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DEVELOPMENT OF AUGMENTED REALITY TECHNOLOGY BASED LEARNING MEDIA OF LATHE MACHINES

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ABSTRACT

Conventionally, in the learning process teachers usually explain lathe machines using only one unit machine thus the students cannot observe and learn the machine comprehensively. Hence, it is necessary to create learning media based on Augmented Reality technology that can be individually accessed with smartphone devices to facilitate the students in examining the lathe parts in detail with ease. This study discusses the development of Augmented Reality technology based learning media to display parts of the lathe in informative details. This study was categorized as Research and Development. The procedure of the study consisted of several stages including finding potential and problem, literature studies, product development, expert validation, product revisions, product trial, product revision, user response, product revision and final product development. The results showed that the developed learning media was applicable. The percentages of product testing and user response testing were 87.50% and 82% respectively which both were categorized as good.

Keywords: augmented reality, lathe, learning media

INTRODUCTION

A lathe machine is a subject that must be understood and studied by the students of mechanical engineering. They consist of vocational high school and mechanical engineering colleges students. Students must master the basics of lathes. There is an obstacle in lathe learning that is the limitation of the tools so that students have trouble knowing parts of the lathe. The learning method used to support the process of teaching and learning activities, especially on the subjects of Mechanical Engineering, the introduction of machine parts still use books, worksheets, and using the original practice materials. The machine used as teaching media is available only 1 unit while the number of students in the class is about 30 students. Of course, this will create atmosphere that is less supportive for the students in the learning process so that the understanding or mastery of the materials is not maximum. The students will find it difficult to understand the materials because they do not have an opportunity to observe the lathe machine. Teachers usually explain directly by displaying 1 piece of an original lathe machine but the explanation will make it difficult for students because not all students can see the lathe machine thoroughly.

Another method used by teachers is to use textbooks and drawings to visualize lathes. This will hinder students' understanding because it seems boring. To overcome these problems, an innovation in the delivery of materials using learning media is necessary. Learning media help teachers to teach because it is interactive, fun and make the students quickly understand the materials. Learning media is very essential in the learning process because it influences the students' achievement (Suyitno, 2016) Learning media follow the development of existing technologies such as the use of video learning, animation, interactive media, and so forth.

A smartphone is an electronic device widely used by the community. Application development on smartphone devices also includes education. New and more sophisticated technologies are beginning to emerge. The development of hardware is directly proportional to the development of software.

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One of the advanced technologies developed now is mixed reality technology. Mixed reality technology is divided into two namely Virtual Reality (VR) and Augmented Reality (AR). Augmented reality (AR) is a type of interactive technology that combines real and virtual objects that will generate 3D objects that will be displayed on the screen. (Azuma, et al., 2001).

Augmented reality that has been applied has a way of working based on images or images detection and commonly called a marker, using a smartphone camera and then detect markers that have been in print. Augmented reality is widely used in many fields, one of them is education. (Pramana, et al., 2018). The application of Augmented Reality is able to realize the virtual world into the real world. It can display 2D drawing objects into 3D objects, so that learning method is not monotonous and students are encouraged to find out more, such as knowing the shape and visualization of the original form (Azuma, et al., 2001). Arief & Umniati (2012) add that AR is expected to provide alternative learning for students that are interesting and easy to understand.

AR technology or can be referred to as Real Reality is the integration of digital elements that are added to the real-world real-time (real-world data) and follow the real-world environment that can be applied to mobile devices. Current AR usage has spread to all aspects of life and will experience significant developments for the future. Augmented Reality (AR) technology is commonly used in many fields such as entertainment, advertising, health, military, and education.

This augmented reality technology can be applied in a learning system on lathe materials. The use of augmented reality is expected to display parts of the lathe in detail and informative to facilitate students in learning. Students do not need to queue to see the lathe in detail. They just need to open this AR application and start observing the lathe as if it were the same as the actual form. This application is equipped with an explanation of each part of the lathe so that it is very helpful for the students.

METHOD

The research method used in this study is Research and Development approach. Research and Development method is a research method used to produce a specific product and test the effectiveness of feasibility of the product. This research method consists of several stages finding potential and problem, literature studies, product development, expert validation, product revisions, product trial, product revision, user response, product revision and the final product (Sugiyono, 2015). The flow diagram of the research procedure can be seen in Figure 1.

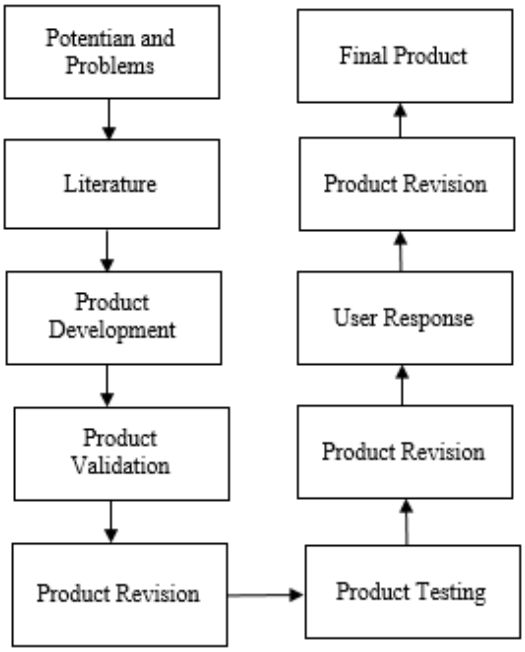

Figure 1. Research Procedure

The stages of the study will be explained as follows: Potential and problem stage is the stage when the researchers found the problem of the limitations of props in learning the lathe and the potential of AR technology applied as machine learning media. Literature Studies consist of searching for supporting data to create the product. The researchers look for

reference books, internet resources, and do a direct shoot on the tool that is lathe machine.

Product development stage consists of required system analysis, flowchart design, use case diagram design, interface design, 3D modelling design with Sketch up software, developing Augmented Reality (AR) with Unity 3D and Vuforia SDK. The product development stage will be explained as follows: (1) Design Flowchart, Flowchart Android system is a sequence of events that occur on Android-based mobile. General flowchart system design of the application can be seen in Figure 2.

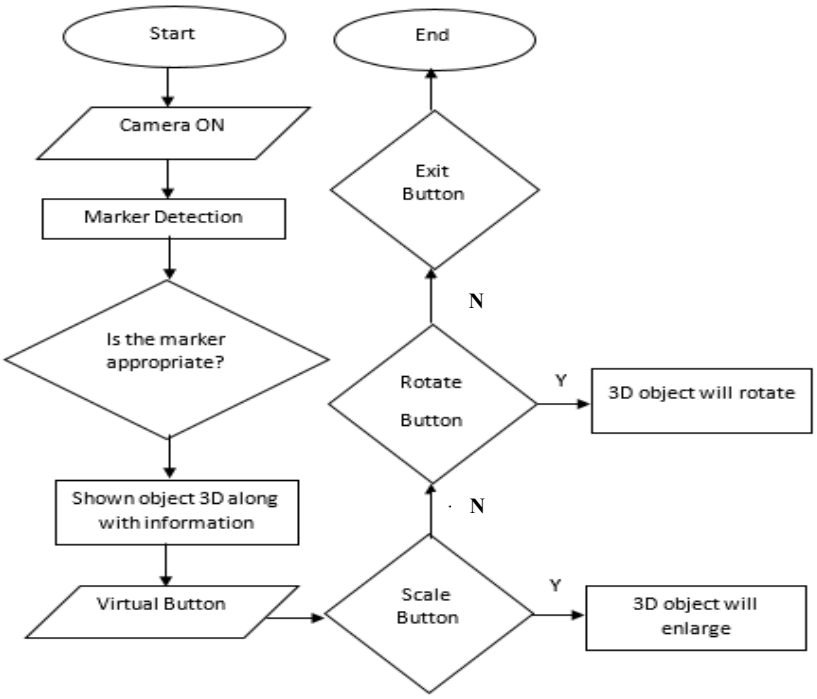

Figure 2. General Flowchart System Design in The Application

(2) Use Case Diagram explains the interaction between the user of a system with the system that will tell how a system is used. Use case diagram consists of an actor and the interaction it does, the actor can Human form as the user interacts with the system. Use case diagram of this system can be seen in Figure 3.

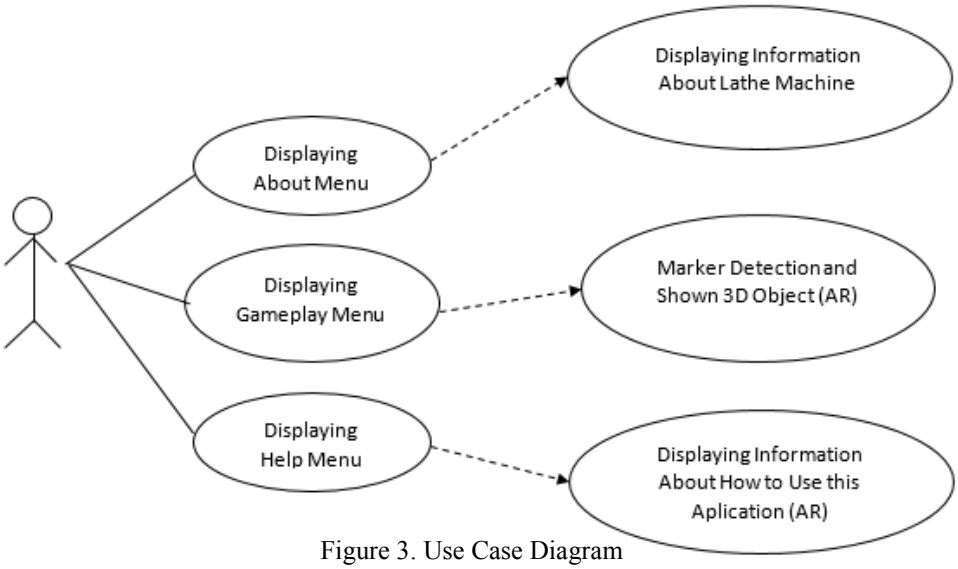

Figure 3. Use Case Diagram

(3) User Interface Design is the design of software applications with the focus on the user's experience and interaction. The goal of user interface design is to make the application as simple and efficient as possible. User interface design of this application can be seen in Figure 4 until Figure 7.

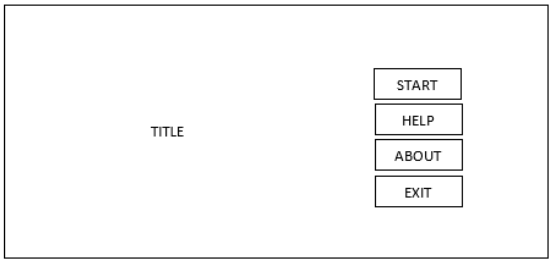

Figure 4. Main Menu UI Design

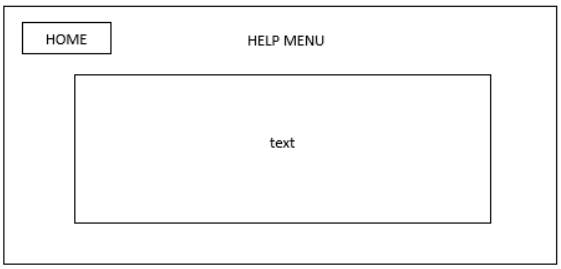

Figure 5. Help Menu UI Design

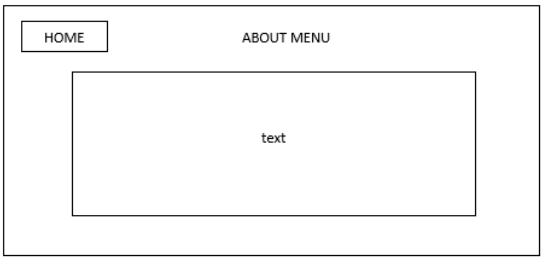

Figure 6. About Menu UI Design

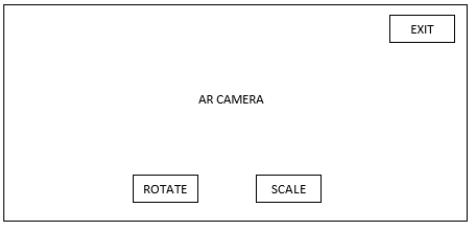

Figure 7. Gameplay Menu (AR) UI Design

3 D modelling design in this application uses Sketchup software. 3D models created in Sketchup will be exported in the .dae type. The next process is importing these assets into Unity software. Development of AR in Unity using Vuforia SDK downloaded on the official website. A database marker is created first in Vuforia account then the database is imported to Unity to do Augmented Reality setting. After the stages are completed, the build application becomes a .apk type that can be installed on the Android smartphones. The Vuforia database process is described in Figure 8.

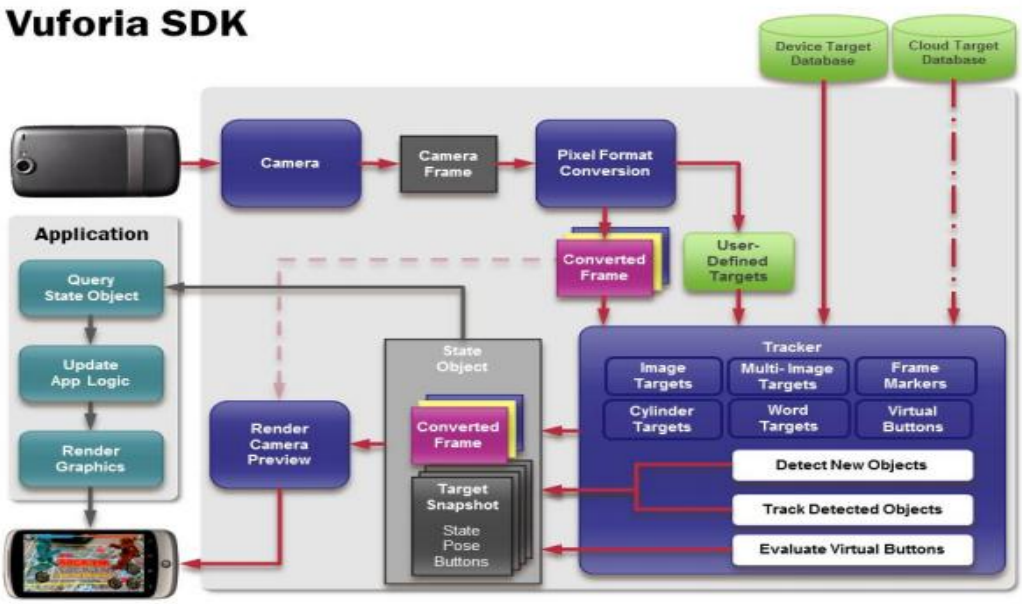

Figure 8.Vuforia SDK Architecture (Domhan, 2010)

Product testing is done by experts with Black box testing methods. Blackbox testing serves to test whether the application runs in accordance with its function. If there is a system error at this stage, the developer will fix it immediately. Product validation is the material assessment of the AR application. The assessment consists of the conformity of the material displayed on the application and the Vocational High Schools' materials. This assessment was done by experts with a questionnaire method. The errors found in this process will be fixed soon by the developer to get good results. User Response is the final assessment performed by the user or the end user of the application. Test user response using questionnaires conducted by students majoring in machines.

RESULTS AND DISCUSSION

This section is divided into 2 parts that consists of the result of software design and the results of software testing. The final product of this study is called ARLathe that run on the Android operating system. This UI design was made in Adobe Illustrator that be imported in Unity. When the player opens this application it will appear main menu screen shown in Figure 9.

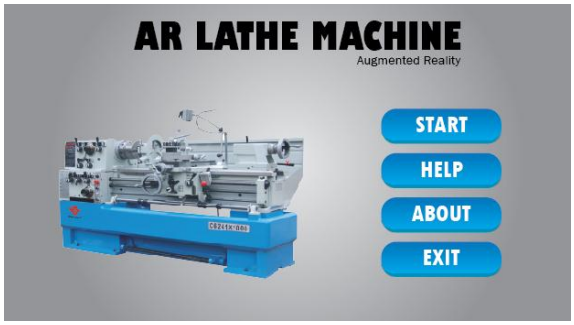

Figure 9. Main Menu ARLathe

The most important thing in the use of this application is the marker as a detector of augmented reality technology. This marker will eventually pull out a 3D lathe object when the user directs their mobile camera to the marker. In this Help Menu. The user can download and print the markers that used. The interface of Help menu is shown in Figure 10.

Figure 10. Help Menu ARLathe

In the Gameplay menu, the user should direct the camera to the printed marker. 3D objects will appear from the lathe along with important information. In this menu, there is a virtual button that is the rotate button to rotate the 3d object, the scale button to enlarge the object, and the exit button to exit the AR menu. The interface of Help menu is shown in Figure 11 and the marker shown in Figure 12.

Figure 11. Gameplay Menu ARLathe

The about menu consists of information about lathe machine. The interface of Help menu is shown in Figure 12.

Figure 11. About Menu ARLathe

Software testing consist of 3 steps that are software testing, validation testing, and user response. The first step was software testing that done by an expert who really knows about the system. This step using a black box method. Software testing was run to discover system functional errors. The software testing result showed the system runs effectively and there are no functional errors. The result of black box testing is presented in Table 1.

Table 1. Black Box Testing Results

Step	Test Case	Expected Results	Actual Result	Status
1	Press Start Button	It displays the AR Mode Gameplay Scene	It displays the AR Mode Gameplay Scene Successfully	Pass
2	Press Rotate Virtual Button	3D Object Rotating	3D Object rotating Successfully	Pass
3	Press Scale Virtual Button	3D Object Scaling Bigger	3D Object Scaling Bigger Successfully	Pass
4	Press Help Button	It displays the Help Menu	It displays the Help Menu Successfully	Pass
5	Press About Button	It displays the About Menu	It displays the About Menu Successfully	Pass
6	Press Exit Button	Close Application	Close Application Successfully	Pass

The second step was validation testing. This step was performed by a material expert who knows about Lathe Machine. The data analysis technique used in validation testing and user response based on Likert scales. The results of the validation testing showed the percentage of assessment was 87.50% which was categorized as good. The last step was user response. This step was conducted by giving questionnaire and testing process. This application was tested by 30 students of mechanical engineering UNNES in the introduction of the lathe.

Students have to install this application on their smartphones and run it. While the lecturers explain the materials, students can observe virtually the lathe by pointing their phones to their respective desks and it will appear virtual 3D form of the lathe. This application provides benefits for lecturers and students. The lecturer explains the material more easily and the students more clearly understand about the lathe. A good understanding will also impact on improving student learning outcomes. The result of user response testing showed the percentage assessment of 82% which is categorized as good.

CONCLUSION

This study has successfully built interactive and efficient learning media with Augmented Reality basis named AR Lathe Machine. The application test has successfully displayed the lathe bag object by using a marker. Each object runs well and quickly appears in the marker tracking process. Each button runs according to their respective functions. The suggestions that the researcher can provide for the development and improvement of this system are as follows: for further development, this application is expected to add a menu to change the texture of the machine so it looks more real and better. For further development, this application is expected to be based on cloud recognition or user-defined target.

REFERENCES

Arief, R. & Umniati, N. 2012. Pengembangan Virtual Class untuk Pembelajaran Augmented Reality Berbasis Android. *Jurnal Pendidikan Teknologi dan Kejuruan*. 21.2, 112-122

Domhan, T. 2010. *Augmented Reality on Android Smartphone*. Dualen Hochschule BadenWürttemberg. Jerman

Pramana, Y.A., Brata, K.C., Brata, A.H., Pembangunan Aplikasi Augmented Reality untuk Pengenalan Benda di Museum berbasis Android (A Case Study: Museum Blambangan Banyuwangi). *Jurnal Pengembangan Teknologi Informasi dan Ilmu Komputer*. 2.5, 2034-2042

R. Azuma, Y. Baillot, R. Behringer, S. Feiner, S. Julier, B. MacIntyre. 2001. Recent Advances in Augmented Reality. *IEEE Computer Graphics & Applications*. 21.6, 34-47

Saputro, R.E., & Saputra D.I.S. 2015. Pengembangan Media Pembelajaran Mengenal Organ Pencernaan Manusia Menggunakan Teknologi *Augmented Reality*. *Jurnal Buana Informatika*. 6.2, 153-162

Sugiyono. *Metode Penelitian dan Pengembangan (Research and Development/R&D)*. Bandung: Alfabeta. 2015

Suyitno. 2016. Pengembangan Multimedia Interaktif Pengukuran Teknik untuk Meningkatkan Hasil Belajar Siswa SMK. *Jurnal Pendidikan Teknologi dan Kejuruan*. 23.1, 101-109