

RANCANGAN AUGMENTED REALITY GROUND STATION AUTOMATIC DEPENDENT SURVEILLANCE BROADCAST BERBASIS ANDROID SEBAGAI MEDIA PEMBELAJARAN DI POLITEKNIK PENERBANGAN SURABAYA

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ABSTRACT

This research aims to design an Augmented Reality (AR) Ground Station Automatic Dependent Surveillance Broadcast (ADS-B) based on Android as a learning media at Politeknik Penerbangan Surabaya. The use of AR technology will provide an interactive learning experience with realistic visual displays. The focus of this research is on the design of a 3D AR application that enables interactive visualization of Ground Station ADS-B. The goal is to create an engaging and effective AR application for learning purposes.

The results of this research are expected to provide more interactive learning solutions at the Surabaya Aviation Polytechnic. This 3D AR application will help learning ADS-B Ground Station material and alternatives more clearly and enjoyably. In addition, this research will also be a reference and contribution to literature in the development of AR technology at the ADS-B Ground Station as a learning medium.

Keywords: *Augmented Reality, Learning Media, Ground Station ADS-B, Android, Surabaya Aviation Polytechnic*

INTRODUCTION

Science always develops and progresses in accordance with the times and the development of human thinking, with science everything can be known, the development of science has a positive impact, including educational technology. The development of science and technology requires society to further improve its competence, so that humans can balance themselves in the current era[1].

Education is a very important foundation to realize the quality of human resources. Education is basically a way to train someone to be more insightful so that it is useful for the nation and dignified. Law of Numbers. 20 Article 3 of 2003 concerning national education. The development of education also goes hand in hand with technological developments. More information and learning materials have been developed with technology and innovation[2]. The

increasingly advanced technology today has an impact on changing many systems, one of which is the learning approach system [3] The learning system is built with the adjustment of methods, factors, and media, one of which is learning media which is a useful tool or intermediary to facilitate the delivery of learning material[4]. Learning media can be print, not print. Do not print for example software. Teachers are required to be more creative in producing learning media that suit the needs and interests of students. In producing learning media with the aim of spurring student creativity and learning motivation. [5]. Each learning media has the appeal of suiting the topic of the lesson with the material, one of the learning media is *augmented reality* AR, the purpose of AR learning media makes it easier for students or students to find out the 3D physical form of an object with the help of laptop devices, when the object is not real around us[6]. One of the

learning media topics studied is about ADS-B. ADSB is a surveillance system equipment defined as a signal transponder-based aircraft system that operates independently of ground-based equipment to detect position, distance, identity, altitude information[7]

Augmented reality (AR) has become a concern for its ability to combine the physical world and the digital world, thus providing a more interactive and engaging learning experience for users. In the context of learning, augmented reality can be used to enrich the learning experience through more realistic and interactive visual displays. In addition to interactive, users can also get a learning experience with a more modern style. That is by using the camera on your laptop or computer device, in real-time and integrating it with the surrounding environment[8].

1. Based on the background above, researchers are interested in creating ADSB 3D equipment visualization products based on *Augmented Reality* (AR) which functions as an alternative learning medium, more interesting and can make it easier to visualize cadets / I Surabaya Aviation Polytechnic understands one of the surveillance equipment or *Surveillance*. With the existence of 3D ADSB based on *Augmented Reality* (AR) can find out virtual visualization of the original form of equipment. Therefore, 3D ADS-B based on *Augmented Reality* (AR) is very useful to improve the quality of insights and alternative learning solutions and help cadets in knowing a piece of equipment without looking directly. So the researcher made a study entitled
 1. How to design a 3D *Augmented Reality* (AR) application that can display ADSB *ground station* object models interactively on Android media?

2. How is ADSB's *Augmented Reality* (AR) *Ground Station* implemented as a learning medium?
3. How to evaluate the performance of *Android-based Augmented Reality* (AR) as a learning medium?

As for the purpose of the above research is?

1. Designing the initial design concept using *software* and design tools from original references and then into products rendered to *augmented reality* with a 3D display on applications in *SmartPhone / Android-based*.
2. Designing the ADSB ground station in the form of an interactive 3D *Augmented Reality* (AR) display and making it easier for cadets to visualize the display of ADSB material from equipment.
3. Evaluate *Android-based Augmented Reality* (AR) to add new insights with learning media that can be displayed in 3D.

1.1. Theoretical Basis

Augmented Reality is a graphic technology that continues to develop. This is along with the quality display both from 2 dimensions and 3 dimensions to build a *virtual world* into real on a computer According to Raajan (2014) mentioned that *Augmented Reality* [9] was first used in 1957-1962 by a cinematographer named Norton Heilig, named Sensorama. *Augmented Reality* is a field of computer research that combines 3D graphics data with the real world. 2-dimensional or 3-dimensional type that will be added to the real environment and projected into real *time* so that *Augmented Reality* is an interaction technology that combines the real world (*real world*) and the virtual world (*virtual world*).

1. Learning Media

Learning media is a tool or intermediary that is useful to facilitate the learning process, to

facilitate the delivery of learning material. Learning media can be print, non-print and can be software[10].

1.1.1 ADS-B (Automatic Dependent Surveillance Broadcast) is a *surveillance* technology. ADS-B is automatic because it does not require a pilot to perform functions and is *dependent* on the aircraft transponder. This device uses a radio frequency of 1090MHz to receive information from the transponder and 1030MHz for transponder transmission from the aircraft so that all devices with the same frequency can capture the information, this mechanism of information dissemination is called *broadcast*[11].

1.1.2 Android is the operating system used in smartphones which consists of an operating system, middleware, and main applications. Like Microsoft, Android also provides an open source that can be used by developers to create their own applications..

1.1.3 Unity 3D is a game engine developed by Unity Technologies, a *Unity Engine* used to build and develop video games and real-time 3D animation. Unity 3D is *cross-platform* which means it runs on Microsoft Android and Mac OS X operating systems.

1.1.4 Blender is an open-source 3D computer graphics software. One of the free and open-source 3D creation software.[12] The software is used to create animated films, visual effects, 3D printed models, interactive 3D applications, and video games. Blender has several features including 3D modeling, texturing, bitmap image editor, looping, fluid and smoke simulation, particle simulation, animation, video editor, digital sculptor, and rendering. Blender is a 3D animation modeling software that features a game engine, Blender was originally developed by Dutch animation company NeoGeo as an internal animation program, Blender grew and developed with NeoGeo's projects.

1.1.5 Vuforia is an Augmented Reality (AR) Software Development Kit (SDK) that functions to provide or access all the needs of AR application development on smartphones. Vuforia has Vuforia's main

functions: detection and tracking. Unity 3D software is a fully integrated game engine that reduces developer time and costs Vuforia is an SDK provided by Qualcomm to help developers build and develop Augmented Reality applications on smartphones.

1.1.6 Marker Based Tracking This marker-based tracking method has long been known in the design of augmented reality technology where this system requires a marker in the form of an image to be analyzed to form a 3D object or reality. Markerless Augmented Reality Markerless Augmented reality is a method that is currently developing, this method does not require markers to display digital elements Markers become one of the important components in making this level project, where the marker functions as a trigger for augmented reality applications in displaying a 3D object. Markers can be 2D or 3D objects. In this project, the marker object is a 2D image of the 3D model created.pembahasan

A. Analisis

At the initial stage of this analysis the author has obtained the results of observation related to the needs of making ADSB Augmented Reality applications, the author uses the main software unity. Then the supporting software is blender 3.4 as 3D authoring software. For the specifications of the 3D asset maker, namely blender and the author of the application, Unity, the author uses the following hardware: Laptop Type, Alienware R12, 16 GB RAM, 64 bit System Type, Intel i7 Processor, 256 Gb Storage Capacity.

In making Augmented Reality applications, hardware to build applications will greatly affect the results of applications made. Minimum hardware specifications are as follows:

- a) PC or Laptop with Core 2 Duo processor
- b) Random Access Memory (RAM) 2 Gb
- c) Hard drive with 500 Mb free space
- d) VGA HD Graphics 1Gb
- e) Smartphone Camera.

You can customize the use of this software with the device you are using so that it is compatible and does not experience laptop malfunction when running unity and blender software which requires certain specifications to use it.

B. Desain

At the design stage the author creates a design application using software and Unity is shown below.

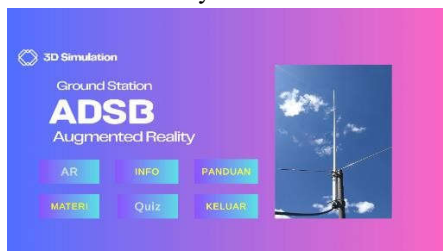


Figure 3. 1 Home view

General view of the application homepage that has been created using Unity software.

C. Development

In the development stage, an explanation of starting the button function application from the home page of the Augmented Reality learning media application, there are 6 features in the AR application, these eight features are carried out to ensure the feature runs properly. Enter the home page (Main Menu) After entering the home page there are features that can be confirmed by the user.

a. Fitur AR (*Augmented Reality*)

Serves to turn on the *smartphone camera* and then display 3D objects ADSB shelves and the guide can be seen in the guide feature button.

b. Fitur Info

Displays the display of brief and frequency information on ADSB.

c. Fitur Materi

Displays identification and knowledge of the hardware used Object.

d. Fitur Quiz

Displays multiple-choice questions that are referenced based on the material in the material feature, which can be added.

e. Fitur Panduan

Displays Procedures for using *Augmented Reality application* information And the last one when you are done using the application can press the exit button.

After everything has been done in making the next stage is the last stage of making the application, namely build into usable software, by clicking > File then select *Build Settings* then click the Android, Mac, Linux platform because it uses an Android-based platform. Then Click Build and the Unity system will calculate all elements of the design and functions that have been made into software with apk format.

The author gives the name of the ARBUFA application which can be changed as desired in the *Build Setting > Player Setting > Name section*.

E. Implementation

In this implementation stage, the preparation of the resources needed for the use of AR applications is carried out. At this stage, resources such as markers, and deploy to users when the learning media AR application runs.

F. Evaluation

In the evaluation phase, AR applications that have been developed will be evaluated to evaluate functionality, and user feedback. This evaluation aims to find out whether there are errors in the application or not, testing is done by running every feature in the application, and seeing whether the output responded is in accordance with the wishes of the program or not.

Data Analysis Techniques

In this study, the authors used criteria to make it easier to analyze the data. as follows will analyze the results of a survey conducted to determine the feasibility of AR applications. The survey was conducted through filling out a questionnaire consisting of 22 statement items from 4 instruments and filled out by 30 respondents. Using the Likert Scale analysis method Furthermore, the analysis technique is to distribute questionnaires to get feedback from users, namely cadets of the TNU study program batch fifteen, fourteen, thirteen, as many as 30 respondents. The questionnaire used the parameters Strongly Agree = 5, Agree = 4, Neutral = 3, Disagree = 2, Strongly Disagree = 1. Next, the questionnaire is distributed.

In order to answer the problem formula above, and the data has been collected, then the data will be analyzed using the following analysis techniques:

Calculating the Index

Analyze data by disseminating the data that has been collected, using percentages with the following formula:

$$Smax = \frac{\sum x}{n} \times 100 \quad (1)$$

Information:

Smax = Maximum Score

$\sum x$ = Total Score

n = maximum number of scores

i) Mean

Mean is the mean value, by adding up all respondents' index data by dividing the number of individuals. Use the formula as follows:

$$M = \frac{\sum x}{N} \quad (2)$$

Information:

M : Mean

$\sum x$: Number of Question Data

N : Total Overall Index Data

TEST RESULTS

In the test above there are test actions when the application is running. Indicators of the test include: After testing on AR cameras.

Tabel 1 Test on Unity Editor

Skenario Pengujian		Hasil Diinginkan	Intensitas Cahaya	Hasil Pengujian
Jarak	Sudut			
15 cm	0	3D Objek Tidak Tampil	Gelap	Berhasil
15 cm	15	3D Objek Tidak Tampil	Gelap	Berhasil
15 cm	30	3D Objek Tidak Tampil	Gelap	Berhasil
20 cm	0	3D Objek Tidak Tampil	Gelap	Berhasil
20 cm	15	3D Objek Tidak Tampil	Gelap	Berhasil
20 cm	30	3D Objek Tidak Tampil	Gelap	Berhasil
25 cm	0	3D Objek Tidak Tampil	Gelap	Berhasil
25 cm	15	3D Objek Tidak Tampil	Gelap	Berhasil
25 cm	30	3D Objek Tidak Tampil	Gelap	Berhasil
30 cm	0	3D Objek Tidak Tampil	Gelap	Berhasil
30 cm	15	3D Objek Tidak Tampil	Gelap	Berhasil
30 cm	30	3D Objek Tidak Tampil	Gelap	Berhasil

In testing AR ADSB objects from the table above with test indicators, namely distances and angles with dark light intensity with the result that the results of testing in dark light intensity were unsuccessful.

Table 2 Test on Unity Editor

Skenario Pengujian		Hasil Yang Ingin Didapat	Intensitas Cahaya	Hasil Pengujian
Jarak	Sudut			
15 cm	0	3D Objek Tidak Tampil	Terang	Berhasil
15 cm	15	3D Objek Tidak Tampil	Terang	Berhasil
15 cm	30	3D Objek Tidak Tampil	Terang	Berhasil
20 cm	0	3D Objek Tidak Tampil	Terang	Berhasil
20 cm	15	3D Objek Tidak Tampil	Terang	Berhasil
20 cm	30	3D Objek Tidak Tampil	Terang	Berhasil
25 cm	0	3D Objek Tidak Tampil	Terang	Berhasil
25 cm	15	3D Objek Tidak Tampil	Terang	Berhasil
25 cm	30	3D Objek Tidak Tampil	Terang	Berhasil
30 cm	0	3D Objek Tidak Tampil	Terang	Berhasil
30 cm	15	3D Objek Tidak Tampil	Terang	Berhasil
30 cm	30	3D Objek Tidak Tampil	Terang	Berhasil





In testing AR ADSB objects from the table above 12 experiments and with different actions different from test indicators, namely the distance of fifteen, twenty, twenty-five, thirty and zero, fifteen, thirty degrees at each distance and then seen at the intensity of bright light obtained results from testing at the intensity of Bright Light successfully.

Testing was carried out with several devices, first the software by opening the camera in the *Unity editor* with bright light intensity conditions using a webcam camera the results appeared using the laptop's internal camera with dim light the results were successful, the third with the editor camera with dark light the results did not display, and the last one using the Apk device on android with the results displayed In the table below.

Tabel 3 Test on Unity Editor

Skenario Pengujian		Hasil Yang Ingin Didapat	Intensitas Cahaya	Hasil Pengujian
Jarak	Sudut			
15 cm	0	3D Objek Tidak Tampil	Redup	Berhasil
15 cm	15	3D Objek Tidak Tampil	Redup	Berhasil
15 cm	30	3D Objek Tidak Tampil	Redup	Berhasil
20 cm	0	3D Objek Tidak Tampil	Redup	Berhasil
20 cm	15	3D Objek Tidak Tampil	Redup	Berhasil
20 cm	30	3D Objek Tidak Tampil	Redup	Berhasil
25 cm	0	3D Objek Tidak Tampil	Redup	Berhasil
25 cm	15	3D Objek Tidak Tampil	Redup	Berhasil
25 cm	30	3D Objek Tidak Tampil	Redup	Berhasil
30 cm	0	3D Objek Tidak Tampil	Redup	Berhasil
30 cm	15	3D Objek Tidak Tampil	Redup	Berhasil
30 cm	30	3D Objek Tidak Tampil	Redup	Berhasil

Based on testing in AR cameras with the table above, 3D results have been obtained for objects on the scale of distances and angles above displayed at the intensity of dim and bright light, and at the intensity of 3D Dim Light objects did not successfully appear.

No	Perangkat Uji	Intensitas Cahaya	Gambar
1	Unity Editor Kamera Webcam	Terang	
2	Unity Editor Kamera Laptop	Redup	
3	Unity Editor Kamera Laptop	Gelap	
4	Perangkat Lunak Apk	Terang	

Testing AR ADSB objects from the table below 12 experiments and with different actions different from test indicators, namely the distance of fifteen thousand, twenty, twenty-five, thirty and angles of zero, fifteen, thirty degrees at each distance then seen at the intensity of bright light obtained results from testing at the intensity of Bright Light successfully.

Table 2 AR Camera Test on ARBUFA Applications

Skenario Pengujian		Hasil Yang Ingin Didapat	Intensitas Cahaya	Hasil Pengujian
Jarak	Sudut			
15 cm	0	3D Objek Tidak Tampil	Terang	Berhasil
15 cm	15	3D Objek Tidak Tampil	Terang	Berhasil
15 cm	30	3D Objek Tidak Tampil	Terang	Berhasil
20 cm	0	3D Objek Tidak Tampil	Terang	Berhasil
20 cm	15	3D Objek Tidak Tampil	Terang	Berhasil
20 cm	30	3D Objek Tidak Tampil	Terang	Berhasil
25 cm	0	3D Objek Tidak Tampil	Terang	Berhasil
25 cm	15	3D Objek Tidak Tampil	Terang	Berhasil
25 cm	30	3D Objek Tidak Tampil	Terang	Berhasil
30 cm	0	3D Objek Tidak Tampil	Terang	Berhasil
30 cm	15	3D Objek Tidak Tampil	Terang	Berhasil
30 cm	30	3D Objek Tidak Tampil	Terang	Berhasil

Design research needs results, results in research or design are obtained by testing application media by obtaining After distributing questionnaires and validation, data obtained from user feedback who have filled out questionnaires. Data presented in the form of pie charts As shown below as follows:

Perbandingan Indeks Kelayakan



Judging from the diagram image above, it shows the percentage of answers to the results of the Android-based Augmented Reality Ground Station Automatic Dependent Surveillance Broadcast as a learning provider at the Surabaya Aviation Polytechnic. With thirty respondents of TNU study program cadets to thirteen, fourteen and fifteen. Based on the results of the study, it can be concluded that TNU study program cadets support the application of *Augmented Reality* learning media to support learning in lectures. This can be known from the results of research conducted through the distribution of questionnaires using google forms. And get a percentage result of 92% in favor.

CONCLUSION AND ADVICE

In this final project, the author analyzes the performance of AR learning media applications. Based on the results of the test data and analysis, how many conclusions are obtained.

1. The application made is well proven from the results of installation testing and can be installed install with apk format and can also boot into the application which directly displays the main menu with features in it. In the test results it was shown that distance, angle, and intensity of environmental light

affect the appearance of 3D objects in AR. The results of AR camera testing were shown that 54 attempts were carried out to get different results.

2. From the results of application media testing involving 30 TNU study program cadet respondents, it was found that 92% of them supported the use of appropriate Augmented Reality (AR) learning media applications in lectures.

3. From the evaluation of the use of usionary and validation, experts support more than those that do not support testing and simulation, showing that the application that has been made is in accordance with the procedures and order of manufacture well.

SUGGESTION

1. We recommend that the platform made used is more flexible as used in Windows Os, or IOS.
2. Develop a system using a markerless detection system in mobile cameras and so on.
3. In the manufacturing process, you should provide more storage space so that you can experiment as needed quickly.
4. Developing more widely learning media and key features of question access to evaluations or quizzes as well as adding gestures with optimal AR technology.

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