LEARNING MEDIA OF BALINESE SCRIPT WRITING BASED ON AUGMENTED REALITY

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ABSTRACT

Balinese Script is one of the Bali Cultural wealth that must be preserved. Balinese Script is a traditional script used to write Balinese Language and Literature. Conventional teaching method with traditional learning media can be one factor of students' disinterest, especially children in writing Balinese Script in their educational institutions. Learning media of Balinese Script writing that is packaged in the form of Augmented Reality applications in gadget with applying the Android operating system is expected to be a solution to increase user interest in studying Balinese Script. Learning media application of Balinese Script based on Augmented Reality focuses on learning of how to write Balinese Script. These features overall are packaged in 3-dimensional animation which is completed by voice instruction in Balinese Language and additional information in the form of explanation of every Balinese and examples of words in Balinese. Learning media of Balinese script writing based on Augmented Reality applies multi target marker methode in order to detect some image target in one object target simultaneously. Raycast technique is applied in order to choose one image target or one of Balinese script 3 dimensional object which is occured as the result of multi target marker detection.

Keywords : *Balinese Script Writing, Learning Media, Augmented Reality, 3D Animation, Multi Target Marker Methode, Raycast Technique.*

1. INTRODUCTION

Balinese Script is a traditional script used to write Balinese Language and Literature. The history of Balinese Script cannot be separated with script developed in India since the development of Balinese Script is begun from the entry of Hinduism and Buddhism from India to Indonesia [1]. Balinese Script has the privilege compared with the other scripts because Balinese Script is not merely used in Balinese Language and Literature but also used as a sacred symbol associated with Hinduism as the use of Balinese Ceremony called Yadnya ceremony [2].

The development of technology makes Balinese Script becomes rare to be learnt and used. Children merely learn Balinese on the local content Balinese language. Learning about the Balinese Script writing needs to be introduced at an early age. The less attractive learning methods become one factor of the disinterest of the students, especially the children in studying of Balinese Script. Interactive and interesting learning media is required to facilitate children in understanding how to write Balinese Script.

The technology of Augmented Reality is one example of the advances in information technology. Augmented Reality is a technology applied to combine real objects with virtual objects so that information of limited real object can be supplemented with information from the virtual object. The example of this application of Augmented Reality technology is making DewataAR application which has function as a media promotion of tourism in Bali [3].

Balinese language especially Balinese Script is the identity of Bali that needs to be preserved. The efforts of Balinese language preservation have been made by applying the translator application from Balinese Language to Indonesian with Android-based binary searching method [4]. However, the effort to introduce and preserve Balinese language especially Balinese Script by using Augmented Reality technology has never been done.

The lack of elementary students' interest in learning Balinese Script because of uninteresting method in teachin [5], it inspired the writer in order to make Learning media of Balinese Script based on Augmented Reality. Learning media of Balinese

Script based on Augmented Reality is a media that is created specifically for students of elementary school which provides information about how to write Balinese Script that is displayed in 3 dimensions animation and guiding voices in writing Balinese Script. Additional information is provided not merely how to write the Balinese Script. Yet in the system, there is also explanation about the use of every Balinese Script and examples of words in Balinese Script.

2. METHODS

2.1 Augmented Reality (AR)

Augmented Reality is a technology which is used to combine real objects with virtual objects so that information from the virtual object can complete the information of the object contained in the real world [3]. Augmented Reality is the embodiment of a virtual object both 2-dimensional and 3-dimensional into a real environment. Augmented Reality is used in order to improve and enhance the understanding or perception about a real object that has limited information by adding additional information on the object through the visualization displayed on the display system of Augmented Reality [6].

The characteristic of Augmented Reality is the incorporation of 3-dimensional virtual objects with objects in the real world. Augmented Reality technology combines the geometry between real objects with virtual information so that virtual content in this case is a 3D animated object can be placed in accordance with the position of the real object. Augmented Reality technology can be applied on a smartphone based on Android and iOS as well as the use of Augmented Reality technology can be used as instructional media, advertising media, health, and entertainment media as well as for the military [7].

Making marker and Markerless can use library of Vuforia. Vuforia is a Software Development Kit (SDK) which is applied to create Augmented Reality applications. Developers can optimize the power of computer vision that is contained in Vuforia in order to recognize images and real objects or reconstruct real-world environments. The main features of Vuforia are recognition and image tracking, object, text, markers, and reconstructed the real environment [8].

The making of learning media of Balinese Script writing based on Augmented Reality application applies library Vuforia in order to identify Balinese Script and also make Balinese becomes an image of the target marker. The previous research on the introduction of Balinese Script is done by using Arc Pattern Localized [9].

2.2 Marker AR

Augmented Reality can be classified into two parts in accordance with whether or not the use of the technique in the application of augmented reality marker. Those techniques are Marker Augmented Reality and Markerless Augmented Reality.

Marker Augmented Reality is a method of using the marker in black and white and has a thick black border. Augmented Reality marker method was developed in the 1990s.

Markerless Augmented Reality is a method that does not require specially made marker or markers in black and white barcode. Markerless can include images that have a value of RGB or gray scale image that will be used as a target marker [10].

Learning Media of Balinese Script writing based on Augmented Reality uses markerless method and multi target marker method which is used in order to detect some images target in one object target simultaneously.

Multi targets marker is a method of detecting some images target in one object target simultaneously. The geometric arrangement of each images target has been defined in the multi targets. This allows multiple targets to detect some images target in one object simultaneously when one of the images target is detected. The geometric arrangement of the image of the target marker are identified as three coordinate axes, x, y, and z.

Flow map of Augmented Reality detection by applying multiple detection methods that the target marker in Figure 1.
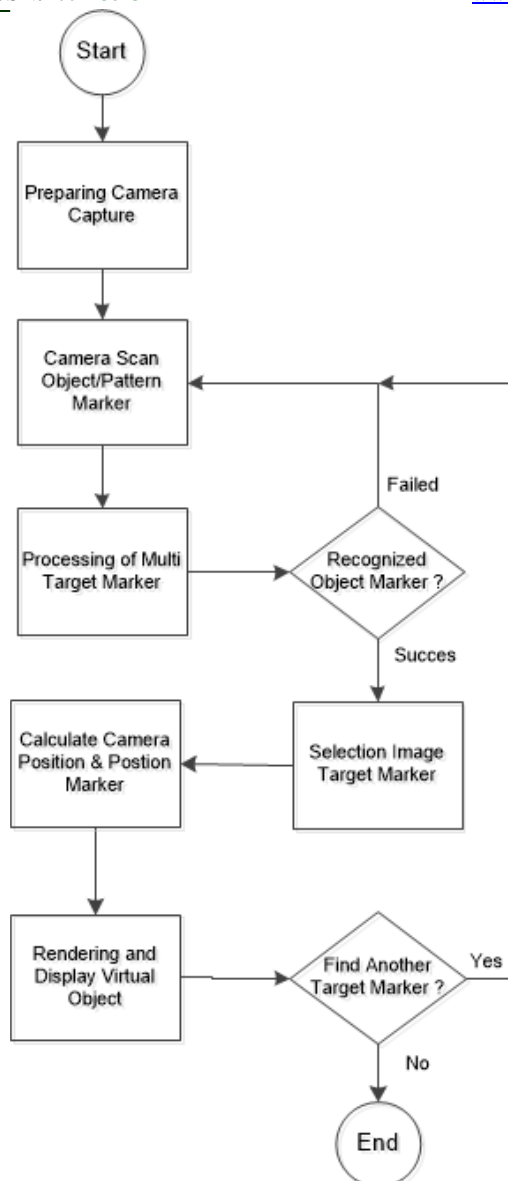
Figure 1 : Flow Map AR Detection and Process Multi Target Marker

Virtual objects will be displayed when the Augmented Reality system can recognize the object. The time needed to identify object target is depending on the size of the image target and the texture of the image target within one object target. The camera position and marker position will be calculated to determine the position of the virtual object.

2.3 Balinese Script

Nowadays, Balinese Script is a combination of Wresastra Script and Swalalita Script. Wresastra Script is used to write common Balinese language. Wresastra Script is divided into six parts: Suara

Script, Wianjana Script, Pengangge Suara, Pengangge Tengenan, Suara Script and Balinese numbers. The examples of Wresastra Script are in writing letter, pangeling-eling, pipil, and etc [1].

Swalalita Script is used to write Kawi Language, Middle Kawi and Sanskrit. For instances, the use of Swalalita Script are in Geguritan, Kidung, dan Kakawinan.

Figure 2 : Balinese Script Table

This research is applied seven target objects regarding to the kinds of Balinese Script. Those are Winjana Script, Gantungan dan Gempelan Wianjana Script, Pengangge Suara, Pengangge Tengenan, Balinese number, Suara dan Swalalita Scripts. Each target object has some images target in accordance with the number of Balinese Script in the object marker.

3.   EXPERIMENT AND RESULT

3.1 System Overview

Learning media of Balinese Script based on Augmented Reality provides information on how to write a Balinese Script that is displayed through 3 dimensional animations completed with a voice for guidance in writing Balinese Script. Additional information is provided not merely how to write the Balinese Script. Yet in the system, there is also explanation about the use of every Balinese Script and examples of words in Balinese Script.
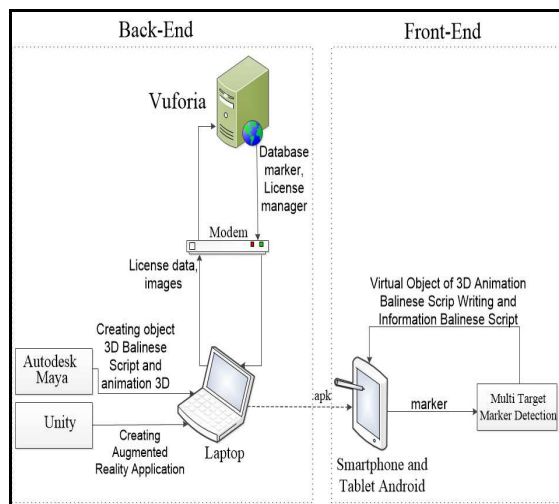
Figure 3 : System Overview

General overview of the application process is divided into two parts, namely the Back-End and Front-End processes. The Back-End process includes the making of Augmented Reality application by using library Vuforia. The use of Vuforia can be done by doing registration in Vuforia website. After registration, the making of license and data base marker will be done. License and database marker are imported into Unity asset. The conducting of 3D model and 3D animation apply cyber Autodesk software with student license. The animation and 3D object will be exported into Unity in the file form of .fbx. The result of conducting Augmented Reality application is to produce .apk file which will be installed in smartphone or android tablet.

Afterwards, the process of front- end includes the installation of .apk file in smartphone or tablet. The installed Augmented Reality application can perform tracking images and match the marker data in the .apk file with each image that is highlighted or captured by the camera user. Pictures or markers which correspond to markers database system will display the object to see Balinese Script in the form of three-dimensional, three-dimensional animation how to write Balinese Script and information about Balinese Script in the smartphone screen as well as.

The creating of learning media of Balinese Script based on Augmented Reality application faces a challenge in creating system function which can detect multiple image targets simultaneously in one object target. Another challenge is in creating system function which users can interact with system. The interaction in this context means that the users can choose one of 3 dimensions Balinese Script object. The last challenge is to create 3

dimensions animation which have small memory size and can be rendered or displayed with a smartphone that has the minimum specification.

3.2 Development Flowchart

Flowchart of making learning media of Balinese Script writing based on Augmented Reality application can be seen as follow:
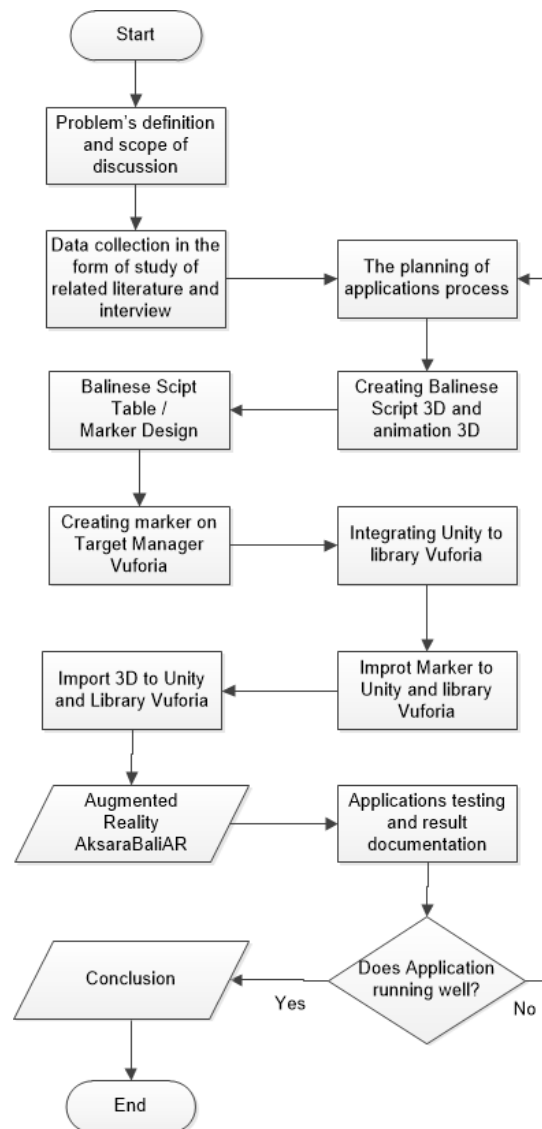

Figure 4 : Development Flowchart of AksaraBaliAR

Flowchart of AksaraBaliAR application is started from the problem definition and limitation of discussion. Library research and interviews was applied in order to collect the data. Then, creating 3D models and 3D animation of writing Balinese Script was done. The conducting of Balinese Script

table marker and integrating Vuforia library with Unity were done. The importing 3D objects and 3D animation to Unity and do testing, analysis and documentation applications. If the application is already running well AksaraBaliAR it can be concluded.

3.3 Use Case Diagram

Use case diagram has function to model and display the services or functionality in the system. The use case of learning media of Balinese Script writing based on Augmented Reality application can be seen as follow.
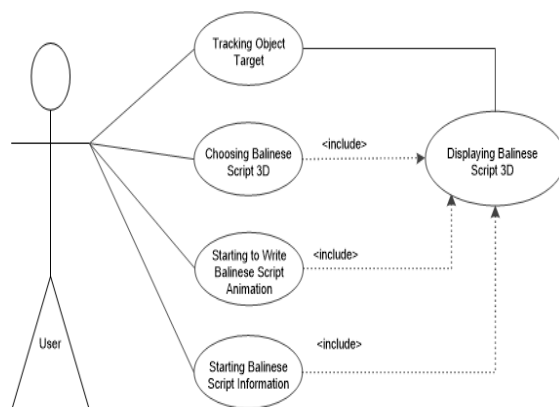
Figure 5 : Use Case Diagram of AksaraBaliAR

Figure 5 is a use case of learning media of Balinese Script writing based on Augmented Reality, where there are four services that are provided by the system. Those are Tracking Object target, Choosing 3D Balinese Script, starting to write Balinese Script animation, and starting information Balinese Script.

3.4 Activity Diagram

Activity diagram is required to describe the process flow that occurs in the system. Activity diagrams in learning media of Balinese Script writing based on Augmented Reality is:
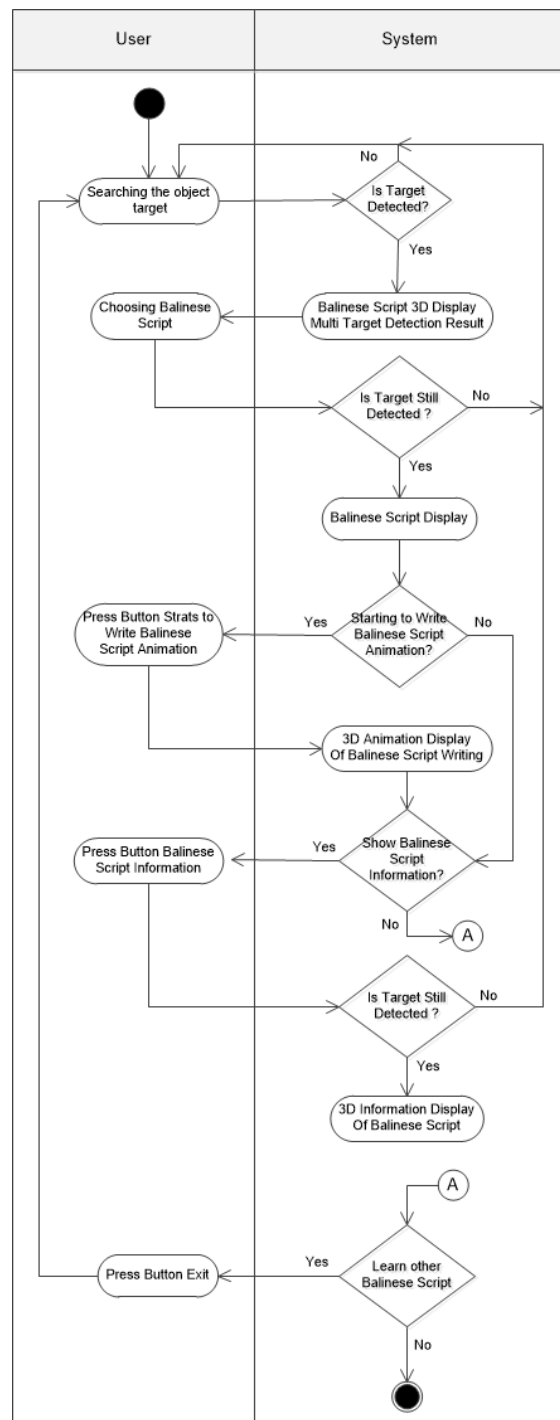
Figure 6 : Activity Diagram

Activity diagram is started from system users to search the object target. Object target search is done by using multi-targeted marker so that the result shown is a 3D Balinese Script display with amount more than one Balinese Script. Users can select one Balinese Script and view the animation how to write Balinese Script and information of the

Balinese Script if target image is still detected by system as well as. In order to choose another Balinese Script, the users must choose exit button than system will do searching images target.

3.5 Creating Marker

Balinese Script contained in Balinese Script table (Figure 2) will be registered as image target on Vuforia website. Picture Balinese Script uploaded to the website will be given Vuforia detection features in form of dots (interest point) in the image. There is an edge analysis process in order to detect the right angle of an image.
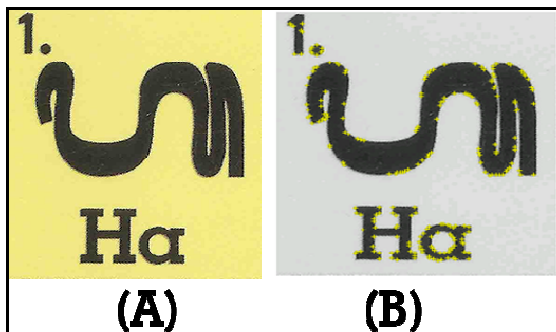

Figure 7 : Detail Image Target and Detection Features

Figure 7 is an image which shows the detail of the image target and detection features. Figure 7 (A) is an example image that is registered as image target to the Vuforia server and Figure 7 (B) are dots of (interest point) that is given by Vuforia image when the image successfully become the image target. Those dots (interest point) will be used as an identifier of Augmented Reality system. The dots (interest point) are also found on the marker used by the application Dewata AR. Display marker and of dots (interest point) of the application DewataAR namely [3].

Figure 8 : Marker of DewataAR Application [3]

The amount number of dots (interest point) will determine Augmentable rating. Augmentable rating has a value range of 0 to 5 for each image. Image with sharp angle texture pattern will produce higher Augmentable value than in image with obtuse angle [3]. If the augmentable value is higher, the image or marker will be faster recognizing by Augmented Reality system.

3.6 Testing and Result Multi Target Detection

The position of image target in one object which is closely of the target marker allows system to detect image target with more than one target marker simultaneously. Therefore, it is needed the using of multiple targets marker detection in order to detect a target object in which there are several the target image at the same time.
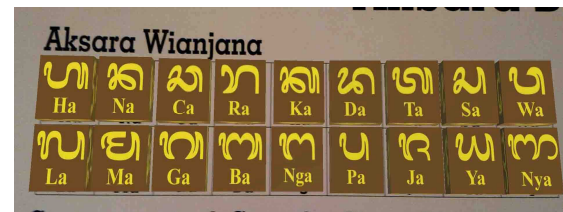

Figure 9 : Result of Multi Target Detection

Figure 9 is the result of multiple targets marker detection with the number of 3-dimensional objects and displayed is 18. The average detection distance between the image target and Android smartphone is 30 cm. Choosing one of 3-dimensional Balinese Script can use Raycast techniques.

```
void Update(){
    if (Input.GetMouseButtonDown (0)) {
        Ray ray = Camera.main.ScreenPointToRay (Input.mousePosition);
        RaycastHit hit;

        if (Physics.Raycast (ray, out hit)) {
            if (hit.transform == target1) {
                show = true;

            }
        }
    }
}
```
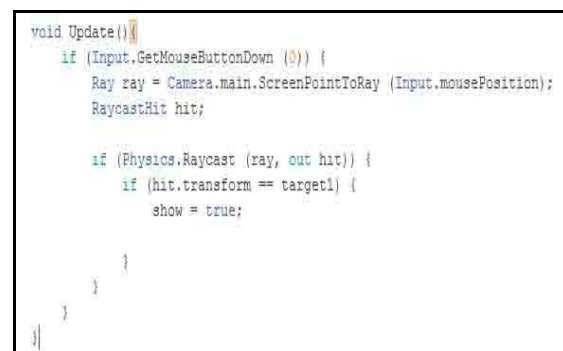
Figure 10 : Raycast Program Code

Figure 10 is a picture that shows Raycast program code which is applied to select one of the 3-dimensional objects or targets marker image displayed on the results of multi-targets detection marker. Each image target has a 3D object. Three dimensions Balinese Script object is completed with collider, so when selecting a 3D object, the value of

3D objects incorporating collider will be transformed and evaluates to true value, so the value of 3D Balinese Script are not selected will evaluate to false value and not displayed.
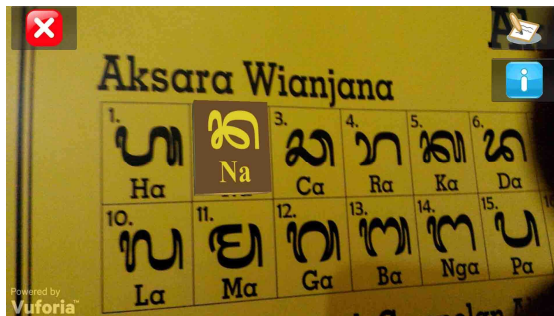

Figure 11 : Result of Raycasting

Figure 11 shows the results of implementation Raycasting techniques. 3D objects is selected script will be true and the system will display three buttons. Those are buttons for displaying animated Balinese Script way of writing, the button to display information Balinese Script and Exit Button which serves to locate the image target to another within one object target.
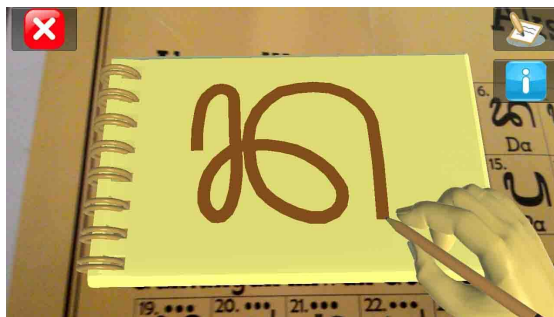

Figure 12 : Virtual Object of 3D Animation Writing Balinese Script

Figure 12 is a 3D animation Balinese Script way of writing in this case the Balinese Script Na "n". Additional information is provided not merely how to write the Balinese Script, but also in the system includes about the explanations of using every Balinese Script and examples of words in Balinese Script.

Figure 13 : Virtual Object 3D Information Balinese Script

Figure 13 is a 3D display that contains information about the name of the Balinese Script, a description of the Balinese Script, and examples of the use of Balinese Script.

Figure 14: Use of Applications by Students of Elementary School.

Figure 14 is a picture that shows the use of learning media of Balinese Script based on Augmented Reality application by students of elementary school and their teacher.

3.7 Testing and Result System

Testing is required in order to ensure the output of the software relevance with the objectives that have been defined. Application functionality testing uses the hardware of smartphone based on Android with specs can be seen in table 1.

Tabel 1 : The specification of smartphone device.

No.	Type of Device	Specification
1.	Vivo Y15	Android Version : 4.2 (Jelly Bean) Processor : Quad-Core 1.3 GHz

		RAM : 512 MB Camera : 5 Mega Pixel Display Screen : 854 x 480 pixels
2.	Asus Zenfone 5	Android Version : 4.4 (Kikat) Processor : Dual-core 1.2 GHz RAM : 2 GB Camera : 8 Mega Pixel Display Screen : 720 x 1280 pixels

Table 1 contains the data of smartphone Android which is used in functionality testing from the system made. The testing of application functionality uses several comparative parameters. The comparative parameters used in order to do application functionality testing are displayed in table 2, 3 and 4.

Tabel 2 : The average time of object target.

No.	Type of Device	The Average Time
1.	Vivo Y15	2 Seconds
2.	Asus Zenfone 5	2 Seconds

Table 2 contains the average time of detecting object target by using Vivo Y15 smartphone and Asus Asus Zenfone 5. The results of the average time of detecting target object both of Vivo Y15 smartphone and Asus Asus Zenfone 5 are 2 seconds.

Tabel 3 :The minimum distance of object target detection and 3 dimensions quality display test.

No.	Type of Device	The minimum distance of the object target detection	3 Dimension Animation Quality
1.	Vivo Y15	6 CM	Good
2.	Asus Zenfone 5	6 CM	Good

The minimum distance of the object target detection with the smartphone testing has function to set a limit on the minimum distance between a smartphone with an object target on an object target detection process. The minimum distance detection of objects targets by using Vivo Y15 smartphone is 6 cm with providing 3-dimensional animation quality displayed which have good quality and a minimum distance detection of objects targets by using Asus Zenfone 5 smartphone is 6 cm with

providing 3-dimensional animation quality displayed that have quality good as well as.

Tabel 4 : The maximum distance of object target detection and 3 dimensions quality display test.

No.	Type of Device	The maximum distance of the object target detection	3 Dimension Animation Quality
1	Vivo Y15	20 CM	Good
2	Asus Zenfone 5	59 CM	Good

Camera specification of the smartphone device determines the maximum distance of the object target detection. The results of the maximum distance testing to detect an object target that is 20 cm by using a Vivo Y15 smartphone and 59 cm for Asus Zenfone 5 smartphones. The quality of 3D objects and 3D animation which is displayed within a maximum distance from the object target detection is of good quality.

Applications can perform rendering process or the process of displaying model and 3 dimensions animation in good performance since the model and 3 dimensions animation apply Low Polygon Modeling (LPM).

3.8 Feedback Application Usage

The application is tested to 4th grade at students of elementary school in order to obtain feedback on the application. The students who already tried the application should fill questioner forms. The total respondents are 30 students.

Tabel 5 : Feedback Application Usage

Statements	Rating			
	Poor	Fair	Good	Excellent
The Ease of Use Applications.	0%	7%	36%	57%
Applications can be run well.	0%	7%	43%	50%
Increase the interest in learning Balinese Script.	0%	3%	20%	77%
Provides an understanding of Balinese Script.	0%	3%	19%	78%
Average	**0%**	**5%**	**29,7 %**	**65.3%**

The students of elementary school appreciate this application as a excellent application in order to increase their interest in learning Balinese Script (77% of respondents stated it). Then, 78% of respondents appreciate this application is excellent in providing understanding of Balinese Script.

4. CONCLUSIONS

The use of multiple targets marker detection on learning media of Balinese Script writing based on Augmented Reality application is applied in order to detect some image target contained in one object target simultaneously. The use of Raycasting technique allows users to select one of several Balinese Script 3-dimensional objects displayed on multiple targets marker detection process.

All functions and features contained in the learning media of Balinese Script writing based on Augmented Reality application can run well. Application can be run with minimum capabilities of smartphones 512 MB RAM, 5 mega pixels camera and dual core processors and the result of rendering 3-dimensional animation produced has good quality, and the average time to detect a target object is 2 seconds.

This application as a excellent application in order to increase their interest in learning Balinese Script (77% of respondents stated it). Then, 78% of respondents appreciate this application is excellent in providing understanding of Balinese Script.

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