IMPLEMENTATION OF AUGMENTED REALITY TECHNOLOGY FOR TEACHING MATERIAL INFORMATIONS OF MULTIMEDIA EQUIPMENTS AT SMK MANDALASARI CIKANCUNG

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ABSTRACT

Multimedia Equipment is a teaching material in the lesson of multimedia equipment of vocational high school level (SMK) class X (Ten), the consideration is based on the syllabus of Multimedia Department of National scale. This material deals with the multimedia tools used in producing multimedia content, such as; images, sounds, video and text. According to the interview data to the head of multimedia lab SMK Mandalasari Cikancung, currently listed in the inventory list of computer lab equipment multimedia equipment available is not yet sufficient as a supporter of teaching materials, students also difficulty in receiving teaching materials, due to the availability of existing tools have limited number , as well as other problems prone to damage to multimedia equipment.

This application is desktop-based with the implementation of augmented reality technology, a technology capable of displaying the 3D object model of a multimedia device, supported by animation to clarify material materials. Applications built using Unity3D tools, and Autodesk 3DsMax. Application testing using blackbox method and questionnaire.

The result of this research can be concluded that multimedia application based on augmented reality technology for information of teaching materials of multimedia equipment that is built is enough to overcome the problem of multimedia equipment equality with simulation form, students also feel ease with application of this teaching material because able to see model of multimedia equipment such as object3D with the exact same detail as the original physical without fear of damaging it.

Keywords *- Teaching Materials, Multimedia Equipment, Technology, Augmented Reality, Multimedia Equipment Information Material, SMK Mandalasari Cikancung.*

1. INTRODUCTION

Multimedia Equipment Subject is a basic subject that must be studied by all students of class X (ten) majors Multimedia at SMK Mandalasari Cikancung. Of course, the considerations are taken based on the syllabus used in Multimedia Vocational High School level, then SMK Mandalasari Cikancung requires its students to understand, recognize and observe the multimedia equipment properly, especially in Multimedia Tools Practicum. But until now the problem often faced by schools in providing a means for students in observing the multimedia equipment has not got a good solution.

The school does not have a complete multimedia equipment such as a digital photo camera device that is available only 2 pieces and 1 video camera as teaching materials, so students have difficulty in receiving teaching materials from the teacher if only using the presentation slides on the computer screen as substitute for the delivery of unavailable multimedia equipment. In addition the student's observations are very limited because it can only see two-dimensional images of examples of images that can not be observed in detail like the physical of the original device.

Ineffective time if the observation of multimedia equipment is done in turn by using the available multimedia tools, because 1 student takes about 10 minutes to observe and learn a multimedia device, while in the syllabus the time allocation available for face to face in 1 meeting time is 2 x 45 minutes = 90 minutes and the students of class X (ten) FY 2016/2017 there are 30 people, in that time it is impossible for each student / i each can get 10 minutes to observe and learn a multimedia equipment if done in turns, although with tolerance if 1 tool used by 3 people still can not be overcome because it must be available at least 10, while the existing equipment is 2 pieces of digital photo camera type DSLR and 1 semi professional video camera.

Multimedia tools that are electronic in the event of damage are very expensive in the maintenance or repair, especially if the damage is very fatal to some specific components and is not able to repair again, did not rule out the equipment must be replaced with new and it is very burdensome school against In terms of information obtained from interviews to Mr. Sandy as head of multimedia lab SMK Mandalasari Cikancung, the case that never happened before in 2016 there are 4 cases of the same one of them at the time students observed a digital camera type of DSLR damage on the Penta Mirror (Viewfinder) because when opening the camera lens there is water that drips on the part and there is damage that requires considerable cost in fixing it, the cost incurred at that time approximately 1 million rupah to repair and change sparepart Penta Mirror (Viewfinder), the case is due to the inevitable student's negligence in observing and learning of a multimedia device.

Based on the problems that have been described above then it takes the media in the form of applications with Augmented Reality technology capable of displaying the 3D objects that can simulate multimedia equipment such as the original device form for students to observe and learn a multimedia equipment before using to the original equipment in order to avoid or minimize damage to multimedia equipment that is observed and studied.

Advantages of Augmented Reality Technology able to provide real-time information to users, marker / image target is the input and output of 3D images that are expected to provide more detailed information.

1.1 *Research Objectives*

Based on the results of the analysis of the problems studied, the purpose of writing this research is the implementation of Augmented Reality Technology for Information materials teaching tools Multimedia at SMK Mandalasari Cikancung.

The objectives to be achieved in the development of this instructional material application are;

Assist and complete the limitations of multimedia equipment by utilizing supporting facilities / infrastructure that is available is using PC (Personal Computer) in multimedia lab.

Effective KBM time for students to observe and learn a multimedia equipment according to the time allocation specified in the syllabus.

Minimize damage to multimedia equipment by implementing augmented reality technology in Multimedia Equipment subjects.

2. CONTENT RESEARCH

2.1 SMK Mandalasari Cikancung *Profile*

This research was conducted at SMK Mandalasari Cikancung Multimedia Department with accreditation C which is located at Jalan Raya Majalaya-Cicalengka Kp. Wirama Rt.03 Rw.10 Mandalasari Cikancung Bandung 40396, which was built by Mr. Usman Fauzi, S.Pd.I as the Principal.

Vision SMK Mandalasari Cikancung Realizing a clean school environment, decent school citizens, religious life and achievement in the field of imtaq and science and technology.

Mission SMK Mandalasari Cikancung namely;

- *Create a clean, healthy, beautiful and comfortable school environment.*
- *Familiarize greetings, smiles, greetings and hospitality to establish a family atmosphere that is conducive for every citizen of the school.*
- *Inculcate the values of religion in everyday life.*
- *Able to compete in the field of imtaq and science and technology.*

2.2 *Multimedia*

Multimedia is a computer used to display and combine text, sound, images and video using the tool, with it the user is able to manipulate, interact, and communicate. Multimedia is often used in the world of informatics and certainly in today's often encountered also in the gaming world, another example is to create a website.

The world of education makes the multimedia is very instrumental for media learning support facilities. In the world of multimedia business is including the main supporters, especially for the company profile, marketing, advertising and the like.

2.3 *Augmented Reality*

Augmented reality (AR) or reality that is added technology that is able to combine 2-dimensional or 3-dimensional virtual objects with a real environment and display the virtual object in realtime. Virtual objects serve to provide information that can not be accepted by humans directly. It makes reality add-on useful as a medium to help users able to interact with the real world. Information projected by virtual objects can help users in real-world activities.

Three principles of AR according to Ronald Azuma 1997;

- *AR is a real-world and virtual integration.*
- *Runs interactively in real time.*
- *Integration between three-dimensional virtual objects in the real world.*

In making AR use webcam as device to capture image. Before the image is converted to digital form, the process of digital image manipulation will not be possible. Digital imagery (f (x, y)) has 2 elements. First is the power of the light core that surrounds our vision of the object (illumination). Second is the amount of light reflected by the object into our eyesight (reflectance components). Both elements are written as functions i (x, y) and r (x, y). Augmented reality can be classified into two based on the presence or absence of marker.

2.3.1 *Marker Augmented Reality*

Markers in general are black and white illustrations in the form of square plaid patterns with black borders and white backgrounds. Deangan position in the direction of the camera of a device, then the device will perform the process of rendering 2-dimensional or 3-dimensional virtual objects.

2.3.2 *Markerless Augmented Reality*

The developing method in Augmented Reality technology, this method is capable of displaying 2dimensional or 3 dimensional virtual objects without markers. Although this markerless method will still have the target object scanned as a reference to the rendering position of the virtual object that appears, and the scanned scope is broader than the Marker Based Tracking.

Currently Augmented reality has been developed by large companies in the world one of them Total Immersion, this company has almost all used Markerless Tracking technique as the company's flagship technology, such as Image Target, Face Tracking, 3D Object Tracking, and Motion Tracking.

a. *Image Target: techniques with markers scanned by the system can be either black or white.*
b. *Face Tracking: A technique capable of scanning the human face structure, this method uses an algorithm that has been developed ..*
c. *3D Object Tracking: wider than the Face Tracking technique, this method is capable of scanning target objects such as inanimate objects, for example cars, boxes, or similar objects.*
d. *Motion Tracking: is a technique that makes the system capable of capturing moving objects.*

2.4 Vuforia

Vuforia Augmented Reality Library, using the source of the Computer Vision method, focuses on image recognition. Vuforia has many features and capabilities such as the virtual button inside the target image, supporting developers to create applications that are almost usable across platforms.

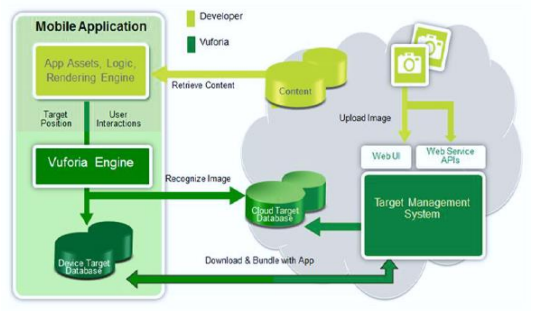


Figure 1 Vuforia Structure

Target on Vuforia is an object in the real world that can be detected by the camera, to display virtual objects. Some types of targets on Vuforia are:

a. *Image targets*
b. *Frame markers*
c. *Multi-target*
d. *Virtual buttons*

2.4.1 FAST *Corner Detection Method*

Initialization feature in Library Vuforia, using FAST Corner Detection method, is for making markers that help developers create a marker / marker in the form of target image. Here is how the FAST Corner Detection method works.

The first step of the Fast Corner Detection method determines a p point on the image with the initial position (xp, yp).

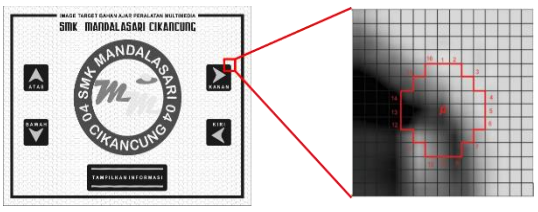


Figure 2 First p point value

Next determine the four points. first (n=1) *located in coordinates* (x_p,y_{p+3}), *second point* (n=2) *located in coordinates* (x_{p+3},y_p), *third point located in coordinates* (n=3) *located in*

coordinates (x_p, y_{p-3}), *fourth point* (n=4) *located in coordinates* (x_{p-3},y_p).

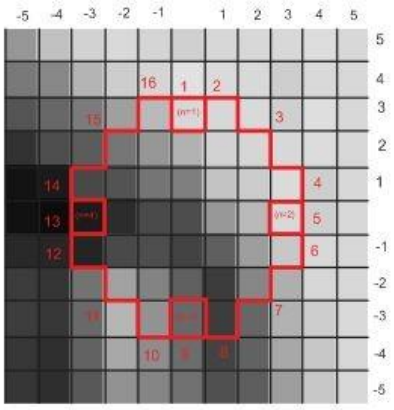


Figure 3 Four Point Coordinates

The intensity of the center point p with the four points around is compared. If the intensity value at the point p is greater or less than the intensity of the three points around it plus the intensity of the limits of the ammbang, it can be said that the point p is an angle.

$$S_{p\rightarrow x} = \begin{cases} d & I_{p\rightarrow x} < I_p - t\ (darker) \\ s, & I_p - t < I_{p\rightarrow x} < I_p + t\ (similar) \\ b, & I_p - t < I_{p\rightarrow x}\quad (brighter) \end{cases}$$

Information;

Sp→x = *Decision point p as angle, value 1 indicates that point is an angle, and value 0 indicates that point is not an angle. Ip = Point intensity value p t = The tolerable intensity intensity threshold limits.*

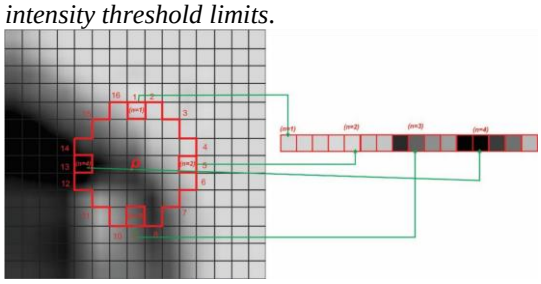


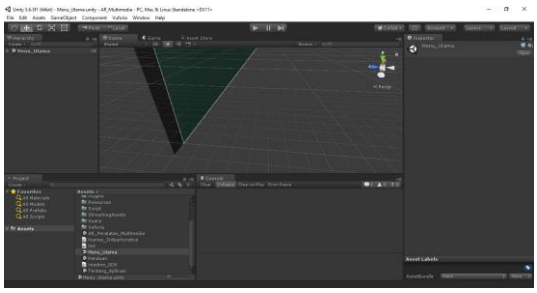
Figure 4 Determining the Point or Angle

The process will continue to repeat until the entire point on the image whose intensity has been compared.

2.5 Unity3D

Unity 3D is a game engine or an editor to develop 3D-based games with multiplatform. With Unity, developers can implement and can be used for various platforms such as Unity Web, Windows, Mac, Android, iOS, Xbox, Playstation 3 and Wii. Unity3D is capable of processing multiple data formats such as 3d object images for example (.obj, .3ds, etc.), sounds, material textures, and so on. Unity3D focuses more on 3D Graphic Design, than similar engines.

The Unity 3D Editor provides several tools to easily develop developers: Unity Tree and Terrain Creator that make terrain, vegetation and MonoDevelop easier for programming.



Gambar 5 Tampilan Unity3D

2.6 Autodesk 3Ds Max 2014

Autodesk 3Ds Max is a software devoted in 3 dimensional modeling or for the creation of 3-dimensional animation. In addition to proven reliable for use in the manufacture of 3-dimensional objects, Autodesk 3Ds Max is also widely used in the manufacture of furniture design, construction, and interior design. In addition, Autodesk 3Ds Max is also often used in making animations or cartoons.

Autodesk 3ds Max provides three possibilities for determining the coordinate system of a point in space, that is, by showing the x, y, z axes and angles. The three possible coordinate systems are:

a. *Cartesian Coordinate (rectangular coordinate). Determine the coordinates by using the* x, y, z axes. ie (x), (y), (z). *The writing* (0.5.0.9.0.0); (0.42,0.39,0.82).

b. *The cylindrical coordinate This method combines the distance, angle and z-axis coordinates: (distance) <(angle), (z) The writing*: (.03 <60.95,0.0); (0.57 <43.0.82)

c. *Spherical coordinates This method combines distance and two angles, and each magnitude is separated by the sign <*, ie: (*distance) <(angle) <(angle), the writing*: (1.03 <60.95 <0); (1 <43 <55).

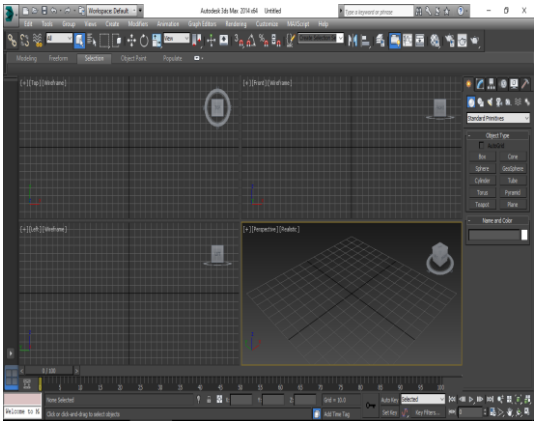


Figure 6 Display Autodesk 3Ds Max 2014

2.7 *Problem Analysis and Proposed Solutions*

During this time students who want to observe the type, form and function of a multimedia equipment in subjects practicum multimedia equipment has not got a good solution. Due to the limited availability of multimeda tools that are available as teaching materials and result in ineffective time in the practicum process, there are also other issues that must be minimized, ie avoidance of damage to multimedia equipment devices used by students in studying and observing multimedia equipment , because if using its original device, it is prone to damage if students learn and observe with care and lack of knowledge due to lack of knowledge of the multimedia equipment devices being studied.

Analysis of the problem itself aims to describe a problem in the writing of a thesis about the implementation of augmented reality for information materials on multimedia equipment that can simulate a multimedia equipment device into a digital object that is expected to interact with users interactively using the technology augmented reality.

2.7.1 *An Analysis of Current System*

Student practicum procedures in the classroom in observing the type, shape and function of a current multimedia equipment in addition to observing directly from existing equipment, currently only use two-dimensional drawing media from the teacher's presentation slide or from the package book. Students can only rely on images of multimedia equipment that can only be seen and observed in two dimensional form.

2.7.2 System Architecture Analysis

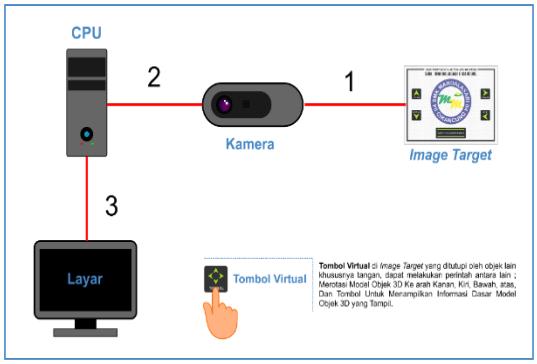


Figure 7 System Architecture

2.7.3 *System Flow Analysis*

Describe how the augmented reality process from initialization, Frame Processing, until the process of the emergence of 3D objects. Broadly speaking, in the design there are three main parts namely;

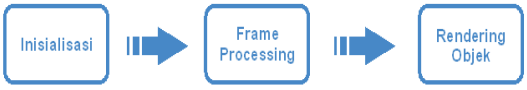


Figure 8 System Flow

2.8 *Augmented Reality System Analysis*

The marker type is very influential on the Augmented Reality work system to read the marker and project a 3D object. Marker used is a marker that is rated more than 2 stars (feature point) and not with the value of the ratenya 0.

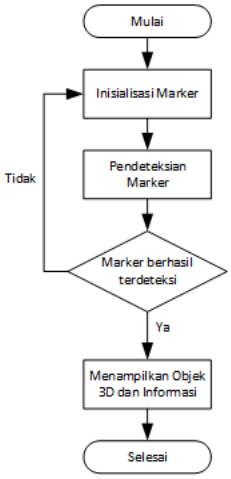


Figure 9 Augmented Reality System

2.9 *Image Target Analysis*

Image Targert or generally said to be a Marker is one of the important components in Augmented Reality system. Generally markers use a pattern of boxes in the form of black barcode

that is laid out white. But already using the shape of the image marker with a free form that has a contrast and sharpness of a very high image.

2.9.1 *Image Target Creation*

Image Target in this research, made automatically by through tools provided in web developer vuforia. Vuforia provides a feature to initialize the feature, the target manager system. This feature serves to provide features and ratting on images that are used as markers.

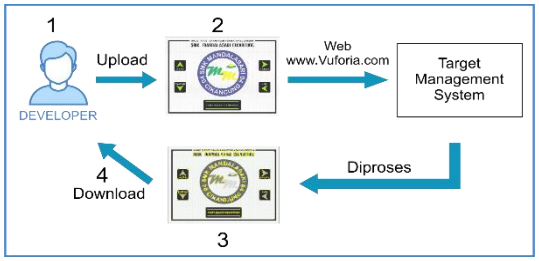


Figure 10 Features on Image Target Creation

2.9.2 *Marker Detection Analysis*

Detection of markers by object tracking techniques by Camera and Image Target on assetspackage vuforia. Detection of feature marker on the image object as the target image at least there are 3-5 star rating. Because so that when the process of detection by the camera is more sensitive in recognizing the feature by the camera so as not to cause lost tracked object (Object Model3D is easily lost).

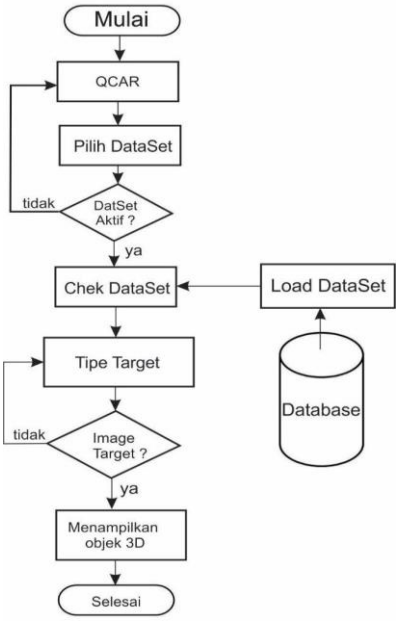


Figure 11 *Marker Detection Flowchart*

2.9.3 *Virtual Button Image Target Analysis*

Virtual Button (Virtual Button) is a useful mechanism to make the target image more interactive. The size and placement of virtual buttons should be considered when designing them. There are several factors that will affect the responsiveness and usefulness of virtual keys, among others:

a. *Long and width buttons*
b. *The target image area it covers*
c. *Placement of button in relation to both border images, and other buttons on the target image.*

In this study the authors use 5 pieces of virtual buttons on the target image with its functions among others;

- *The function to rotate the 3D object model in the Right direction*
- *The function to rotate the 3D object model in the Left direction*
- *The function to rotate the 3D object model in the Upper direction*
- *The function to rotate the 3D object model towards the bottom and*
- *Function to display the Basic Information or Description of the 3D object model that appears.*

2.10 *Hardware Requirement Analysis*

Hardware requirements for Augmented Reality technology, in terms of 3D graphics object model that will be made relatively high, because in modeling object3D will be there rendering process. Then get the minimum specification of the hardware requirements.

Table 1 Hardware Specification Required (Development)

No	Hardware	Specification
1	Processor	AMD Brazos Dual Core E350 ~ 1.6 GHz
2	Harddisk	500 GB
3	RAM	6144 MB
4	VGA	AMD Radeon HD 6310 Graphics, 1 GB, DDR 3
5	WEBCAM	External (Logitech C270 ~ 3 Mega Pixel)

Tabel 2 Hardware Specification Required (School)

No	Hardware	Specification
1	Processor	Intel Dual Core ~1.5 GHz
2	Harddisk	~80 GB
3	RAM	2048 MB

4	VGA	AMD/Intel Graphic, ~1 GB, DDR 3
5	WEBCAM	External (~ 3 Mega Pixel)

2.11 *Software Requirements Analysis*

Software requirements analysis consists of the minimum specifications required to build applications, among others;

a. *Operating System* : Windows 10 Pro 32/64 Bit
b. *Builder Software* : Unity3D v.5.2, Microsoft Visual Studio Professional 2013
c. *Design Software*: Autodesk 3Ds Max 2014, Corel Draw X7, Adobe Photoshop CS6.

2.12 *Functional Requirements Analysis*

In this functional analysis using UML modeling (Unifield Modeling Language). UML is a set of modeling conversions used to define or describe systems related to objects.

There are several diagrams in the design of UML modeling system and there are several diagrams designed in this system including; Use Case Diagrams, Activity Diagrams, Sequence Diagrams, and Class Diagrams.

2.12.1 *Use Case Diagram*

Is a diagram designed to show the functionality of a system that interacts with the user.

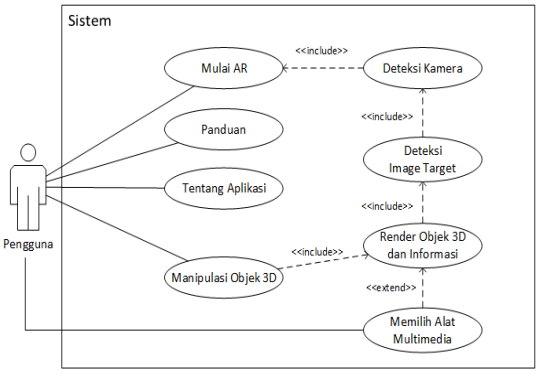


Figure 12 Use Case Diagram

2.12.2 *Activity Diagram*

Activity diagram is the flow of activity in the system that in the design process, which bgimana every functionality works, and how a functional ended. Activity diagram modeled the events that occurred on Use Case.

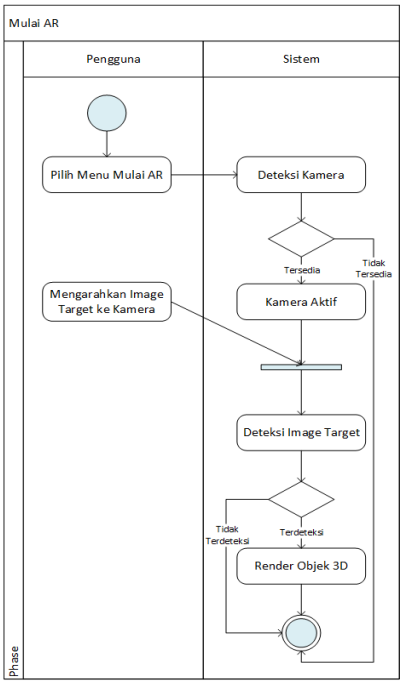


Figure 13 *Activity Diagram* Mulai AR

2.12.3 *Class Diagram*

The system structure is depicted with the Class Diagram of each definition of all classes that will be created to build the system.

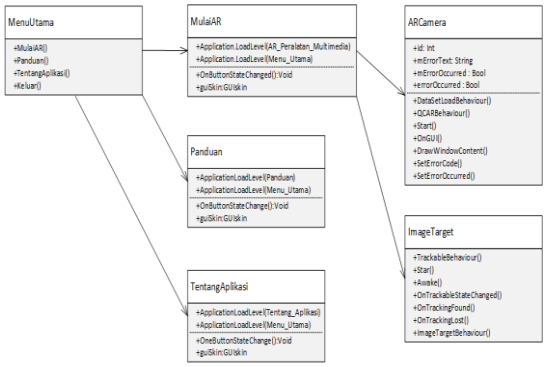


Figure 14 Class Diagram

2.13 *Material Analysis*

Materials on Multimedia Tools to be featured in this appli- cation as teaching materials among others:

a. *Multimedia Tools*
   - *Digital Camere Foto*
   - *Video Camera*
   - *Tape Recorder*
   - *Speaker*
   - *Infocus*
   - *Webcam*
b. *Multimedia standars support tools*
   - *Gimbal Camera Stabilizer*

c. *General functions of Multimedia Tools outline.*

2.14 *Interface Implementation*

At this stage, the implementation of interface design results into applications built using software that has been described in the sub-chapter of software implementation.

a. *Initial view of the app*



Figure 15 Initial view of the app

a. Tampilan Aplikasi Mulai AR

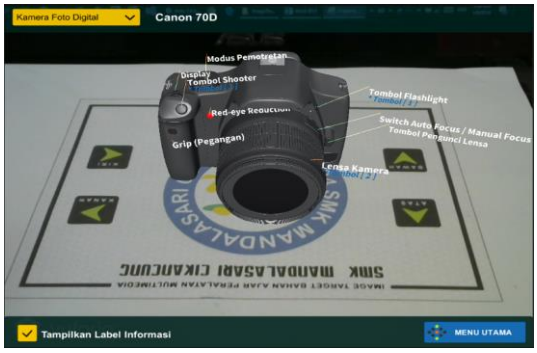


Figure 16 Application Mulai AR view

b. *App Guide View*

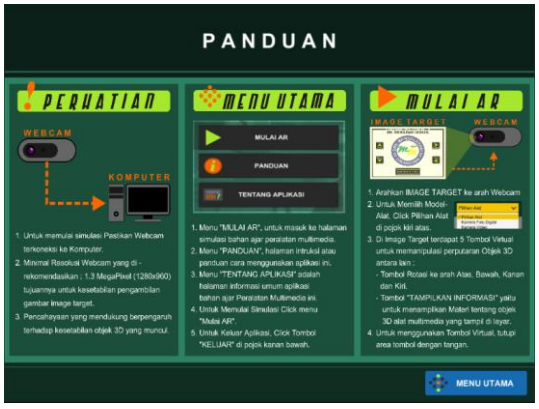


Figure 17 App Guide View

c. *App views*



Figure 18 App views

2.15 *Testing*

System testing is done to find (bugs) errors or deficiencies in the application being tested. Testing aims to find out the application that is made already meet the criteria in accordance with the purpose of designing the application.

2.15.1 *Alpha (Blackbox)Testing*

Alpha testing is done on the development side that records all errors and usage problems. Alpha testing is done in a controlled environment. Alpha Testing Cases include Menu Button Testing, 3D Object Testing, 3D Animation Tests, Virtual Button Testing, and Image Target Image Testing.

Table 3 Application Testing Plan

No	Components Tested	Test Items	Type of Testing
1	**Tombol Menu**	"Mulai AR" Button	*Blackbox*
		"Panduan" Button	*Blackbox*
		"Tentang Aplikasi" Button	*Blackbox*
2	**Objek 3D**	Foto Digital Camera	*Blackbox*
		Video Camera	*Blackbox*
		Tape Recorder	*Blackbox*
		Speaker	*Blackbox*
		Infokus	*Balckbox*
		Webcam	*Blackbox*
3	**Animasi 3D**	Kamera Foto Digital	*Blackbox*
		Kamera Video	*Blackbox*
		Tape Recorder	*Blackbox*
		Speaker	*Blackbox*

		Infokus	*Blackbox*
		Webcam	*Blackbox*
4	***Virtual Button***	Tool Information Button	*Blackbox*
		Play Button to Right	*Blackbox*
		Play Button to Left	*Blackbox*
		Play Button to Up	*Blackbox*
		Play Button to Down	*Blackbox*
5	**Image Target distance**	Webcam specification	*Blackbox*

2.15.2 *Beta Testing*

The beta test is done objectively with the test carried out directly to the respondent. This test is done to 1 teacher and 50 students.

2.15.3 *Conclusion Testing*

The conclusions of this test consist of the conclusions of blackbox testing and Beta testing that will be explained in the sub chapters below.

2.15.4 *Conclusion Blackbox Testing*

Based on the results of testing the built applications all went well and in line with expectations.

2.15.5 *Conclusion Beta Testing*

Conclusion Testing with Questionnaire and Interview.

This built application helps teachers in teaching and learning activities, guiding students in learning and absorbing information and practice in a simulation directly about Multimedia Tools and quite capable of streamlining study time. Applications made easy to use, the material created is quite appropriate to the expected teaching materials for multimedia equipment, has an interesting appearance.

3. CLOSING

3.1 Conclusion

Based on the results of research that has been done then it can be concluded:

a. In accordance with the results of practicum of teaching materials multimedia equipment, this application can help teachers in teaching and learning activities to attract students to be more interactive.

b. Augmented Reality Technology can be implemented in this application as teaching material of multimedia equipment.

c. In this application Augmented Reality technology is able to simulate multimedia equipment to avoid damage if using the original equipment.

3.2 Saran

Berdasarkan kesimpulan diatas, maka saran yang dapat dikemukkan agar untuk kedepannya menjadi perbaikan dan pertimbangan adalah sebagai berikut:

a. Platform yang digunakan diharapkan bisa diperluas dengan harapan siswa dapat belajar dimanapun mengingat perkembangan teknologi saat ini sangat pesat.
b. Materi yang dimunculkan kurang begitu lengkap dan harus di sesuaikan dengan perubahan kurikulum setiap waktunya.
c. Aplikasi diharapkan bisa dinamis untuk penambahan model objek 3D dan materi dengan alasan kemungkinan teknologi peralatan multimedia yang dimasa akan datang terdapat perubahan.

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