

Development of Augmented Reality (AR) Based *Trompong*

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Abstract

In gamelan, one of the most important instruments is trompong. Trompong is an idiophones instrument that has 10 rows of round shaped metal called pencon. As a traditional music instrument, gamelan especially trompong must be preserved continuously. Unfortunately, playing Balinese gamelan with real instrument is hard to do because the difficulty to find real gamelan. By using Augmented Reality, playing trompong possible to do even without having the real instrument. Augmented Reality will be develop using Unity 3D along with Vuforia SDK using Android smartphone as base of the application. This application called TrompongAR and will be marker based Augmented Reality. The marker help Augmented Reality to place the 3-dimensional trompong. The 3-dimensional trompong will have 10 pencon that can played by touched the pencon and will produce sound like the real instrument. The 3-dimensional trompong created with Blender by using pencon photo as reference. The sound of trompong obtained by recording every pencon sound. The TrompongAR application get result 100% of success rate from black box testing method. This means the application can run properly without any error.

Keywords: Augmented Reality, Unity 3D, Vuforia, Trompong, Pencon, Marker

1. Introduction

Bali is one of Indonesian province that famous for its cultural arts. One of many cultural arts that can be found in Bali is Balinese traditional music. This traditional music can't be created without traditional musical instruments. One of Balinese traditional music instrument that very well-known both in Indonesia even in the world is *gamelan*.

Gamelan is a whole instrument that played together by several musicians. *Gamelan* comes from Javanese *gamel* that mean to hit and followed by suffix *-an* which mean an object. Balinese *gamelan* classified into 3 groups based on ages of *gamelan*. The classification of Balinese *gamelan* is: old *gamelan*, intermediate *gamelan*, and new *gamelan*. Each groups of *gamelan* have different characteristic and types of instruments [1].

One of most important instruments in *gamelan* is *trompong*. *Trompong* is an idiophones instrument that use 10 rows of round shaped metal called *pencon* that has 10 variety of tones from low to high starting from : (1) dang, (3) ding, (4) dong, (5) deng, (7) dung, (1) dang, (3) ding, (4) dong, (5) deng, (7) dung [2]. *Trompong* is an important instrument because its position which usually played in *pengawit* or intro to start *gending* or *tabuh*.

With position as one of the traditional musical instruments make Balinese *gamelan* one of the cultural arts that must be preserved continuously. Unfortunately, playing Balinese *gamelan* with the real instruments runs into difficulty because its hard to find real *gamelan* in the real world [3]. Based on these conditions, people must took initiative to start preserving own culture.

By using technology, a medium can be created to preserve the traditional culture. One of technology that can be used to preserve traditional culture is Augmented Reality. Augmented Reality is a technology that can combine virtual object such as image, 3D object, video, and sound into a real world [4].

One of studies that utilizes Augmented Reality as a medium for preserving culture, especially Balinese gamelan is studies by I Kadek Yostab Mariyantoni and friends. In this study, an Augmented Reality application was created on an Android smartphone device that can able to bring up 3-dimensional objects on a marker in the form of a book and was also able to play record narrative voice explanations of the *gamelan* and recorded sound from selected gamelan. But in this study, user cannot play selected *gamelan* by them self [3].

Based on studies above, writer wants to create an Augmented Reality Application that not only display objects and play recorded sounds but can also played like a general musical instrument. The Augmented Reality application will be created on Unity 3D, a software that integrated to create a game, simulation, and architectur [4]. Making marker base Augmented Relaiity can use Vuforia library. Vuforia is a Software Development Kit which applied to create an Augmented Reality application. With vuforia, computer can recognition and image tracking, object, text, markers, and reconstructed the real environment [5]. Seeing how *trompong* is one of the important instruments in *gamelan*, this research will focus on *trompong* instrument. So that in this research a *trompong* application based on an Augmented Reality called TrompongAR will be created on an Android smartphone.

2. Reseach Methods

Method used in this research is SDLC (Software Development Life Cycle) waterfall model. Waterfall model or also called linear sequential model, this model proposes a systematic and sequential approach to software developers [6]. The process of SDLC waterfall model in this research is collecting data, software analysis, software design, software implementation, and software testing.

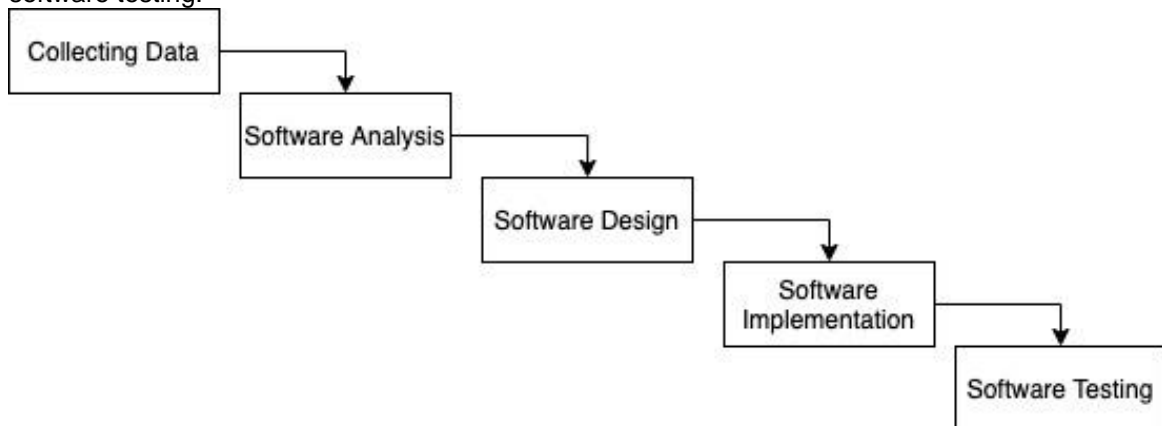


Figure 1. SDLC Waterfall Model

2.1 Collecting Data

Data collected were data in form of sound of each *pencon* in *trompong* and also image of the *trompong*. The *pencon* sound is collected by directly recording every *pencon* in *trompong* when it played. The image of *trompong* also collected directly by taking *trompong* photo. *Trompong* image is used as a reference when 3-dimensional model of *trompong* is made. The 3D model created by using Blender software.

2.2 Software Analysis

After the required data collected, then next progress is software analysis. Software analysis functions is to determine software development designing process.

a. Software Requirements

The software that to be built is an Android-based application that use Augmented Reality technology by using an image as a maker that can support this application. This marker will show 3-dimensional object of *trompong* instrument that can be played by user.

b. Software Development Goal

Goals of this development is to develop a software that can show 3-dimensional object of *trompong* instrument right above marker. The 3-dimensional object that appear can

played directly by the user, so anyone can play *trompong* instrument without need to have the real instrument and can play it everywhere and every time.

c. Software Input and Output

Input of this software is marker displayed on paper or digital images. The marker functions as a marker where the AR object appears. While the output of this software is the result of rendered 3-dimensional model of *trompong* and also sound from the *pencon* when the *pencon* in the *trompong* model is pressed.

2.3 Software Design

Software designing is a process that will translate the software needs before implementation process [7]. The design step can be done after software requirements have been completed.

a. Software Limitation

The limitation implementing this software is are the Android devices need to have Android version 4.1 (Jelly Bean) and above with minimum OpenGL ES 2.0 and above.

b. System Flowchart

Flowchart illustrate the application proses flow based on software analysis that has been done. This application created by using Unity 3D software. The first step is prepare image, 3D object that created in Blender software, and recorded *pencon* sound. Then create AR environment and input image as a marker, if the image accepted as a marker then insert the 3D object, recorded sound, and tap fuction, so the *pencon* sound can played when the *pencon* touched.

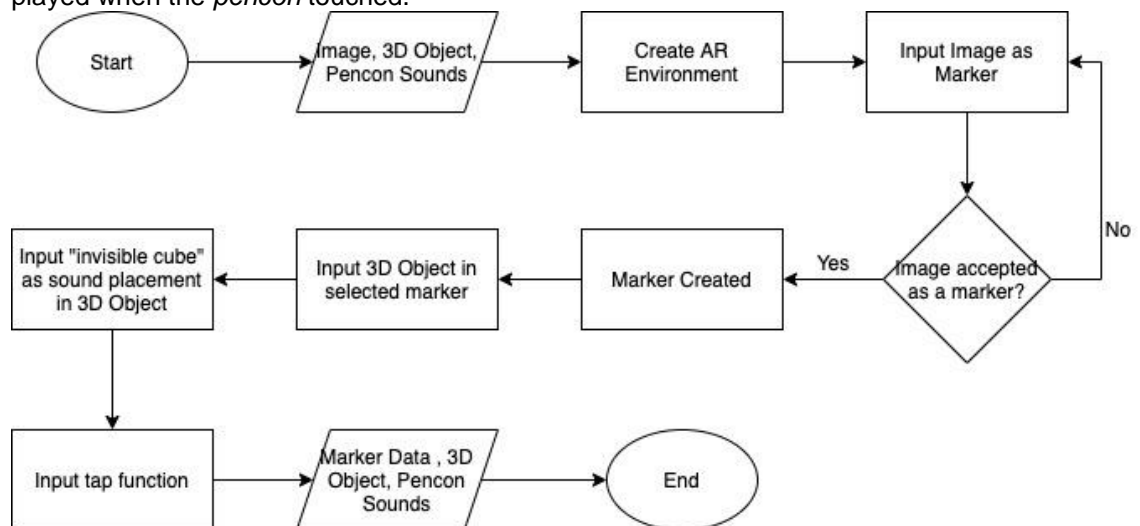


Figure 2. AR Implementation Flowchart

When the application start, the system will take marker data from the database, then the marker detection will be done by using camera, if marker detected then the 3-dimension object of *trompong* will appear after that, if *pencon* touched then the touched *pencon* sound will be played, if the system want to be terminated then the system will end.

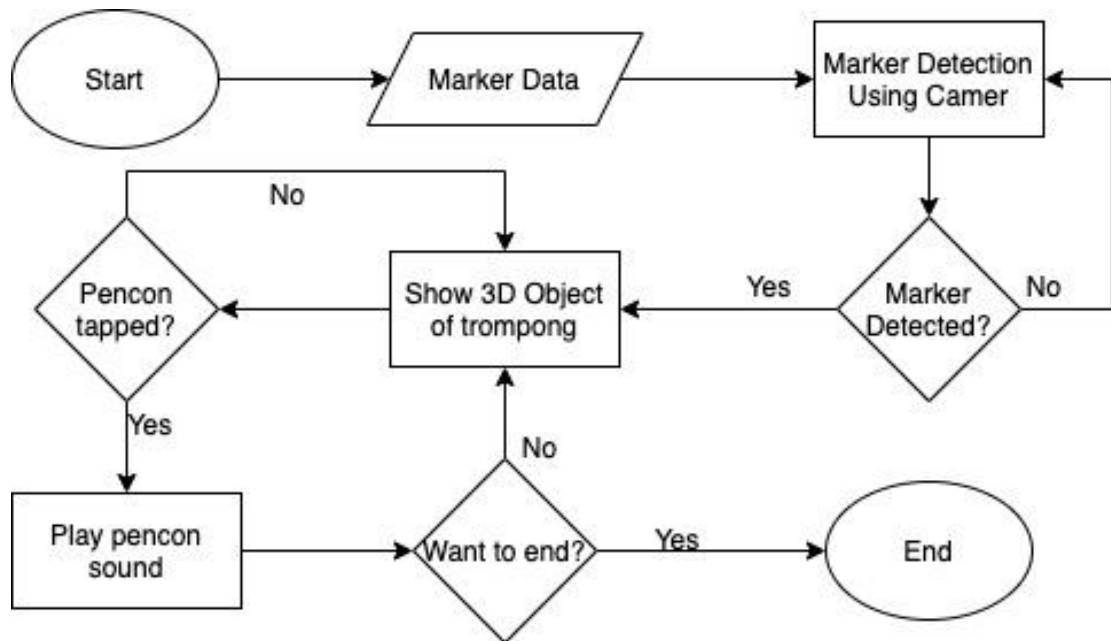


Figure 3. System Flowchart

c. Use Case Diagram

Use case diagram has function to model and display expected functionality of a system [5]. In use case diagram, an actor illustrates a human entity that interact with the system to do certain job. In this use case there are one actor that can do 5 tasks, there is Start Application, Display AR Menu, Display How to Use Menu, Display About Menu, and Exit Application.

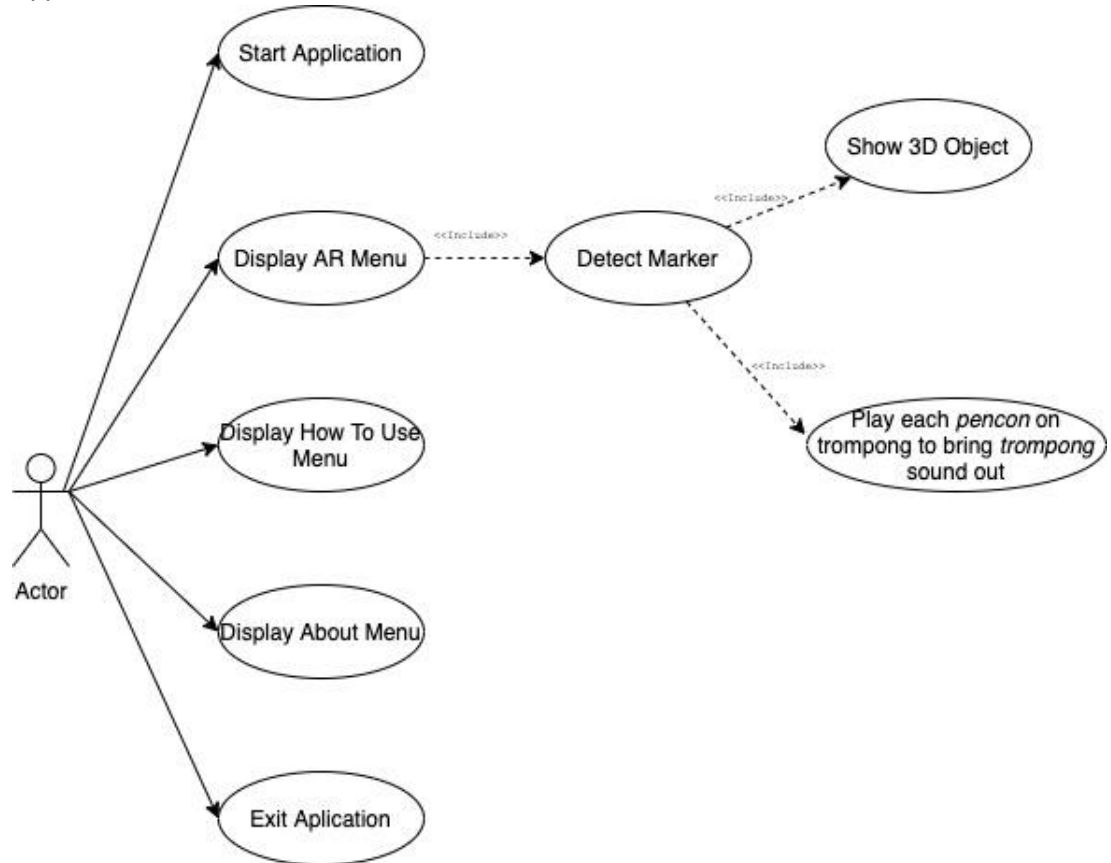


Figure 4. Use Case Diagram

d. Activity Diagram

Activity diagram show various activity flows in the designed system. Activity diagram show how activity flow start, decision possibility, and how they are ended.

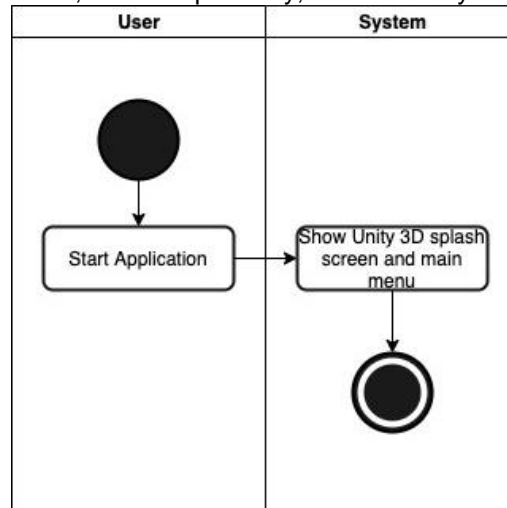


Figure 5. Activity Diagram When Application Started

The activity diagram above contain process when the application opened. When application started by user, the system will show Unity 3D splash screen and main menu.

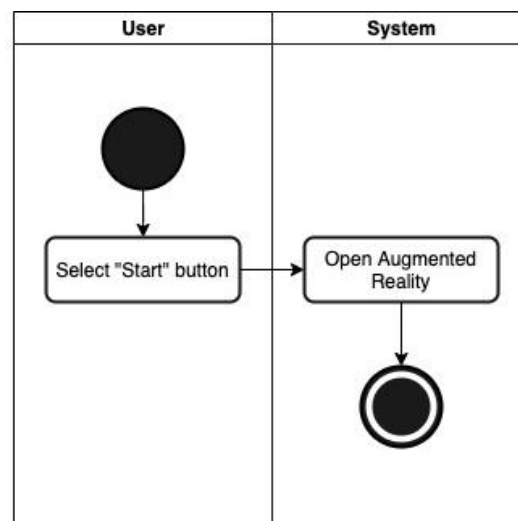


Figure 6. Activity Diagram About Select "Start AR" Button

The activity diagram above contain process when user select "Start AR" button. When the button pressed, system will open smartphone camera and started the augmented reality.

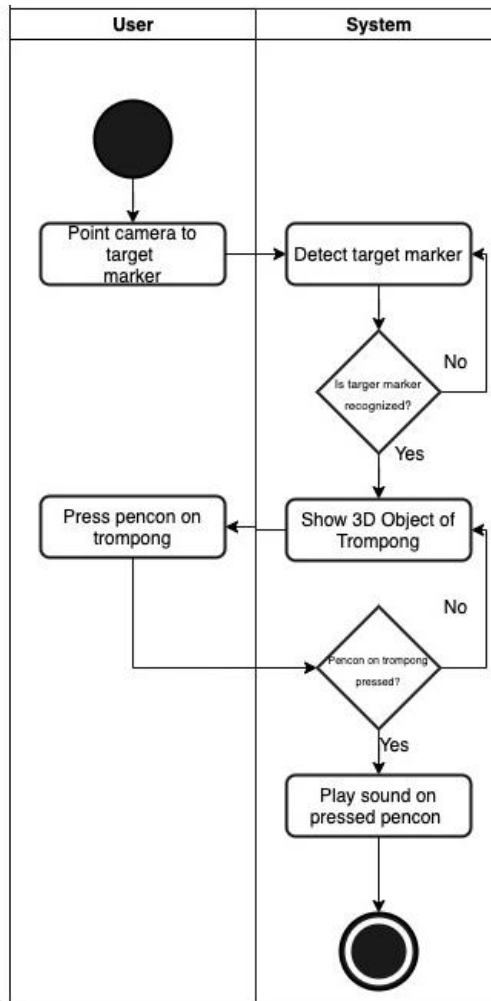


Figure 7. Activity Diagram About Augmented Reality Process

The activity diagram above contain the augmented reality process. After the camera is open, user can point the camera to target marker. If the target marker recognized, the system will show 3-dimension object of *trompong*. The *trompong* object has 10 *pencon* in it, when *pencon* pressed, the system will play sound of pressed *pencon*.

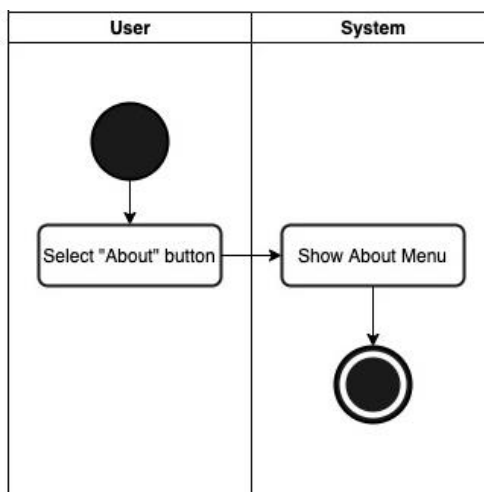


Figure 8. Activity Diagram About Select "About" Button

The activity diagram above contain process when user select “About” button. When “Above” button pressed, system will show About menu which contain information about application and the developer.

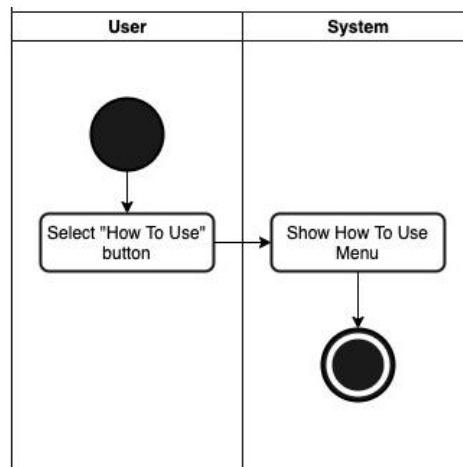


Figure 9. Activity Diagram About Select “How To Use” Button

The activity diagram above contain process when user select “How To Use” button. When “How To Use” button pressed, system will show short guide about How To Use the application.

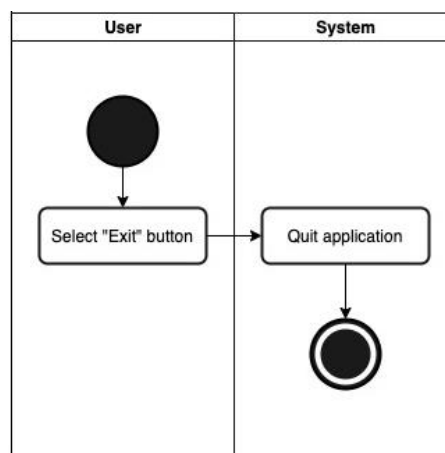


Figure 10. Activity Diagram About Select “Exit” Button

The activity diagram above contain process when user select “Exit” button. The application will close if that button pressed.

3. Result and Discussion

3.1 Software Implementation

a. Main Menu

The main screen will appear after the Unity splash screen appears. This main screen contains 4 buttons. The buttons that is “Start AR” button, “About” button, “How To Use” button, and “Exit” button. The “Start AR” button is used to open smartphone camera, “About” button is used to open about menu, “How To Use” button is used to open how to use menu, and “Exit” button is used to end the application.



Figure 11. Main Menu

b. About

On the about menu there is information about TrompongAR application and biodata from the application developer. On this menu, there is also “Back” button, which function to return to main menu.



Figure 12. About Menu

c. How To Use

On the how to use menu there is short guide about how to use the application. There is also “Back” button, which function to return to main menu.

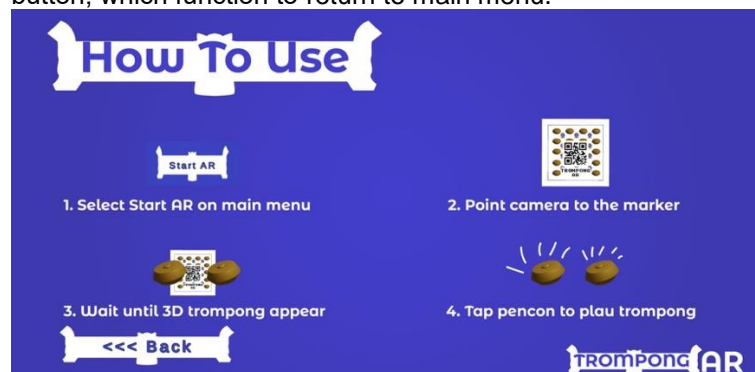


Figure 13. How To Use Menu

d. Augmented Reality Display

Start AR button functions to open smartphone camera. User tracks the target marker to show the 3-dimension object of *trompong*. One *trompong* contains 10 *pencon*, every

pencon have its own sound. The sound will be played if user touches the *pencon*. In this page, there is one “Back” button that functions to back to main menu.



Figure 14. Augmented Reality Display

e. Software Testing

Software testing is done by black box testing method. Black box testing is a software application testing method that focused on application functionality without paying attention to the process being carried out so that it gets the desired output. This test was carried out on several Android smartphone devices with different specifications both in terms of processor, memory, resolution, and camera. Android devices used in this test are Huawei Nova 5T, Xiaomi Mi 9T Pro, Oppo A83, Xiaomi Redmi K20 Pro, Samsung A10. Application functionality testing uses the hardware of smartphone based on Android with specs can be seen in table 1.

Table 1. Smartphone Specification

No	Smartphone of Device	Specification
1	Huawei Nova 5T	128 GB Memory, 8 GB RAM, Huawei Kirin 980 processor, and camera up to 48 MP.
2	Xiaomi Mi 9T Pro	128 GB memory, 8 GB RAM, Qualcomm Snapdragon 855 chipset, Adreno 640 GPU, and camera up to 48 MP
3	Oppo A83	64 GB memory, 4 GB RAM, MediaTek MT6763T Helio P23 chipset, and 13 MP camera
4	Xiaomi Redmi K20 Pro	128 GB memory, 8 GB RAM, Qualcomm Snapdragon 855 chipset, Adreno 640 GPU, and camera up to 48 MP
5	Samsung A10	32 GB memory, 4 GB RAM, Samsung Exynos 7 Octa 7884 chipset, and 13 MP camera

Table 1 contains the data of Android smartphone which is used in application testing. The result of testing can be seen in table 2.

Table 2. Black Box Testing Result

No	Functional	Test Result	Explanation	Test Devices	Accuracy
1	Start Application	Success	Application started and show main menu	All Devices	100%
2	Press “Start” button	Success	Open camera	All Devices	100%
3	Tracks the target marker	Success	Show 3D <i>trompong</i> object above marker	All Devices	100%
4	Press <i>pencon</i> in the	Success	Play sound of the	All Devices	100%

	<i>trompong</i> 3D object		pressed <i>pencon</i> in <i>trompong</i> 3D object		
5	Press "Back" button	Success	Back to the application main menu	All Devices	100%
6	Press "How to Use" button	Success	Show how to use menu along with the information	All Devices	100%
7	Press "About" button	Success	Show about menu along with the information	All Devices	100%
8	Press "Exit" button	Success	Application closed	All Devices	100%

From the black box testing on table 2 obtained result that there is 8 kind of functional test done in this black box testing. The result of the test is TrompongAR can do all functional test with success rate 100% in every testing devices. It means the application can work properly without any error.

4. Conclusion

TrompongAR is an application that was created with the aim to help people to play *trompong* instrument from home without having the real instrument. *Trompong* selected as the main object of this application because *trompong* is one of the most important instruments in the gamelan. This application uses Augmented Reality technology as a main feature. TrompongAR is a marker based Augmented Reality, therefore a marker is needed as an input to display expected output. The expected output is when marker detected by the software, a 3-dimensional *trompong* model is appear, this 3-dimensional object can play sound of every *pencon* in *trompong* if user tap the *trompong pencon*.

This application made with Unity 3D, a software to make a game, along with Vuforia SDK, a library to develop an Augmented Reality Application. The software development design is designed with Software Development Life Cycle (SDLC) waterfall model.

From the software testing using black box method, this research obtains result that TrompongAR can do all test with success rate 100% in every testing device. This test shows all function in the application can run smoothly without any problem in all testing devices.

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