

APPLICATION OF ANDROID-BASED AUGMENTED REALITY TECHNOLOGY AS AN INTRODUCTION OF MAKETS IN CV. MANDIRI EXPRES

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ABSTRAK

CV. Mandiri Expres is a company engaged in the manufacturing and design of miniature models of models. From the project acceptance process to the making of the mockups, CV. Mandiri Express often experiences obstacles in terms of the compatibility between the design of the model mockups with its three-dimensional mockups. The mockup design is given first to the customer to be corrected, but in reality the customer is still correcting the shape of the three-dimensional model. This happens because the mockup design is only displayed from a few angles so customers cannot see the mockup design in detail. So we need technology that can help in the introduction of the design of the model. Augmented Reality (AR) is a technique that combines cyberspace into a real scope. This study uses Augmented Reality Technology to display 3D objects in accordance with the floor plan. The method used in the software development process is Luther's version of multimedia software development. Luther revealed there are six stages in the development of multimedia, namely concept, design, material collecting, assembly, testing, and distribution. Based on the results of tests that have been carried out on the application of mock recognition in the CV. Mandiri Express, it can be concluded that the mock recognition application helps the mock recognition activities carried out by the marketing department in introducing mockups to customers so that customers better understand the form of mockups and the marketing department understands customer desires.

Keywords: Augmented Reality, Luther Method, Mockups, Floor Plans, Application Introduction, CV. Mandiri Expres

1. INTRODUCTION

CV. Mandiri Expres is a company engaged in the field of Miniature Market Design and Design Services, located in Bandung precisely on Jalan Saluyu B VII No. 14 RT.002 RW.009, Cipamokolan Village, Rancasari District, Bandung

City. CV. Mandiri Expres makes a detailed model of building construction such as offices and companies, complete with its supporting in accordance with the project theme requested by the client / customer. With mockups that illustrate the three-dimensional appearance of the building, no doubt the media mockups are very interesting to present a building design. By looking directly at the three-dimensional replica object, it can be seen how the shape of the building when it has stood up, so that it can be seen the layout or floor plan, the circulation of space, to the lighting.

From the process of receiving project themes to making mockups, CV. Mandiri Express often experiences obstacles in terms of the compatibility between the design of the model mockups with its three-dimensional mockups. The design of the model is made separately between the layout / floor plan of the building and the objects / objects in the building. Although the mockup design is given in advance to the customer to be corrected, in reality the customer is still correcting the shape of the three-dimensional model. This happens because the mockup design is only displayed from a few angles so customers cannot see the mockup design in detail. In addition, the color of objects is often a problem in making a three-dimensional model. As happened in 2018, out of 10 themes that were worked on making mockups, 4 of them were changed. These problems can be detrimental to the company because changes in the design of the model will result in additional time and cost in making the model. Therefore, we need a technology that can help companies to introduce their designs, so that customers better understand the design of the model before it is translated into a model.

Based on the description of the existing problems, it is necessary to build an application that can display the details of the 3D model of the mockup in accordance with the plan and can change color. This application uses the android platform. Android is a Linux kernel based mobile operating system that is open source so that programmers can create applications easily. Android is an operating system that is widely used

[1]. This application makes use of Augmented Reality (AR) Technology. Augmented Reality (AR) is a technique that combines two-dimensional and three-dimensional virtual objects into a real three-dimensional sphere and then projects these virtual objects in real time. The use of technology [2] Augmented Reality is intended so that the client / customer can see firsthand the detailed form of the three-dimensional object model in accordance with the floor plan. So the author raised the title "Application Of Android-Based Augmented Reality Technology As An Introduction Of Makets In Cv. Mandiri Expres".

1.1 Identification of Problems

Based on the background of the problem described earlier, the problem identification is obtained as follows:

1. Can not see the object in detail because it only displays objects from several angles.
2. Changes in the customer's will to the desired color of the model design.

1.2 Purpose and Objectives

Based on the existing problems, the purpose of this research is to build an application "APPLICATION OF ANDROID-BASED AUGMENTED REALITY TECHNOLOGY AS INTRODUCTION OF MAKETS IN CV. MANDIRI EXPRES". The objectives to be achieved from this study include the following:

1. Make it easier for customers to understand the design of models that match the building plan in detail.
2. With this application built, it can simplify the marketing department in adjusting the color that the customer wants.

1.3 Limitation Problems

Remembering the problems studied are quite extensive and so that the work of this research does not deviate from the objectives and identification of the problem, this research is limited to the following matters:

1. 3D objects are displayed using Augmented Reality technology.
2. Application built based on Android mobile.
3. Changes that can be used in the application are only color changes.
4. 3D objects that can be changed are determined by company policy.
5. 3D objects use the .FBX file format.

1.4 Research Metodology

The method used in the software development process is Luther's version of multimedia software development. Luther revealed there are six stages in the development of multimedia, namely the concept (concept), design (design), material collection (material collecting), manufacture (assembly),

testing (testing), and distribution (distribution), as in Figure 1[3].

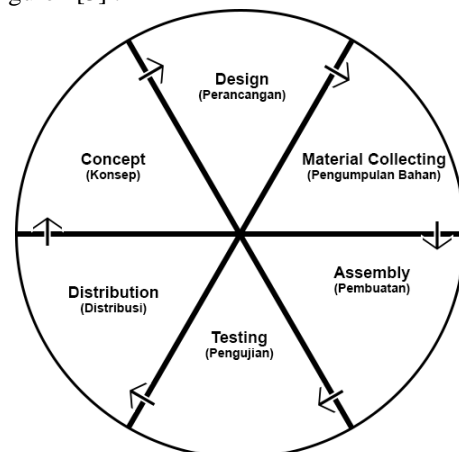


Figure 1. Luther Model [3]

1. Concept

The concept stage is carried out determining the objectives and specifications in general making the application. After that, read the literature in determining the stages of making the right application based on existing problems.

2. Design

The design phase has the aim of making detailed specifications regarding the project architecture and style. This stage describes a series that is easily understood by the user. The design includes designing the menu structure and the design of the scout that will be applied to the application.

3. Material Collecting

Material collecting stage is the stage of collecting materials that suit your needs. Materials needed include, among others, floor plans, 3D objects, and materials to support the application.

4. Assembly

At this stage is the stage of making the application. After collecting the required materials, enter the stage of making an augmented reality application that can display 3D objects from the floor plan with the color change feature.

5. Testing

Testing is done after all stages of application development are complete. In the development of this application, the testing phase is carried out by running the application and carrying out functional checks on whether it is running in accordance with the original purpose or not.

6. Distribution

Distribution phase is the evaluation phase of a multimedia product. At this stage the application

builds into the package so that it can be implemented on the user's smartphone.

2. RESEARCH CONTENT

2.1 Literature Review

Literature review aims to provide explanations from various sources and theories related to the development of the introduction of the Market Application in CV. Mandiri Express.

2.1.1 Mockup

A mockup is an artificial form of an object that is made into a small scale. A mockup is not a good and beautiful illustration in a work other than in the form of pictures, but it is still in two dimensions, whereas on the other hand a mockup can be displayed in three dimensions and it is very interesting to display [4].

2.1.2 Augmented Reality

Augmented Reality is a variation of virtual environment or better known as virtual reality. VR technology brings users into a virtual environment so that users cannot see the real world around them. AR allows users to see the real world and virtual objects combined. Therefore, AR has the concept of completing reality rather than replacing it completely[2]. Augmented Reality can be used in several fields, one of which is as a media introduction such as that done by Zaid Arham who introduces eyewear products[9]. There are two types of Augmented Reality, as follows [2]:

1. Marker Based

Various types of Augmented Reality markers are images that can be detected by the camera and used with software as locations for virtual assets placed in a scene. Most are black and white, although colors can be used as long as the contrast between them can be well recognized by the camera.

2. Markerless

One method of Augmented Reality is to use the Markerless Augmented Reality method, with this method the user does not need to use a marker to display digital elements. Augmented Reality Markerless technology developed on android devices is expected to make the implementation of Augmented Reality much more efficient, practical, interesting, and can be used anywhere, anytime, by anyone without the need to print markers [5].

2.1.3 Android

Android is an operating system on Linux-based phones that includes an operating system and middleware. Open source facilities or operating systems that can be developed freely for its users make many people to develop it with innovations that are increasingly developing the operating

system and the development of its mobile applications. [1].

2.1.4 Plan

Plan is a cross section of a horizontal piece of an object / building whose pieces are located at a height of 1 meter from the top of the indoor floor of the building. The plan reflects the organization scheme of activities in the building which are the determining elements of the building's form. The plan is useful for revealing many things such as circulation space with space for activities, and the relationship between the space inside the building and outside the building which is still located inside the site, as a whole gives meaning to the building [6]. Each floor plan has a scale. Scale is the ratio of the linear size in the image to the linear size of the actual object [10].

2.1.5 Unity3D

Unity is a software used in making games. Unity has provided various tools that can be used to create games and can add scripts to control the game's running. Unity is cross-platform based, unity can be used to make a game that can be used on various devices such as computers, Android smartphones, iPhones and X-Box. Pregnancy is developed using C / C ++ programming languages and can well support other programming languages such as C # , BOO, and JAVASCRIPT [7].

2.1.6 Vuforia

Vuforia is an AR-based Software Development Kit that uses a mobile device screen as a lens or glass to look into the Augmented world where the real world and virtual world appear side by side. This application makes a live camera preview appear on the smartphone screen to represent the view of the physical world. 3D objects will appear directly on the smartphone screen, so 3D objects will be seen in the real world. Vuforia consists of 2 main components, namely the QCAR library and the target management system [8].

2.2 Analysis of the Current System

Analysis of the current system is a stage that gives an overview of the system that is running now. This analysis has the aim to provide an overview of how the system is running. The procedure for introducing the mockup design is as follows:

1. The customer provides a mockup theme to be made.
2. The marketing department accepts the theme and then introduces the mock-up design to the customer based on a floor plan that matches the theme.
3. Customers see a mockup design in the form of 2D drawings and floor plans in accordance with the request

- If the mockup design is in accordance with the wishes of the customer, the customer approves the design to be made. If it is not appropriate, the Customer provides changes to the design of the model.

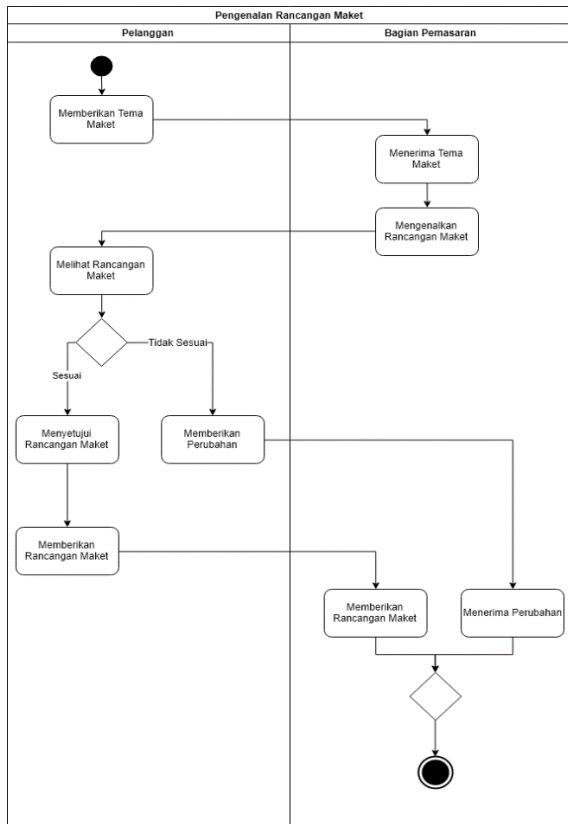


Figure 2. Analysis of Current Systems

2.3 Analysis of System Architecture

The system will be built using augmented reality technology with a plan as a marker. The system architecture can be seen in Figure 3.

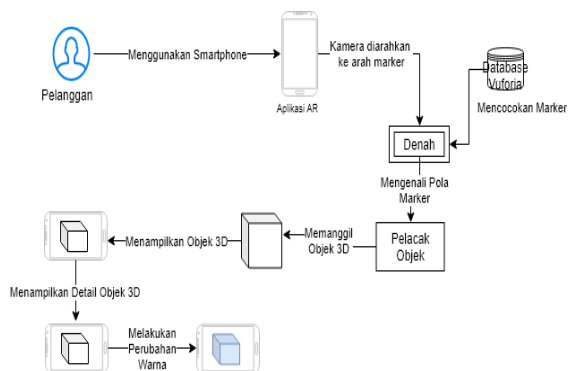


Figure 3. Analysis of Systems Architecture

- Customers use a smartphone that has the AR Application installed
- Customers point the smartphone camera towards the floor plan using the AR application.

- The plan will be tracked to recognize the marker pattern and match it to the marker in the vuforia database.
- The Object Tracker will call 3D Objects.
- 3D objects displayed on the smartphone screen.
- Customers see 3D Object detail view
- Customers make color changes

2.4 Analysis of Augmented Reality

Augmented reality analysis is a stage carried out in building an augmented reality system in the application. The stages that must be carried out in the development of augmented reality systems are:

1. Marker Making

The process of making a marker is done at the web developer provided by Vuforia. The process can be done if you have logged into the Vuforia web developer. The floor plan produced by Vuforia will get a pattern similar to Figure 4.

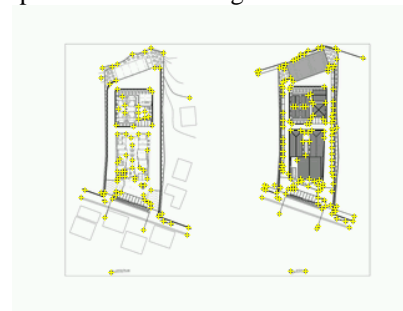


Figure 4. Floor Plan Marker Pattern

The Workflow of Marker Making can be seen in Figure 5.

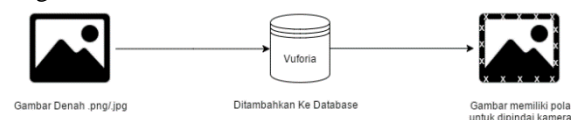


Figure 5. The Workflow of Marker Making

2. Making Augmented Reality Assets

Making augmented reality assets is a process carried out to create 3D objects that are used so that the system can be optimally invoked. 3D objects that are used are arranged position and components are then built into assets that will produce files and manifest files. The workflow for making augmented reality assets can be seen in Figure 6.

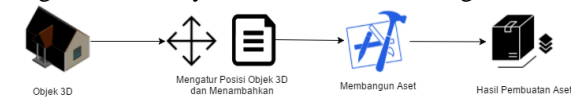


Figure 6. The Workflow of Making Augmented Reality Assets

3. Object Tracking

Object tracking is the application process tracking markers with the aim to display augmented reality objects in the form of mock 3D objects. Each marker that is used in the tracking process

will be matched with the 3D model of the model. Markers can be read in applications using the Vuforia API and Vuforia Library. Marker patterns that have been obtained will be read by the camera that is used to display 3D objects in the augmented reality scene in accordance with the markers being read. The workflow in Object Tracking can be seen in Figure 7.

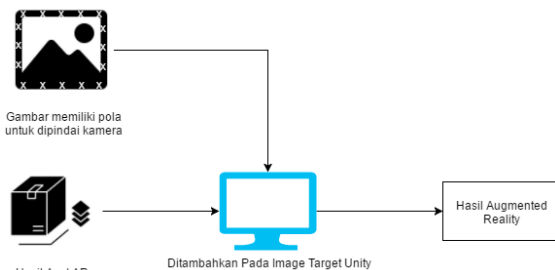


Figure 7. The Workflow of Object Tracking

2.5 Analysis of Feature in Application

Analysis of Features in the Application is a stage that must be done to build features that exist in the application. In developing this application there are three stages that must be carried out to build existing features, namely:

1. Making 3D Object Detail Assets

Making 3D object detail assets is a process undertaken to create 3D objects that are used so that the system can be optimally invoked. Making 3D object detail assets is done by setting the position, adding cameras, camera positions and components then built into assets that will produce files and manifest files. The workflow for making assets can be seen in Figure 8.



Figure 8. The Workflow of Making 3D Object Detail Asset

2. Displaying 3D Object Details

Displays details of 3D objects triggered by 3D objects that result from augmented reality object tracking. In the 3D object details there are several cameras that will display the sides of the 3D object. The workflow of viewing 3D object details can be seen in Figure 9.



Figure 9. The Workflow of Displays 3D Object Details

3. Change the Color of 3D Objects

In this application using the color picker assets that are directly connected to 3D objects. The color chosen in the palette will be used as the color of the object. So that the selected 3D object will change its color. The workflow of the object's color change can be seen in Figure 10.

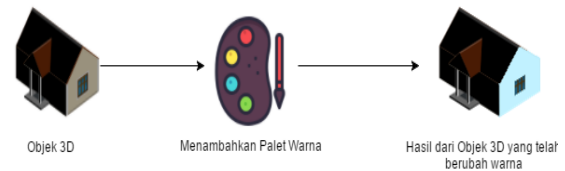


Figure 10. 3D Object Color Change Workflow

2.6 Analysis of Non-Functional Requirements

Non-functional requirements analysis is an analysis conducted to determine the specifications needed by the system. This analysis covers software requirements and hardware requirements.

2.6.1 Analysis of Software Requirements

Analysis of software requirements is determined based on the minimum requirements in building this system. System software specifications for developers can be seen in Table 1.

Table 1. Developer Software Requirement Specifications

| Type of Software | Specification |
|---------------------|---------------------------|
| Operating system | Windows 10 64bit |
| Tools Engine | a. Unity3D b. Vuforia |
| Supporting Software | a. SkeethUp b. AutoCad |

System software specifications for users can be seen in Table 2.

Table 2. User Software Requirements Specifications

| Type of Software | Specification |
|------------------|----------------------------|
| Operating system | Android OS 6.0 Marshmallow |

2.6.2 Analysis of Hardware Requirements

Analysis of hardware requirements is determined based on the minimum requirements in building this system. System hardware specifications for developers can be seen in Table 3.

Table 3. Developer Hardware Requirement Specifications

| Type of Hardware | Specification |
|------------------|------------------------------|
| Processor | Intel Core i3-6006U 2.00 GHz |

| | |
|--------------------|------------|
| RAM | 4 GB |
| Harddisk | 500 GB |
| Monitor | 1366 x 768 |
| Mouse and Keyboard | - |

System hardware specifications for users can be seen in Table 4.

Table 4. Specification of User Hardware Requirements

| Type of Hardware | Specification |
|------------------|---------------|
| Resolution | 1080x720 |
| RAM | 2 GB |
| Processor | 1.4 GHz |
| Camera | 5 Megapixel |

2.7 Analysis of Fuctional Requirements

Functional requirements analysis is an analysis that describes the needs of the system to be built. System analysis is performed using the UML model. The stages in the system analysis consist of Use Case Diagrams, Activity Diagrams, Class Diagrams, and Sequence Diagrams.

2.7.1 Use Case Diagram

Use case diagrams are used to describe the function of a system so that it can describe the needs of users. Use case diagrams can be seen in Figure 3.

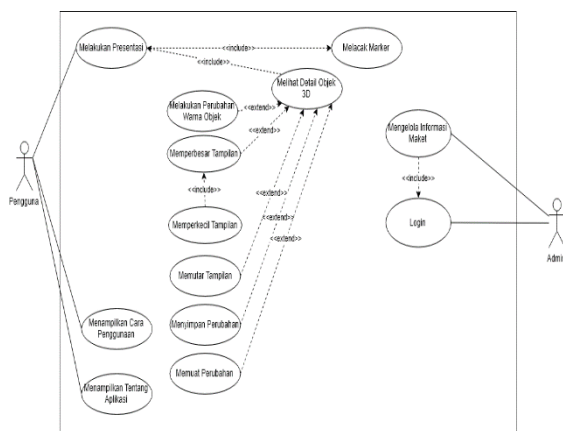


Figure 4. Use Case Diagram

2.8 System Implementation

Implementation is the stage of implementing system design and analysis results. The purpose of system implementation is to explain the program that has been designed to the user so that it can provide input to the system developer. The hardware implementation used can be seen in Table 5.

Table 5. Hardware Implementation

| Type of Hardware | Specification |
|------------------|---------------|
| Resolution | 1080x720 |
| RAM | 2 GB |
| Processor | 1.4 GHz |
| Camera | 5 Megapixel |

Implementation of the software used can be seen in Table 6.

Table 6. Software Implementation

| Type of Software | Specification |
|------------------|----------------------------|
| Operating system | Android OS 6.0 Marshmallow |

2.9 System Testing

Testing is a stage that is carried out after the system has been implemented. Testing is done by testing alpha and beta testing.

2.9.1 Alpha Testing

Alpha testing is used to find out the software development is in accordance with the expected needs. This test is carried out using the Black-Box testing method. The alpha testing scenario can be seen in Table 7.

Table 7. Alpha Testing Scenarios

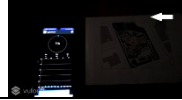
| No | Components Tested | Testing Method |
|----|------------------------------|----------------|
| 1 | Mulai Presentasi | Black-Box |
| 2 | Melacak Marker | Black-Box |
| 3 | Melihat Detail Objek 3D | Black-Box |
| 4 | Melakukan Perubahan Warna | Black-Box |
| 5 | Memperbesar Tampilan | Black-Box |
| 6 | Memperkecil Tampilan | Black-Box |
| 7 | Memutar Tampilan | Black-Box |
| 8 | Menyimpan Perubahan | Black-Box |
| 9 | Memuat Perubahan | Black-Box |
| 10 | Menampilkan Cara Penggunaan | Black-Box |
| 11 | Menampilkan Tentang Aplikasi | Black-Box |
| 12 | Login | Black-Box |
| 13 | Mengelola Informasi Maket | Black-Box |





Based on the results of alpha testing that has been done, it can be concluded that the system is running in accordance with the needs of the system that has been designed.

2.9.2 Light Testing

Light testing is done by tracking markers with various lights. Light testing can be seen in Table 8.

Table 8. Light Testing

| No | Light intensity (lux) | Condition | Information |
|----|-----------------------|---|---------------------|
| 1 | 1 lux |  | Marker not detected |

| | | | |
|---|---------|---|-----------------|
| 2 | 11 lux |  | Marker detected |
| 3 | 22 lux |  | Marker detected |
| 4 | 59 lux |  | Marker detected |
| 5 | 168 lux |  | Marker detected |

2.9.3 Beta Testing

Beta testing aims to determine whether the system built is in accordance with the objectives or not. Beta testing uses the User Acceptance Test (UAT) which is done by interviewing the company's marketing department and a questionnaire to prospective customers.

1. Testing the UAT Interview

Testing the UAT interview conducted by conducting question and answer to the marketing department of the company CV. Mandiri Express. The questions can be seen in Table 9.

Table 9. List of Interview Questions

| No | Questions |
|----|--|
| 1 | Can this application help in the implementation of mockups? |
| 2 | Does this application help in understanding customers? |
| 3 | Is this Maket Introduction Application Display interesting? |
| 4 | Is this Maket Recognition Application easy to use? |
| 5 | Is this mock recognition application feasible to use to help introduce mockups in CV. Mandiri Express? |

Based on the results of interviews conducted, it can be concluded that the application made is in accordance with the objectives that can help the marketing department in understanding the desires of color change from customers.

2. Testing the UAT Questionnaire

UAT testing of the questionnaire is done by giving a questionnaire to the target users in this case prospective customers to find out whether the system is built according to the purpose of this study. The percentage results of each question given to the target have 5 scales using a Likert scale. Score criteria can be seen in Table 10.

Table 10. Likert Scale Score Criteria

| Scale of Answers | Information | Score | Percentage |
|------------------|-------------------|-------|------------|
| SS | Strongly agree | 5 | 100% - 80% |
| ST | Agree | 4 | 79%-60% |
| RG | Doubtful | 3 | 59%-40% |
| TS | Disagree | 2 | 39%-20% |
| STS | Strongly Disagree | 1 | 19%-0% |

The questionnaire given to prospective customers consisted of 5 statements. The statement can be seen in Table 11.

Table 11. List of Questionnaire Statements

| No | Pernyataan |
|----|---|
| 1 | Appearance of this Introduction to Maket Application Interesting. |
| 2 | This Maket Introduction Application Is Easy To Use. |
| 3 | How to Use this Application Easy to Understand. |
| 4 | The shape of the mockups displayed in this mock recognition application are easy to understand. |
| 5 | This application makes it easy to adjust the color as desired. |

Based on the results of beta testing that has been done on the mock recognition application to potential customers, it can be concluded that the mock recognition application helps customers understand the shape of the mockups and makes it easier for customers to adjust the desired color.

3. CLOSING

Closing is an explanation of the conclusions that contain the results of the study. And there are some suggestions for developers so that further research is better.

3.1 Conclusions

Based on the implementation and testing of the mock recognition application, the following conclusions can be drawn:

1. The development of the mock recognition application with the application of augmented reality technology helps customers understand the shape of the model.
2. This mock recognition application helps the marketing department in understanding the colors that are in accordance with customer wishes.

3.2 Suggestion

Based on all the results that have been achieved at this time, that the Maket Introduction Application CV. Mandiri Expres has several shortcomings. Therefore, below are some suggestions that can be given to support the development of this application:

1. The dynamic part must be easier to use, for example it can be used directly without using the help of Unity3D.
2. The reading of the marker must be better.

Cemerlang, 2014.

BIBLIOGRAPHY

- [1] J. Enterprise, Step by Step Ponsel Android, Jakarta: PT. Elex Media Komputindo, 2010.
- [2] A. K. Pamoedji, Maryuni and R. Sanjaya, Mudah Membuat Game Augmented Reality (AR) dan Virtual Reality (VR) dengan Unity 3D, Jakarta: PT Elex Media Komputindo, 2017.
- [3] I. Binanto, Multimedia Digital-Dasar Teori dan Pengembangannya, Yogyakarta: CV. Andi Offset, 2010.
- [4] Madjid, Teknik Singkat Membuat Maket, Yogyakarta: Kanisius, 2003.
- [5] Y. Rizki, M. Hariadi and Cristyowidiasmoro, "Markerless Augmented Reality Pada Perangkat Android," *Jurnal Teknik Elektro*, 2012.
- [6] A. Awen, "Mengkomunikasikan Figure Denah, Potongan, Tampak, Dan Detail Bangunan," [Online]. Available: https://www.academia.edu/12106525/MENG_KOMUNIKASIKAN_FIGURE_DENAH_POTONGAN_TAMPAK_DAN_DETAIL_BANGUNAN. [Accessed 29 Maret 2019].
- [7] A. Zaki, E. Winarto, M.Eng and S. Community, Animasi Karakter dengan Blender dan Unity, Jakarta: Gramedia, 2016.
- [8] Vuforia, "Vuforia Developer Library," [Online]. Available: <https://library.vuforia.com/content/vuforia-library/en/features/overview.html>. [Accessed 13 April 2019].
- [9] Z. Arham and N. Indriani, "PEMBANGUNAN VIRTUAL MIRROR EYEGASSES MENGGUNAKAN TEKNOLOGI AUGMENTED REALITY," *Jurnal Ilmiah Komputer dan Informatika (KOMPUTA)*, vol. I, pp. 79-84, 2012.
- [10] M. D. Ferdiana, Dasar-Dasar Menggambar Bangunan, Yogyakarta: PT. Macananjaya