

TABLE 1. Differences in AR System Technology Design [8]

No	Optical	Video Based
1	Optical blending simpler	Easier to match the brightness
2	Safety (power failure)	Wide field-of-view displays are easier to build
3	No reduction of resolution (of the real world)	Real and virtual view delays can be matched

The type of display that can be used in AR applications is by using Head Mounted Display (HMD), Handheld Display and Projection Display. Head Mounted Display (HMD) consist of LCD base, head worn and virtual retina display. Handheld display (HHD) is a device used to display applications by using handheld devices. On this device is also equipped with a camera. The use of HHD is intended to facilitate the movement of application users [9]. Projection display is a display model by utilizing the surface of an object that can reflect the resultant of light from the projector. Through the surface users of the application can directly interact.

One of the most important parts of AR applications is the tracking process. AR application has two tracking methods that is by using marker and without using marker. Marker is a 2 dimensional drawing pattern with square shape. This marker uses a black and white pattern. The tracking process of this marker will produce 3 dimensional objects that have been defined in the scene generator section in the computer. Fig 5 shows the type of marker that can be used in AR applications.

Fig.5. Marker Augmented Reality.

To know the pattern of marker hence done detection process maker by using camera. The marker pattern recognition process is shown in Fig 6.

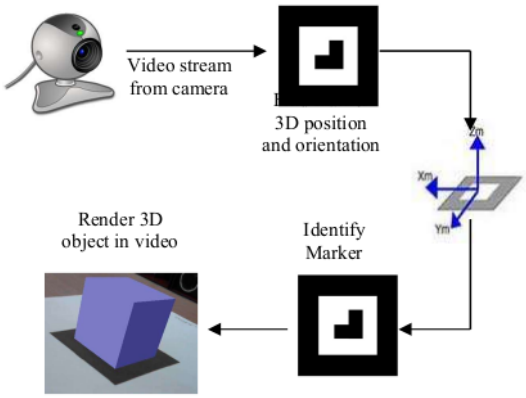

Fig.6. Marker Detection Augmented Reality.

Another tracking method is to use a marker less model. In this method there is no need for markers to display 3D objects in the application. The technique used in this model is by using face tracking, motion tracking and 3d object tracking.

IV. SYSTEM DESIGN METHOD

In the research system design method used is by using waterfall method. The use of this method is intended to obtain optimal results. Stages performed in this study are as follows:

1. Needs analysis

At this stage the need of the application to be developed is done data collection and analysis process. Needs required in this study include the needs of hardware, software and materials. the hardware requirement used in this study is a computer and camera. The camera used is webcam type camera. This camera is used to recognize the image of a predefined marker. For the purposes of software is using visual studio, ARToolKit and Blender 3D. the material needs used is to collect the characteristics of the fish.

2. Design

At this stage is done interface design process that will be developed in making the application. The interface developed includes two things: the interface on the computer and the interface on the marker. Fig 7 shows the interface design developed in the application.

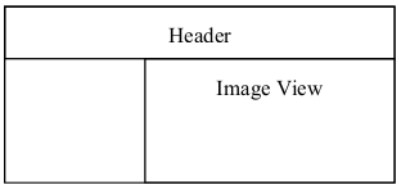

Fig.7. Design of Application Interface

Explanation of Fig 8 is as follows, Header is used to put title and button to close application, while Image View is used to display virtual object that will be punch when marker is detected by camera.

The interface design for markers is shown in Fig 8. This design combines markers with information of each type of fish to be displayed. The information shown is the Latin name of the fish and the living location of the fish.

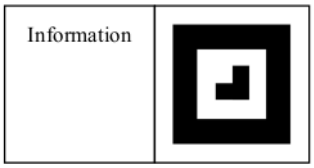

Fig.8. Marker Interface Design

3. Implementation

Implementation done in this research is to translate the design into programming language that can be understood by computer. The program used in application development in this research is by using Blender, Visual Studio C ++, Glut 32 and ArToolKit.

4. Testing

To know the performance of the application that has been developed then the testing process. Tests in this study is to test the distance marker of the camera, camera angle and light intensity.

V. RESULT

The system was developed using a desktop computer with specification shown in Table 5.1

TABLE 2. Computer Specification for Development

No	Part	Specification
1	Processor	Intel Core i5-3470, 3,2GHz
2	Memory RAM	DDR 3 8 GB
3	Memory GPU	Nvidia GeForce GT620
4	Display	LED Monitor 23 in

The software used in the development of this application using visual studio, glut32 library and ARToolkit. Application testing is done in multimedia laboratory using desktop computer equipped with webcam camera. Test parameters include camera angle to marker, distance camera to marker and marker rotation. Fig 9 shows the initial process when the application is run.

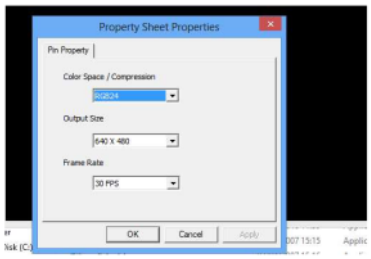

Fig.9. Initial View

At this initial screen the user will be asked to select the color compression whether using RGB24 or by using I420. Next the user will select the pixel size to be used in apikasi. The pixel size can be selected from 640x480 to 1280 x 960. In addition the frame rate can also be set from 5 FPS up to 30 FPS. Fig 10 shows the results of the camera capture. When no marker is detected then the system will not display virtual objects. The system displays only the real conditions of the environment captured by the camera.

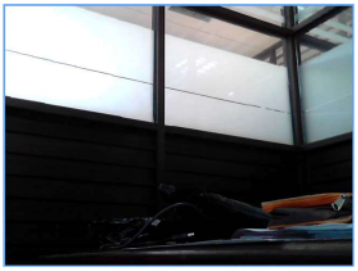

Fig.10. Camera Capture

To get results in this application then the camera will be confronted on a marker that has been designed on a book. Books with this marker will be used by the user to interact. Markers used this application is by using a single marker. Fig 11 Shows the book design used to interact with the system

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Fig.11. Book Design and marker

Fig 12 shows the application results when the camera takes a picture of the marker. 3D object shown is a catfish.

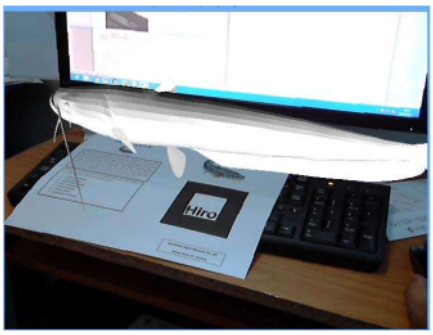

Fig.12. Virtual Object View

When the camera detects the marker, the marker information will be sent to the computer for translation and then the ARToolkit library will display a virtual object. The following program snippet explains how the marker detection process produces.

```
#pattern 1
VRML Wrl/lele.dat
Data/patt.hiro
80.0
0.0 0.0
```

In the above program snippet shown that when the marker with patt .hiro pattern it will call the wrl object with the name lele.dat. The value 80.0 represents the relative size of the object. The wrl object is an extension of the VRML file. VRML is one of the computer languages for creating 3 dimensional object model in virtual world. 3D object developed by using 3ds max will be converted into vrml form to be displayed in this system. Table 3 display the results of the system test using the parameter of the camera angle change to the marker.

TABLE 3 The Results Of The System Test Using The Parameter Of The Camera Angle Change To The Marker.

No	Angle of Camera	Result
1	0	No 3D Object Detected
2	10	No 3D Object Detected
3	20	No 3D Object Detected
4	30	3D Object Detected
5	40	3D Object Detected
6	50	3D Object Detected
7	60	3D Object Detected
8	70	3D Object Detected
9	80	3D Object Detected
10	90	3D Object Detected

Based on Table 3 the results show that 3D objects will appear when the camera position against the marker at an angle of 300 up to 900 angles. For the position of the marker rotation we get the result that when the marker is rotated either clockwise or the 3D object is still able to appear and the 3D object follows the direction rotation. So the user can see every part of 3D object. The test result of camera distance to marker is shown in Table 4.

TABLE 4 The Test Results Of Camera Distance To Marker

No	Distance of Camera to marker (cm)	Result
1	0	No 3D Object Detected
2	5	No 3D Object Detected
3	10	3D Object Detected
4	15	3D Object Detected
5	20	3D Object Detected
6	25	3D Object Detected
7	30	3D Object Detected
8	35	3D Object Detected
9	40	3D Object Detected
10	45	3D Object Detected
11	50	3D Object Detected
12	55	3D Object Detected
13	60	3D Object Detected
14	65	3D Object Detected
15	70	3D Object Detected
16	75	3D Object Detected
17	80	3D Object Detected
18	85	3D Object Detected
19	90	3D Object Detected
20	95	3D Object Detected
21	100	3D Object Detected

Based on the results from table 4 then the minimum distance for 3D objects can be displayed is 10 Cm. in this test the distance taken up to 100 Cm.

VI. CONCLUSION

The conclusions of this research are as follows:

- Augmented reality-based learning media has been successfully implemented using the ARToolkit library.
- The result of this research is the application of learning media introduction of fish classification. app users can learn to recognize the name of the fish classification and see the shape of the fish with a 3D view, so that users can gain new experiences in learning
- The test results of camera distance to the marker obtained results where the minimum distance for 3D objects can be displayed is at 10 Cm.
- The results of testing the camera angle to the marker obtained the minimum angle is 300 to 900
- To view 3D objects from various sides, the result of the rotation marker successfully displays every side of the 3D object and when the 3D object rotation is not interrupted.

Suggestions in this study are as follows:

- Advanced research can be done by adding interaction with 3D objects, so as to provide a new experience for the user.
- Use of display with HMD can be done to give real effect when interacting with 3D object.

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