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The Use of *Augmented Reality* to Introduce Wijaya Kusuma Flower

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Abstract. **This paper describes the use of AR technology to develop multimedia learning material for the introduction of plant morphology structure, especially Wijaya Kusuma flower to college students. The subject of the research was 2nd-semester students. The framework to analyze the material against the students' understanding of the parts of a flower and their functions with applications of *Augmented Reality* (AR) is a linear form of multimedia film and video as well as animation effects to reinforce the students' understanding. AR application developed by problem-based learning methods included the stage of the analysis, design, development, and testing. The application of AR used images of 3D animation was designed using Autodesk 3ds Max and was built using the FLARToolkit flash program, Papaervision3D, and FLARGenerator. The findings showed that the prototype of Wijaya Kusuma flower as virtual objects inserted into the real environment in real-time had been gained. A thorough development is required to improve the application by applying AR into mobile applications.**

Keywords: augmented reality, wijaya kusuma flower, FLARToolkit

INTRODUCTION

Information and communication technologies evolve rapidly, which affects the range of existing media. It encourages people to get more creative in managing science and to be able to think effectively and efficiently to get along with the development of information and communication technology. The development of information and communication technology currently involves multimedia since it is more effective to convey information. One of the multimedia technologies developing at the moment is Augmented Reality. *Augmented Reality* is a technology which combines virtual objects of two-dimensional and three-dimensional. This technology is capable of presenting objects in a virtual world such as human-made animation object into the world or real environment [1]. Augmented Reality is an innovative form of human-machine interaction where information is presented to users through e. g. A head-mounted display. It occurs in a context-sensitive manner in accordance with and derived from the observed object, such as a part of an assembly environment. In this case, Augmented Reality replaces the traditional assembly manual and provides additional updated information which is relevant to the process such as pressure, temperature, rpm, etc. In addition to the situation-sensitive interaction, the use of computers enables AR applications to gain a high degree of mobility as well as process, measuring, or simulation data to support the workflow. Currently, AR has been a subject of individual research projects and a small number of application-specific industrial projects on a global scale of 5/6. The current state of the art and the available appliances in 2003 only permit a niche-oriented application of the technology. However, AR enables a new innovative form of human-machine interaction that not only places the individual in the center of the industrial workflow but also offers a high potential for process and quality improvements in production and process workflows. While Virtual Reality, especially in the development phases of a product, supports the design and improvement of products without any real environment, Augmented Reality focuses on the real product and the real environment and augments this reality in a situation-sensitive manner with information attached to the object which enables or facilitate the design, manufacture, or maintenance of an industrial product [2].

Augmented Reality or abbreviated as AR currently undergoes rapid development and has touched the life of one variety in the world of education. The AR technology can be used to build many productions using hardware camera or webcam to capture images or objects that have been designed. Presently, with the applications available on a smartphone make it easier to do a translation that will be designed later. The reason to use *augmented reality* is that the process is interactive, simple, effective, efficient, and potential to be used as a media training [3]. In addition, AR is a form of human interaction with new machines that bring new experiences for its users. The application of AR using cameras would detect a marker that has been created and displays a combination of real images with animation. The AR is applied in education because the virtue owned by combining real-world situations and a virtual object can be used to address problems in understanding lessons [4].

In today's technological advancements, a number of innovative applications continue to emerge and support

education and learning. The application of using virtual reality technology has greatly differentiated the educational learning way compared to the traditional computer-assisted instruction, for instance, abstract concept simulation, virtual object manipulation, and interactive 3D gaming system. Through innovative technology-based learning, many learners may produce effective learning, and based on this learning effectiveness, more and more different kinds of technology-transfer medium system were requested to support learners in their computer-based learning system. Therefore, Augmented Reality (AR) technology gains attention in educational use because of its feature of combing real-life situation and the characteristics of virtual objects [5].

"Learning is a result of practices," it gives an illustration that learning brings changes in performance, and this change is a result of practices. Understanding practice shows that there is an effort from individuals to learn. Humans as living things have particular needs, and humans tend to try to meet those needs. To achieve the needs, humans will behave as the result of the learning process [6]. According to Wahono [7], there are three aspects and criteria for the standard of multimedia learning assessment, namely issues of software engineering, aspects of learning design, and elements of visual communication. Based on the standards, the learning multimedia products that exist today still have disadvantages [6].

The use of multimedia, such as AR may improve the students' understanding and support the teaching and learning process. AR is believed to have more streamlined approaches with wider user adoption than before due to the improvement in computer and information technology [3]. Based on Sari's finding, the use of the AR application was effective to introduce five senses towards elementary school students grade 4 [8]. Further, Azuma [9] stated that AR is a technology which combines two or three dimensional and virtual objects into a real three-dimensional environment and then projects the virtual objects into real-like. AR allows the users to see the virtual objects composited with the real world. Therefore, AR supplements reality rather than replace it. Ideally, it would appear to the user that the virtual and real objects coexisted in the same space [10]. In addition, Sari [4] claimed that AR is a view directly or indirectly from the physical objects by adding information which can be displayed virtually. The information displayed helps users to carry out activities in the real world. Unlike virtual reality, which completely replaces the fact, the AR partially add or complement a reality.

FLAR Marker Generator is software used to create a marker in AR applications that will be detected by webcam when AR runs. Marker is fundamental in AR applications. It is a file pattern that will be used as orientation in attaching a 3D object. Marker made images using image processing applications such as a paintbrush or other instant image processing. This image contains a pattern described and bordered by a thick black box.

On the other hand, Augmented Reality-Toolkit (AR-ToolKit) is a library for displaying information in combining the real world and cyberspace. FLARToolKit is based on ARToolKit [11] and uses ActionScript 3. FlarToolkit is a library that is used in the AR application development to flash images and calculate the 3D position and orientation.

This research aims to develop application based on AR to introduce the structure of plant morphology and its functions, especially Wijaya Kusuma flower, to college students. By applying AR, the display pictures of flowers became more tangible and eased the students to learn and memorized the information about the structures and functions of Wijaya Kusuma flower.

METHOD

The research development covers analysis, design, development, and testing. The analysis stage focused on the learning objectives, especially targets to be achieved by the students. The design stage concentrated on the subject, particularly the structure and function of the parts of Wijaya Kusuma flower. The development stage determined the application development, including the presentation of learning using the developer tools to get the expected implementation. The testing stage is conducted to test the reliability of the application.

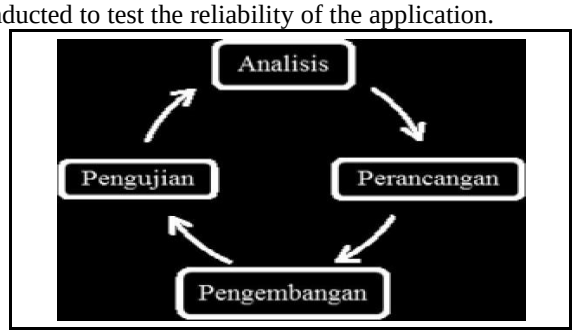

Figure 1: Stages of Problem-Based Learning

Hardware specification used in AR includes PC and webcam. In this study, the PC used is ACER ASPIRE 4535 with specifications of AMD Turion X 2, VGA ATI Radeon HD 3200 Graphics, RAM 2 GB, and attached webcam. Printers are also required to print the markers. Additionally, the software is also used, including FlashDevelop to create AR, FLARToolkit and Papervision 3D to be used as a library file, FLARToolkit Actionscript 3 to deal with the language, Autodesk 3ds Max to generate 3D images of Wijaya Kusuma flower, and SWF file to show the result.

RESULT

The study has successfully created a prototype of Wijaya Kusuma flower. Figure 2 shows the marker of Wijaya Kusuma flower to represent the 3D object of Wijaya Kusuma flower, as illustrated in Figure 3.

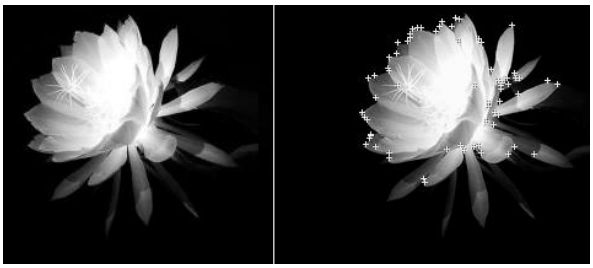

Figure 2. The picture with and without Marker

Markers are made based on images of Wijaya Kusuma flower taken from books or photographs. The function of this marker is to mark images as the object to be displayed. The two images, as shown in Figure 2, are a comparison of the original image before and after being marked. A yellow cross indicates the markers along the edge of the flower petals. This marker is used as the basis of its 3D form.

3D modeling is made to visualize objects using AR technology. The modeling process used Blender 3D software. The object of the 3D image made in this study is the shape of the Wijaya Kusuma flower which is placed in a pot so that the parts of the anatomy of the Wijaya Kusuma flower look like leaves and stems as shown in figure 3.

Figure 3. 3D Model of Wijaya Kusuma Flower

Figure 4 shows a 3D model of the blossoming petals. This model is made close to its original size to make it look real.

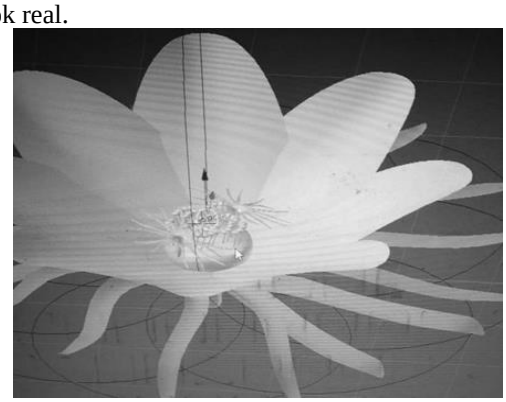

Figure 4. 3D Model of Petals

After the 3D modeling stage, the rendering process is then carried out. The rendering process is the final process for the entire modeling process. In this process, the two 3D models that have been created earlier are combined into one model. The result of the rendering process after being combined is shown in figure 5.

Figure 5. Rendering Result

This stage is the process of making an AR model from the rendering of the 3D shapes of the Wijaya Kusuma flower using the Unity 3D software as a development tool and Vuforia engine software to produce 3D objects with augmented reality. As a result, the Wijaya Kusuma flower object that has been modeled in 3D will look real. The trial was carried out using a microcomputer equipped with a USB camera. The result of the trial showed that the 3D object of Wijaya Kusuma flower with augmented reality was generated when a tracking process occurs on the marker. The steps are, first, we put the picture of Wijaya Kusuma flower in front of the PC camera, then the software will work to track and read the markers that have been made as shown in figure 6.

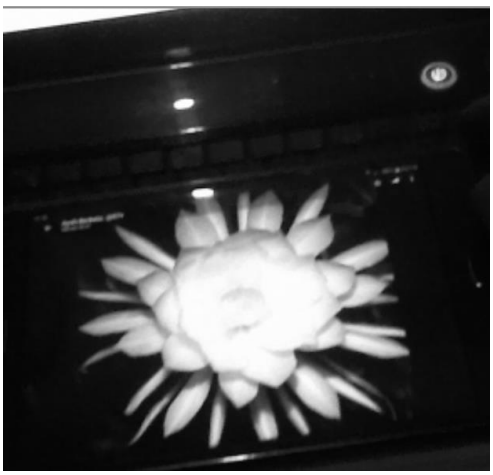

Figure 6. Tracking Process before Object Found

If the software successfully traces based on the database, then it can generate 3D models of flowers, as shown in figure 7.

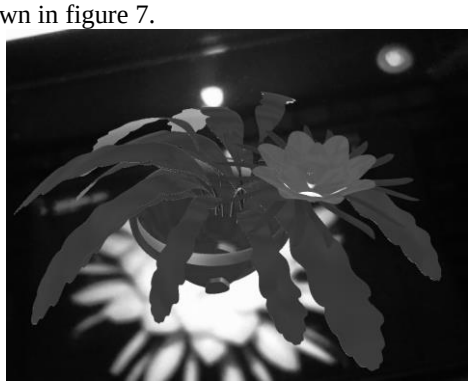

Figure 7. Generating 3D Model after Object Found

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The next step is to create an animation process to simulate the appearance of the Wijaya Kusuma flower. The animation is the process of making movements on an object so that it looks real. The animation process was based on the 3D model of Wijaya Kusuma flower that has been processed using Blender software.

After the animation was made, the final rendering process was conducted, which included the final calculation of the 3D model that has been given texture, lighting, environment effect, and animation. Thus, the results of the animation of the Wijaya Kusuma flower looked real and attractive.

The description of the workflow in the introduction of the AR to identify plant parts and functions, especially Wijaya Kusuma flower, can be seen in Figure 8:

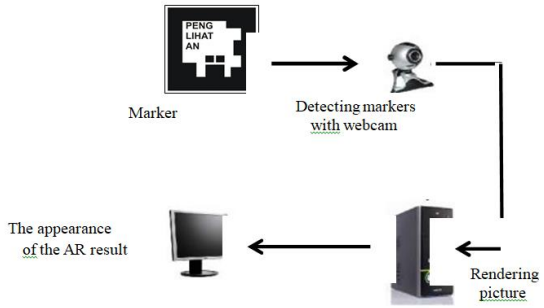

Figure 8: Introduction to workflow objects in AR applications

CONCLUSION

The AR technology can be used by lecturers as a teaching aid in the classroom to help students to have a better understanding of plant morphology, particularly the structures and function of Wijaya Kusuma flower. The AR technology can be applied as an alternative method other than the conventional learning method. The result showed that the prototype of AR technology on Wijaya Kusuma flower produced a real-look virtual object. For the application improvement, a thorough development is required by applying it into mobile applications.

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