Augmented Reality Application for Introduction Traditional House and Objects of Aceh

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Augmented Reality Application for Introduction Traditional House and Objects of Aceh

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Abstract. The traditional house is one of the highest culture of art value. Lack of knowledge about traditional houses and traditional Acehnese objects among the general public, making the cultural values of Aceh diminishing. Efforts to improve realization of Acehnese people to preserving a culture of Aceh, one of them is by making Augmented Reality technology as a medium to visualize traditional house and traditional Acehnese objects to be 3D animation. The method used in this research is marker based tracking. The software that used was Vuforia, blender 3D and unity. In this application, a user will find an animation traditional house of Aceh and 9 3D object traditional object of Aceh. Conclusions from the study are augmented reality technology can be applied to Android devices, with the best distance test results of a camera reading the marker is 20 cm to 60 cm and 0º to 40º for the best angle.

1. Introduction
The technology of Augmented Reality (AR) is used to describe a combination of technologies that allows mixing of real-time computer-generated content with a direct video display. AR is based on techniques developed in Virtual Reality (VR) [1]. Many of the benefits that can be gained with the technology of augmented reality, this technology has begun to be applied in various fields, such as in the health world as props for medical purposes, one of which displays the anatomy of the human body in real-time [2].

Custom House is one of the most high-value cultural art in a tribe/community is one example of the cultural heritage of ancestors is a traditional House. This augmented reality technology in use to introduce 10 existing area custom homes in Indonesia by making use of ID as a marker. [3]

In this research, the author makes an Augmented Reality Application for Introduction Traditional House, Objects of Aceh and, added features of the translation and rotation of 3D objects in the application.

2. Methodology

2.1. Augmented Reality
In General, Augmented Reality (AR) is a merger between virtual objects with the real object. For example, is when a television station broadcast a football game, there is a virtual object about the score of the match taking place.

Augmented Reality is combining real and virtual world, are interactive in real time, and is a 3D animation. History about augmented reality starting from the years 1957-1962, when an inventor named

Morton Heilig, a cinematographer, creates and patents a simulator called Sensorama with visuals, vibrations and odors [4].

2.2. Marker/Image Target
The marker is an important component that is present in the environment of Augmented Reality. Marker required by tracking library ARToolkit to put a virtual model in the real world by way of determining coordinates relative marker towards the camera. In the environment AR, the marker can also be used as a tool of interaction that is natural and with some specific technique, the marker can make interactions become more varied and can expand new interaction techniques in AR. [5]

2.3. Vuforia Augmented Reality SDK
Vuforia is (Software Development Kit) SDK provided by Qualcomm to help developers create applications of Augmented Reality (AR) in mobile phones (IOS, Android). AR Vuforia provides a way of interacting that utilizes mobile phones to be used as input devices, as an electronic eye that recognizes a specific marker, so that display can be shown a mix of the real world drawn by applications. In other words, Vuforia is the SDK for computer vision-based AR.

Computer Vision technology is used to identify and track the planar image (the Target Image) and simple 3D objects, such as boxes, in real-time. Image registration capability allows developers to set the position and orientation of the object, such as a virtual 3D models and other media, in connection with an image of the real world when it is seen through the camera of a mobile device. The virtual object and then track the position and orientation of the image in real-time so that the user's perspective on the object in accordance with their perspective on the target Image, making it appear that the virtual object is part of the real-world scenes. [6]

2.4. Designing System

2.4.1. Diagram Making Marker
The marker is a pattern that is used to display a 3D object that exists on the application of Augmented Reality. On the application of the introduction of custom homes and traditional objects of this author uses Vuforia as Augmented Reality Software Development Kit (SDK). As for example, the process of making marker can be seen in Figure 1 below.
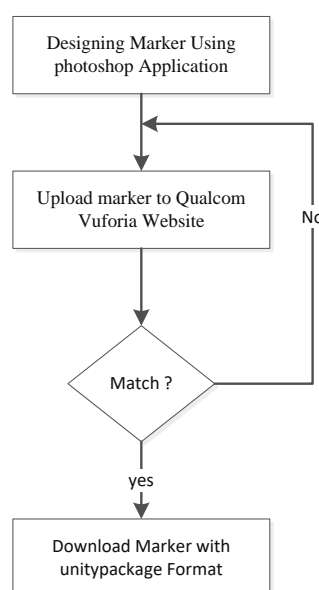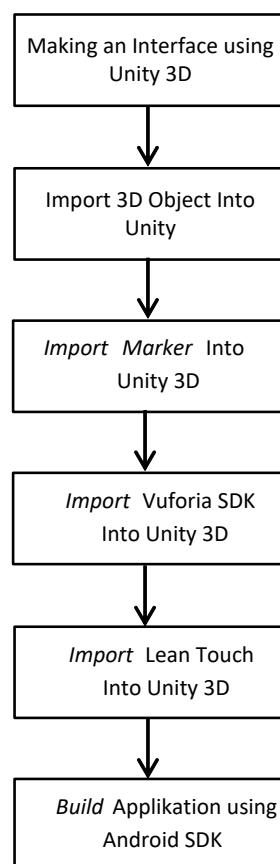

Figure 1. Diagram Making Marker

In the diagram, the creation of the first stage of the marker does is determine the image that will be used as the marker with how to make Photoshop application by using marker cc 2014 with the dimensions of 1024 x 1024 pixels. After that the author upload images that have been created with the format *. jpg to QUALCOMM developer website then set the size and give the name of the marker. The last step does is download the marker in the form of unity package for the device.

2.4.2. Diagram Creation application.
The process of making Augmented Reality application is done using software Unity 3D. As for the ingredients required in making this application, namely Aceh traditional house with animation format. MP4, the 3D object of traditional objects, Vuforia SDK, marker in the form of unity package, lean touch, and the Android SDK. As for the design of the process of making this application can be seen in the Diagram of Figure 4 below.

```
        ┌─────────────────────────┐
        │  Making an Interface using │
        │        Unity 3D          │
        └─────────────────────────┘
                   │
                   ▼
        ┌─────────────────────────┐
        │  Import 3D Object Into   │
        │        Unity             │
        └─────────────────────────┘
                   │
                   ▼
        ┌─────────────────────────┐
        │  *Import  Marker* Into    │
        │        Unity 3D          │
        └─────────────────────────┘
                   │
                   ▼
        ┌─────────────────────────┐
        │  *Import*  Vuforia SDK    │
        │       Into Unity 3D      │
        └─────────────────────────┘
                   │
                   ▼
        ┌─────────────────────────┐
        │  *Import*  Lean Touch     │
        │       Into Unity 3D      │
        └─────────────────────────┘
                   │
                   ▼
        ┌─────────────────────────┐
        │  *Build* Applikation using │
        │        Android SDK       │
        └─────────────────────────┘
```

Figure 2. Diagram Creation application.

Based on the above diagram, the first thing to do is make the interface, for more explanation can be seen in the sub-chapter the design of user interfaces. Then, the animation imported custom homes in mp4 format and traditional equipment objects that have been created in the form file, blend into a unity by means of drag and drop, next to the imported marker that has been created with the format *. unity package into unity. Next imported Library Qcar, inside the library, is the Vuforia unity used for 3D objects and Vuforia video playback used for animated custom homes Aceh. Next imported Lean Touch into unity from the asset store author uses lean touch to do translation and rotation for 3D objects, the last step is to set the minimum API level and presentation of Android and then build applications using the Android SDK.

2.4.3. Translation and rotation of the 3D object.

a. Translation.

The translation process is used to move the object in the direction of axis x, y, z of (dx, dy, dz) transformation matrix of 2-dimensional translational processes by adding the value of the following translation matrix z:

$$T = \begin{vmatrix} 1 & 0 & 0 & dx \\ 0 & 1 & 0 & dy \\ 0 & 0 & 1 & dz \\ 0 & 0 & 0 & 1 \end{vmatrix}$$

b. Rotation.

For the 3-dimensional rotation process, there are three kinds of rotation, i.e. a rotation axis X, Y axis rotation and rotation on the axis Z. The difference of each rotation matrix it is laying on the value of cos (a) and sin (a).

X axis rotation.

$$Rx = \begin{vmatrix} 0 & 0 & 0 & 0 \\ 0 & \cos(a) & -\sin(a) & 0 \\ 0 & \sin(a) & \cos(a) & 0 \\ 0 & 0 & 0 & 1 \end{vmatrix}$$

Y-axis rotation.

$$Ry = \begin{vmatrix} \cos(a) & 0 & -\sin(a) & 0 \\ 0 & 0 & 0 & 0 \\ \sin(a) & 0 & \cos(a) & 0 \\ 0 & 0 & 0 & 1 \end{vmatrix}$$

Z axis rotation.

$$Rz = \begin{vmatrix} \cos(a) & -\sin(a) & 0 & 0 \\ \sin(a) & \cos(a) & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 \end{vmatrix}$$

*2.4.4. Flowchart Application Usage.*

At the first stage of application usage flowchart does is run the application of Augmented Reality. After the application is running, and then directs the marker into the camera. Then the marker will be captured by cameras from Android smartphones and will adjust the marker with a 3D object. If the marker is appropriate, then the object will show up and if not, then the object will not appear. For the flowchart, application usage can be seen in Figure 3 below.
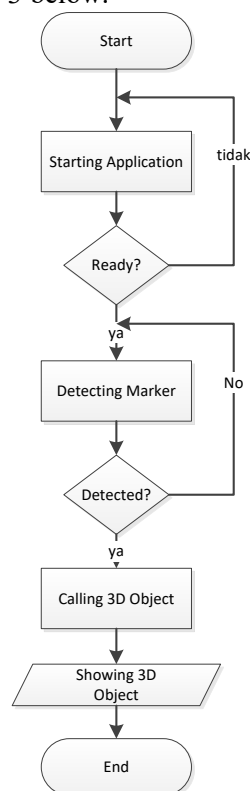
**Figure 3.** Flowchart Application Usage.

3. Discussion

Tests carried out with the purpose to find out the effects or no application is running on the device, in addition to knowing whether the marker is read properly or not. While the discussion was done for the analysis of the trial results in generating conclusions and suggestions are used to develop applications in order to be better.
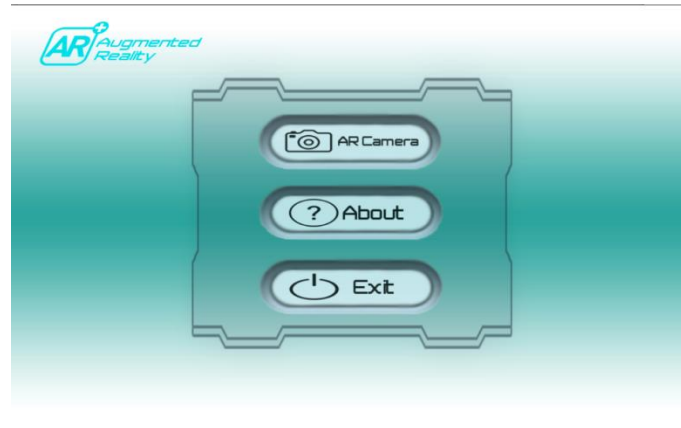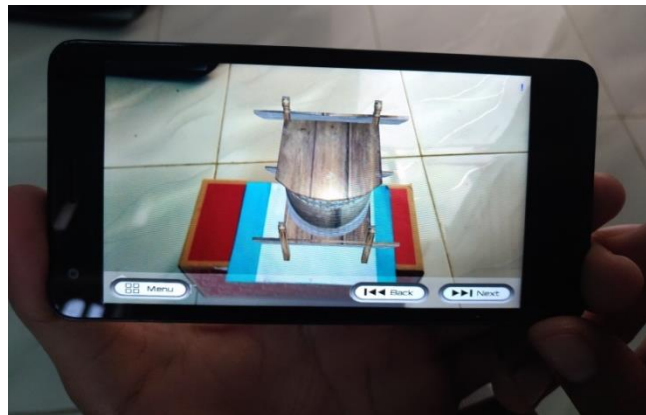

Figure 4. Main Menu Application

Figure 5. Display Object before Rotate
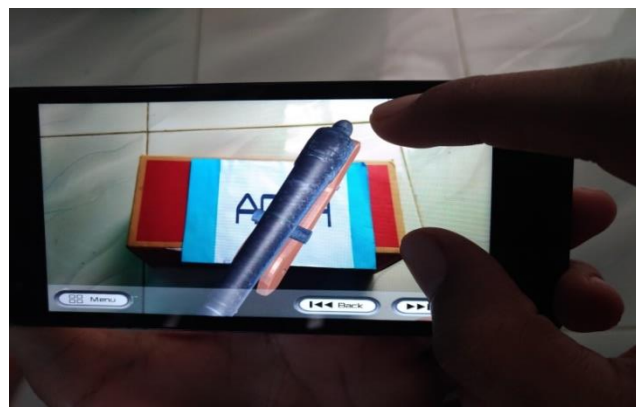
**Figure 6.** Display Object After Rotate

Figure 7. Display Object before Translate

Figure 8. Display Object After Translate

3.1. Testing the application
Testing was done with some of the components of the test is distance and angel between camera marker. To find out the values of the camera that was used to test a marker is the same camera and illumination intensity is also the same. The author does a slope angle testing the camera clockwise. For the distance and angle of the testing can be seen in Figure 9 below.
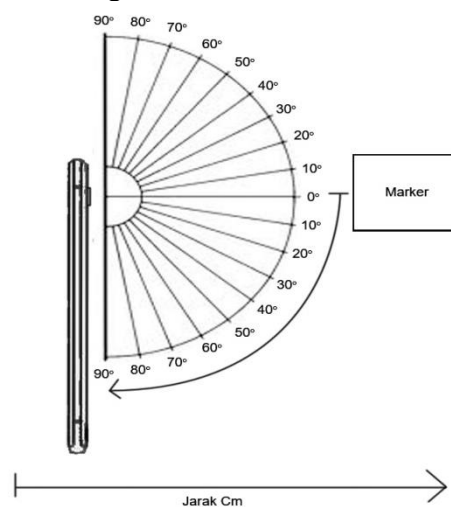
Figure 9. Testing Distance and Angel of The Marker

On this testing, the author uses Smart Phone Xiaomi 2 pro which has camera 8 megapixel with wide visibility 80º, and marker dimension 15 x 15 Cm. Author doing testing in the room with the Lamb lighting. Marker test results between the distance and angle can be seen in Table 1 below.

Table 1. 20 Cm Distance Marker testing

Distance	Angel	Description
	0º	Detected
	10º	Detected
	20º	Detected
	30º	Detected
20 Cm	40º	Detected
	50º	Not Detected
	60º	Not Detected
	70º	Not Detected
	80º	Not Detected
	90º	Not Detected

Testing on Table 1 done with the distance between the marker with the camera by 20 Cm. Criteria are done with the Lamb lighting the room with slope angle of 0º to 90º camera angles. The results of testing applications of augmented reality can find the target image so that it displays the animation and 3D object at an angle of 0º to 40º, while at an angle of 90º to 50º Application could not found the target image.

Table 2. 40 Cm Distance Marker testing

Distance	Angel	Description
	0º	Detected
	10º	Detected
	20º	Detected
	30º	Detected
40 Cm	40º	Detected
	50º	Not Detected
	60º	Not Detected
	70º	Not Detected
	80º	Not Detected
	90º	Not Detected

Table 3. 60 Cm Distance Marker testing

Distance	Angel	Description
	0º	Detected
	10º	Detected
	20º	Detected
	30º	Not Detected
	40º	Not Detected
60 Cm	50º	Not Detected
	60º	Not Detected
	70º	Not Detected
	80º	Not Detected
	90º	Not Detected

Testing on Table 2 done with the distance between the marker with the camera of 40 Cm. Criteria are done with a light room with slope angle of 0^0 to 90^0 camera angles. The results of testing applications

of augmented reality can find the target image so that it displays the animation and 3D object at an angle of 0º to 40°, while at an angle of 90º to 50º application could not find the target image.

Testing on Table 3. done with the distance between the marker with the cameras of 60 Cm. Criteria are carried out by lamp lighting the room with a slope angle of 0º to 90º camera angles. The results of testing applications of augmented reality can find the target image so that it displays the animation and 3D object at an angle of 0º to 20º, while angle on 30º to 90º application could not find the target image.

Table 4. 80 Cm Distance Marker testing

Distance	Angel	Description
	0º	Not Detected
	10º	Not Detected
	20º	Not Detected
	30º	Not Detected
	40º	Not Detected
80 Cm	50º	Not Detected
	60º	Not Detected
	70º	Not Detected
	80º	Not Detected
	90º	Not Detected

Testing on Table 4. done with the distance between the marker with the camera of 80 Cm. Criteria are done with a light room with slope angle of 0º to 90º camera. The results of testing applications of augmented reality could not find the target image pattern because the distance marker is too far from the camera.

4. Conclusion

Based on the results and discussion on the previous description of the application against the introduction of the Custom House and objects using the traditional method of marker-based android-based tracking, then it can be summed up as follows:

1. The technology of augmented reality can be applied on android devices with either using Vuforia SDK.
2. marker Testing that has been done get a result that is the minimum distance of the camera to detect marker is 20 Cm and the maximum distance of the camera to detect marker is 60 Cm. when the distance exceeds 60 Cm from marker then the objects cannot be on the show.
3. the maximum slope Angle marker is detected is 40°, the minimum slope angle marker is detected is 0º, and angle of the slope with the best results is 0º to 40°. When the angle of slope of the marker above 40° then the object is not in the show.

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