DEVELOPMENT OF INFORMATION MEDIA SIMULATION OF TSUNAMI (CASE STUDY OF BANDUNG BMKG)

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ABSTRACT

Indonesia is a country located on the ring of fire. This geographical location resulted in Indonesia often experiencing earthquakes under the sea. Tsunamis can be triggered by a variety of large-scale disruptions to sea water, such as earthquakes, plate shifts, volcanic eruptions under the sea, or collisions of celestial bodies. BMKG is a non-departmental government agency whose task is to inform in the fields of meteorology, climatology, and geophysics. To be able to hold socialization said that they have not been able to disseminate disaster simulation in all regions of Indonesia equally. Because of limited time, money, and the territory of Indonesia that is too broad. So BMKG Bandung needs disaster simulation socialization tools, in addition to those carried out directly. Then the application of Tsunami Disaster Simulation Information Media was developed, with the aim of making it easier for the public to find out information about tsunami disaster mitigation, helping to facilitate BMKG to socialize tsunami disaster mitigation simulations especially for people living in the highlands. In the overall application test results, it can be concluded, that testing the functionality of the tsunami disaster simulation socialization application is in accordance with user needs. On the results of the distribution of questionnaires given to 50 community respondents around Bandung, said that the results of testing the questionnaire with a score of 994 included in a positive attitude. And applications that are built can help the community in understanding the occurrence of tsunamis and understanding how to reduce risk and face the threat of disaster.

Keywords : Tsunami, Simulation, Disaster, Dissemination, BMKG.

1. INTRODUCTION

Indonesia is a country that has many islands and is located on the ring of fire, which is a center for the meeting of tectonic plates. This geographical location causes Indonesia to experience frequent tsunamis [1]. Tsunamis can be triggered by various large-scale disturbances to sea water, such as earthquakes, plate shifts, volcanic eruptions under the sea, or collisions of celestial bodies [2].

Disaster simulation is an important method for testing and increasing the effectiveness of system elements [3]. Tsunami disaster simulation is carried out in accordance with a scenario made as closely as possible to the tsunami events that occurred. Simulations can be carried out by focusing on one or several elements of a tsunami early warning system according to the scale and type of evacuation drill and full-scale tsunami simulation (field rehearsal) [4].

From the results of interviews with BMKG Bandung, at present BMKG throughout Indonesia as a means of organizing disaster simulation socialization, said that they have not been able to disseminate disaster simulations in all regions of Indonesia equally. Because of limited time, money, and the territory of Indonesia that is too broad. So BMKG Bandung needs disaster simulation socialization tools, in addition to those carried out directly. So that the socialization of disaster simulations can be carried out by Indonesians who are not socialized with disaster simulations in their area of residence. In addition to conducting socialization on tsunami disaster mitigation simulation, BMKG Bandung also disseminates information on tsunami disaster mitigation through printed media in the form of pocket books, and electronic media.

From the results of the random distribution of questionnaires to people who live in areas far from the coast of Bandung, that 68 out of 100 respondents have never participated in a tsunami disaster simulation because simulations were not held in their homes. 9 out of 100 respondents are not interested in participating in a disaster simulation. 15 of 100 respondents admitted that they did not know of a tsunami disaster simulation. And 8 out of 100 respondents have participated in a tsunami disaster simulation.

Based on the problems that occur, the researchers will build a mobile application about the dissemination of tsunami disaster mitigation simulation with virtual reality technology, to assist

BMKG Bandung in disseminating information on tsunami disaster mitigation and to provide facilities to the public who wish to take part in socializing tsunami disaster mitigation simulations, but in the area where he lived there was no tsunami disaster mitigation simulation. So the author raised the title "Development Of Information Media Simulation Of Tsunami (Case Study Of Bandung BMKG)". The aims and objectives of this thesis are as follows:

1. Make it easy for the public to find out information about tsunami disaster mitigation.
2. Help facilitate BMKG in socializing tsunami disaster mitigation simulations especially for people living in the highlands.

2. RESEARCH CONTENTS

2.1 Tsunami

Tsunami are ocean waves that occur due to impulsive interference in the sea. Impulsive disturbances occur due to sudden changes in the shape of the seabed in the vertical direction or in the horizontal direction. These changes are caused by three main sources, namely tectonic earthquakes, volcanic eruptions, or landslides that occur on the seabed. From these three sources, earthquake in Indonesia is the main cause [2].

Indonesia is an area prone to earthquakes because it is crossed by a meeting point of 3 tectonic plates, namely: the Indo-Australian Plate, the Eurasian Plate, and the Pacific Plate. The Indo-Australian Plate moves relatively northward and infiltrates the Eurasian plate, while the Pacific plate moves relatively westward [5].

2.2 Disaster Mitigation

Disaster mitigation is a series of efforts to reduce disaster risk, both through physical development and awareness raising and capacity to face the threat of disaster. Disasters themselves are events or series of events that threaten and disrupt people's lives and livelihoods caused, both by natural and / or non-natural factors as well as human factors, resulting in human casualties, environmental damage, property losses, and psychological impacts. Disasters can take the form of fires, tsunamis, earthquakes, volcanic eruptions, floods, landslides, tropical storms, and others [6].

2.3 Virtual Reality

Virtual Reality (VR) is a technology that allows users to interact with an environment that is simulated by a computer, an actual environment that is imitated or truly an environment that only exists in imagination. The current virtual reality environment generally presents a visual experience, which is displayed on a computer screen or through a stereocopic viewer, but some simulations include additional sensory information, such as sound through speakers or headphones [7]. Virtual Reality is understood as an interactive computer simulation that can affect the user's senses and even replace one or more human senses, so that users dissolve into a simulated environment (virtual environment) [8].

2.4 Android

Android is an operating system for cellular phones based on Linux. Android provides an open platform for developers to create their own applications for use by a variety of mobile devices. Initially, Google Inc. buy Android Inc., a newcomer who makes software for mobile phones. Then to develop Android, the Open Handset Alliance was formed, a consortium of 34 hardware, software and telecommunications companies, including Google, HTC, Intel, Motorola, Qualcomm, T-Mobile, and Nvidia [11].

2.5 Unity

The Unity 3D Engine application is a game engine. Game engine is a software designed to make a game. A game engine is usually built by encapsulating some standard functions commonly used in making a game. For example, rendering functions, voice calling, network or particle creation for special effects. Most game engines are generally in the form of libraries or a set of functions whose use is integrated with a programming language [9].

2.6 Software Development Modeling

The software development method used is the Luther version of the MDLC method which argues that there are 6 (six) stages, namely concept, design, material collecting, assembly, testing and distribution [10]. Following are the stages of the method can be seen in Figure 1

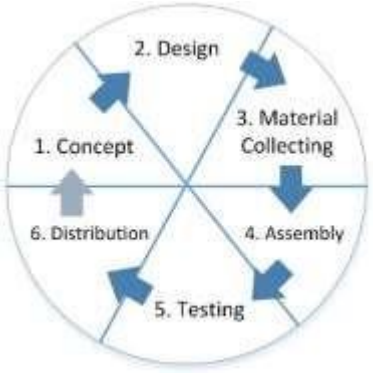


Figure 1 Software Development Modeling

2.6 System Analysis

System analysis is the breakdown of a whole system into component parts. In order to be able to identify and evaluate problems that occur as well as the desired needs so that it can be proposed an improvement.

2.6.1 Problem Analysis

Problem analysis is the stage of elaboration of problems that occur, before the application is made and has a goal to help the making of the application. Analysis of the existing problems include:

1. Communities have difficulty in finding information about tsunami disaster mitigation.
2. BMKG has not been able to disseminate tsunami mitigation especially to people who live in the highlands.

2.6.2 Analysis of The Current System

Analysis of the current system provides an overview of the system currently running. System analysis aims to find out more clearly how the system works, so that the advantages and disadvantages of the system can be known. Analysis of the current system is obtained from interviews with employees at BMKG, so as to get an overview of the system that is running there. The system that is currently running in the tsunami simulation disaster simulation process can be seen in Figure 2

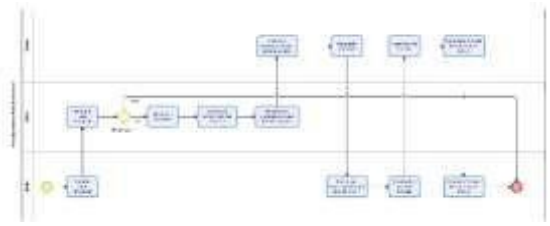


Figure 2 Analysis of The Current System

2.6.3 Proposed System Analysis

With the system to be built, it is hoped that BMKG will be able to socialize tsunami disaster mitigation simulations and be able to help the communities where they live do not hold tsunami disaster simulations. The procedure on the proposed system can be seen in Figure 3

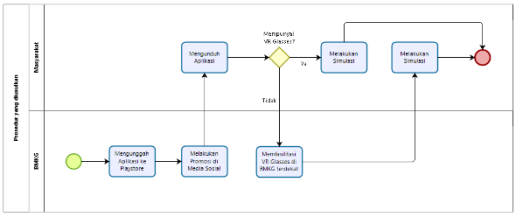


Figure 3 Proposed System Analysis

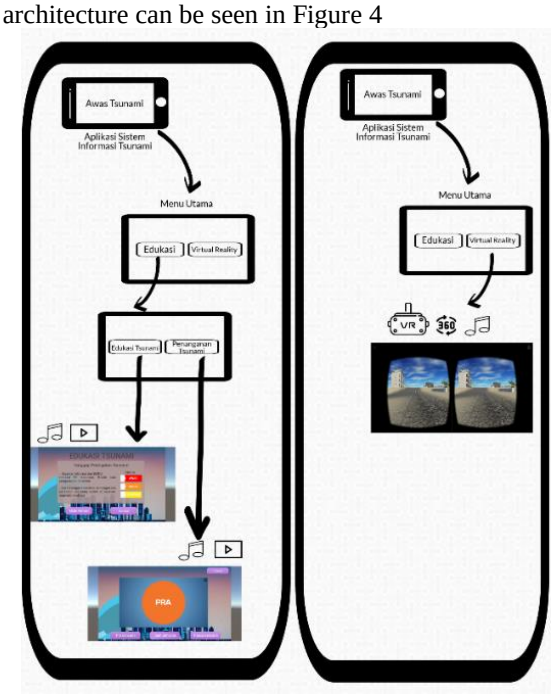
2.6.4 System Concept Analysis

Analysis of the application to be built contains a big picture of the system to be built. The application to be built is named Awas Tsunami. Awas Tsunami will contain education about tsunamis and tsunami disaster simulation and virtual reality. Users can see various information about the tsunami disaster. To use the virtual reality feature, users are required to use virtual reality glasses (cardboard). Tsunami Awas application is static and can be used offline (not connected to the internet). Tsunami Awas application can be used on android-based smartphones.

The concept of virtual reality in the application that was built, contains a tsunami disaster simulation that starts from the siren that sounds as a sign of a tsunami disaster, then evacuation routes to high ground, and the evacuation site in the form of a hill. After the user has made it to the evacuation site, it will automatically exit the virtual reality menu.

2.6.5 System Architecture

The tsunami disaster simulation information media application that will be built is an Interactive Mobile Android based Multimedia application. Users are required to use the VR Headset as a tool for simulating virtual tsunami disasters. The system architecture can be seen in Figure 4



Gambar 4 Arsitektur Sistem

In picture 4 there is a picture of system architecture consisting of players, devices, virtual reality tools. Beware of the tsunami itself using C# programming language. To build this Awas Tsunami application using Unity. Users can use tsunami alert to view various information about tsunamis and also take a virtual tour of tsunami simulations in three dimensions.

1. Tsunami Information

Users can see various information available such as explaining the occurrence of tsunamis and also animations about tsunamis. The information available also includes handling prior to, when it occurred, and after the tsunami. The information presented is intended for users to find out the

responsive steps in dealing with the tsunami disaster.

a. Tsunami Animation

This Tsunami Animation illustrates how the process of the tsunami as a whole, from the time the tsunami was formed until the tsunami destroyed residents' settlements. Figure 5 shows a tsunami animation.

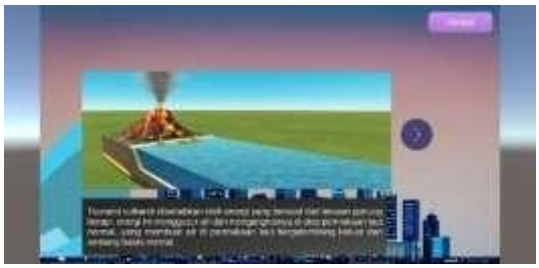


Figure 5 Tsunami Animation

b. Tsunami Pre-disaster Management Animation Tsunamai pre-disaster management animation illustrates how the process or action must be taken before a tsunami disaster occurs. Figure 6 shows an animation of pre tsunami disaster management.

Figure 6 Pre Tsunami Disaster Animation

c. Animation of Handling during Tsunami Disaster Animation of handling during tsunamai disaster illustrates how the process or action must be taken when a tsunami disaster occurs. Figure 7 shows the animation of handling during the tsunami disaster.

Figure 7 During The Tsunami Disaster Animation

d. Animation in Post-Tsunami Disaster Management
Tsunamai post-disaster animation illustrates how the process or action must be taken after the tsunami disaster. Figure 8 shows an animation of post-tsunami disaster management.

Figure 8 Post Tsunami Disaster Animation

1. Virtual Reality Tsunami Disaster

In this virtual reality mode the user can directly feel the condition of a tsunami disaster and the user can interact directly in the virtual reality, such as running by looking downwards, to avoid the tsunami disaster that will occur by following the directions provided. Figure 9 shows virtual reality.

Figure 9 Virtual Reality of Tsunami Disaster

In a tsunami alert application, a smartphone that wants to do a virtual reality tsunami simulation must have a gyroscope feature in it, this feature functions as a direction and rotation determinant for the smartphone. And also an accelerometer is needed to detect and measure vibrations when the user moves the smartphone, similar to a gyroscope but only to determine the direction is not like a gyroscope that has more functions.

2.7 System Planing

2.7.1 Menu Structure

The layout of the menu structure can be seen in Figure 10

Figure 10 Menu Structure

2.8 Implementation

2.8.1 Hardware Implementation

The hardware specifications used to use the system can be seen in Table 1

Tabel 1 Hardware Implementation

No.	Hardware	Specification
1	Processor	Snapdragon 835 2.3 Ghz
2	RAM	6GB
3	Screen Size	6.3”
4	Resolution	2220px X 1080px
5	Storage	500MB

2.8.2 Software Implementation

Software specifications used to use the system can be seen in Table 2

Table 2 Software Implementation

No	Software	Awas Tsunami
1	Operating System	Android 8.0

2.8.3 Implementasi Class

Class Implementation is the implementation of class diagrams that exist on the system. Class implementation can be seen in Table 3

Table 3 Class Implementation

No.	Class Name	Name File Class
1	Home	Kehome.cs
2	Kembali	Kebaliii.cs
3	MasukVR	Mskvr.cs
4	Video	Kevideo.cs
5	Quit	QuitApplication.cs
6	Pengaturan	Kepengaturan.cs

2.8.4 Interface Implementation

The interface implementation can be seen in Figure 15

Figure 15 Interface Implementation

The interface implementation can be seen in Figure 16

Figure 16 Interface Implementation

The interface implementation can be seen in Figure 17

Figure 17 Interface Implementation

2.9 System Testing

2.9.1 Black Box Testing

This method is used to find out whether the software is functioning properly. The scenario that will be done in this application can be seen in Table 4

Table 4 Black Box Testing Scenarios

No.	Component Tested	Testing Scenarios	Type of Test
1	Home	Shows the main page	Black Box
2	Menampilkan animasi	Displays the settings page	Black Box
3	Mengeluarkan suara	Displays the education page	Black Box
4	Masuk rirtual reality	Displays the Virtual Reality page	Black Box
5	Menggerakan virtual reality	Cover what a tsunami is	Black Box
6	Keluar dari virtual reality	Displays the tsunami disaster management page	Black Box

Based on the results of the testing that has been done, it can be concluded that the functionality of the tsunami disaster simulation application has met the functional requirements.

2.9.2 Testing Questionnaire

Testing on a system that is built is important, having a goal to find out about the system being built whether it has achieved the goal. The following can be seen the Likert scale table used in this study can be seen in Table 5

Table 5 Assessment Criteria

Level	Skor
Strongly Agree	5
Agree	4
Enough	3
Disagree	2
Strongly Disagree	1

The following can be seen the questionnaire testing scenario in Table 6

Table 6 Questionnaire Scenarios

No	Purpose	Question
1	Can make it easy for users to get information about tsunami disaster simulations	1. Does the Awas Tsunami application increase my knowledge of tsunamis? 2. Are the mitigation / rescue instructions in this application easy to understand? 3. Does this application provide complete information about tsunamis? 4. Is using the Awas Tsunami app more attractive than other information media? 5. Does this tsunami alert application help you to be more alert to tsunami disasters?
2	Make it easy for BMKG to disseminate tsunami disaster mitigation socialization in areas far from the coast	1. Can the tsunami alert application be said to be efficient in terms of use and outreach compared to direct outreach? 2. Can the tsunami alert application provide complete tsunami disaster simulation information? 3. Does this application help you determine what you should do in the event of a tsunami disaster? 4. Is the tsunami alert application easy to use?

The score limit is based on previous calculations and can be seen in Table 7

Table 7 Attitude Category 1

Category	Score limit
Very positive	$1000 \leq x \leq 1250$
Positive	$750 \leq x \leq 1000$
Negative	$500 \leq x \leq 750$
Very Negative	$250 \leq x \leq 500$

The score limit is based on previous calculations and can be seen in Table 8

Table 8 Attitude Category 2

Category	Batas Skor
Very Positive	$850 \leq x \leq 1000$
Positive	$700 \leq x \leq 850$
Negative	$450 \leq x \leq 700$
Very Negative	$200 \leq x \leq 450$

a. Very Positive Category, which is the area bounded by quartile 3 and the maximum score (quartile 3 ≤ x ≤ maximum score).
b. Positive Category, which is the area bounded by the median and the third quartile (median ≤ x <quartile 3).
c. Negative Category, which is the area bounded by quartile 1 and median (quartile 1 ≤ x <median).
d. Very Negative Category, which is the area bounded by a minimum score and quartile 1 (minimum score ≤ x <quartile 1).

The following can be seen in Table? questionnaire test results 1

Table 9 Questionnaire Testing Results 1

Answer Category	Skor	Answer Frequenc	Total Skor	Categori
Strongly Agree	5	60	300	Positive
Agree	4	129	516	
Enough	3	56	168	
Disagree	2	5	10	
Strongly	1	0	0	

Disagree				
Total		250	994	

The following can be seen in Table? Questionnaire testing results 2

Tabel 10 Questionnaire Testing Results 2

Answer Category	Skor	Answer Frequenc	Total Skor	Category
Strongly Agree	5	44	220	Positif
Agree	4	102	408	
Enough	3	52	156	
Disagree	2	2	4	
Strongly Disagree	1	0	0	
Total	250	788		

Based on the results of the overall test, it can be concluded, that testing the functionality of the tsunami disaster simulation socialization application is in accordance with the needs of users with scores of 994 and 788.

3. CLOSING

3.1 Conclusion

The conclusions of this thesis are as follows:

1. The system can help the people of Bandung in informing about disaster simulation and mitigation from the results of the questionnaire test with a score of 994 which is included in a positive attitude.
2. Facilitate BMKG to be able to socialize the results of tsunami disaster mitigation simulation in areas far from the coast according to the results of the questionnaire test with a score of 788 which is included in a positive attitude.

3.2 Future Works

The suggestions for further development of the system are as follows:

1. The information presented can be even more complete.
2. In the virtual reality feature is made to be more real.
3. Increased interactivity in the application.

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