

Geographical Information System of Disaster Victims Location Using Web-Based and Mobile Application

Puji Winar Cahyo
Department of Informatics
Islamic State
University(UIN) of Sunan
Kalijaga
Yogyakarta, Indonesia
pwcahyo@gmail.com

Naufal Asyhab
Department of Informatics
Islamic State
University(UIN) of Sunan
Kalijaga
Yogyakarta, Indonesia
naufalasyhab@gmail.com

Ahmad Subhan Yazid
Department of Informatics
Islamic State
University(UIN) of Sunan
Kalijaga
Yogyakarta, Indonesia
yazid.anfalah@gmail.com

M. Taufiq Nuruzzaman
Department of Informatics
Islamic State
University(UIN) of Sunan
Kalijaga
Yogyakarta, Indonesia

Abstract— Disasters that have occurred in the city of Yogyakarta, causing no casualties were relatively few. Result of the many victims of the disaster led to the spread of location affected to some areas. Then it takes the system is fast in the submission of data in each affected area. Method of UML (Unified Modeling Language) is used to build this system, the method UML is focused in the development of object-oriented systems, suitable for use in android programming, CodeIgniter PHP framework that accommodates the library Google Map. Mobile apps (android) is used as a client that handles input data disaster victims, Geographic Information Systems (GIS) as a server whose job is to receive and data mapping disaster victims. Coordinator unit rescue can send disaster relief information notice to each member through a GIS that has been communicated to the SMS Gateway (Short Message Service). Geographic Information System of Disaster Victims Location Using Web-Based and Mobile Application built to help control aid disaster victims, especially accuracy in mapping location of the disaster victims, because it uses a GPS (Global Positioning System) to determine the coordinates of disaster victims.

Keywords—GPS; Android; Disaster Victim Location; GIS; Google Maps; UML.

I. INTRODUCTION

Geographical location of each region has an important influence on the potential for natural disasters. As with coastal areas that have the potential for tsunamis, areas that are above the earth's plates that have the potential for earthquakes, as well as the slopes of volcanoes that have the potential for disasters of volcanic eruptions.

No exception to the geographical location of the city of Yogyakarta (Special Region of Yogyakarta) is among the potential - potential disasters. Like the disaster that had occurred before, on May 27, 2006 an earthquake shook Yogyakarta with the epicenter at Bantul. October 27, 2010 the eruption of Mount Merapi destroyed the hamlet of Kinahrejo, Cangkringan hamlet and the hamlet of umbulharjo. With a serious impact, volcanic ash covered almost the entire city of Sleman. Both of these disasters claimed no small number of victims, many people lost their property, residence and family members. Many disaster victims are scattered in several regional points. Victims of natural disasters desperately need various kinds of help. Among them are medical, logistical and psychological help.

For this reason, every agency and humanitarian organization has a major responsibility in providing assistance to victims of natural disasters. The humanitarian organization needs preliminary assessment data to find out information on the condition of the victims of the natural disaster. Each assessment group is divided into several locations for evacuation.

With the map from Google and GPS (Global Positioning System), especially in the Android operating system, it is expected to help provide fast and accurate information, especially knowing the exact location of the evacuation point [1]. So as to facilitate the initial assessment group in providing information to the head office for handling victims of natural disasters.

With this background, to analyze the extent to which the web-based boarding information system in processing boarding information, whether in the form of boarding pictures, complete equipment in boarding, as well as a price list per boarding contract, it is proposed to build a-based boarding house information system web so students and students can find out boarding information in certain areas. To build this system will use the PHP programming language and MySQL database and utilize the Google Maps API to display a map of boarding locations.

II. RESEARCH PURPOSES

The objectives to be achieved in this study are:

1. Simplify the performance of disaster management units, especially the assessment unit.
2. Accelerate the flow of disaster victims data to the center for handling disaster victims.
3. Using GPS (*Global Positioning System*) accurately.

III. RESEARCH METHOD

The steps used for research method used in this research are library studies, identification of system requirements, data

collection, system equipment requirements, and system development methods.

A. Library Studies

Library studies can be interpreted as a step to obtain information from previous research that must be done, regardless of whether a study uses primary data or secondary data. In this case, try to gather information that is relevant to the topic and problem to be studied. This step is carried out to study theories related to and support research topics so that they get an overview of system design and more accurate analysis.

B. System Identification

Identification of system requirements in this research is carried out by identifying the system requirements to implement the algorithm of the system itself and knowing what is needed in making this geographical information system. With this system, users are expected to be more helpful in finding the desired boarding house.

C. System Development Methods

System Development Methods used in this study is referring to the stages in the SDLC standard (System Development Life Cycle) using the model waterfall or Linear Sequential method [2]. The model waterfall in the figure below and approaches systematically and sequentially starting from the level of system requirements, then towards analysis, design, coding, and testing/verification.

1. Analysis, at this stage, an analysis of the system requirements will be made. Both the software needs and user needs. Gather data sources that support the achievement of the final results of the study, compile the time that will be used for research and describe the tools used.
2. Design, Object-oriented programming (OOP) is seen as the best current framework to replace structured methods. With OOP the developers create code blocks called objects. These objects are then used by various applications. And if one day a change occurs, the developers only make changes once and easily pass it on to other objects that are derivatives.
3. Programming, This stage is the stage of system development, that is, designs that have been made before, be it data design and interface design, must be translated into readable machine language. In the development of this system, the PHP programming language, specifically the CodeIgniter framework, is used on the server side and also uses the Google map API as a library for downloading google maps. While on the client side, using the Android programming language includes the use of GPS (Global Positioning System) on Android mobile devices.
4. Testing, at this testing stage, all results of the system that have been built must be known about the performance and performance of the system. This study use testing techniques black-box. testing techniques Black-box focus on the domain of information from software, by carrying out a test case by partitioning the input domain of a program in a



way that provides in-depth testing coverage. trials Black-box try to find errors in several categories.

IV. ANALYSIS AND SYSTEM DESIGN

A. Requirement Analysis

Before stepping into system design, requirement analysis is a procedure that must be fulfilled, because with the requirement analysis, what needs to be identified used to build a system. Then these needs will be implemented in the module design/function of the system itself. These needs are divided into three types, namely information needs (mainly about natural disaster unit for victims), functional requirements, and non-functional requirements.

1. Natural Disaster Unit Information

To be able to perform tasks and activities of each entity, the web-based boarding house information system must be able to provide the required information including:

- Assessment Unit :
 - Arranging planning of assessment activities.
 - Collecting data on victims of natural disasters.
 - Making a mapping of the location of victims of natural disasters, etc.
- Logistics and Equipment Unit :
 - Providing facilities for equipment and services to be used by officers/volunteers from work units that carry out emergency response activities for natural disaster victims.
 - Receiving, administering and distributing aid to disaster victims.
 - Coordinating all logistical assistance and equipment from all institutions, assemblies, organizations / relevant agencies, etc.
- Medical Unit :
 - Preparing medical activity plan.
 - Contacting and inventorying the hospital in the closest area that will be involved in response to handling an emergency natural disaster.
 - Placing the medical team the hospital location service points that determined, etc.
- SAR Unit:
 - Make a SAR operation plan.
 - Lead search activities, rescue and evacuate disaster victims.
 - Detect and map hazard areas and are prone to secondary disasters.
 - Control, monitor and evaluate the activities of the team, etc.

- Psychological Unit:
 - Make plans for psychosocial assistance activities.
 - Review and analyze psychological and social problems and learn about the condition and character of the community to be assisted.
 - Placing officer / volunteer psychosocial team at the point of location assistance predetermined and agreed upon the head of emergency response, etc.

2. Functional Requirements

Functional requirements are needs that generally must be owned by the system to run a business processing and managing data. These needs include:

1. General Needs:
 - a. Users can find out the location of the map of disaster victims.
 - b. Users can find information on disaster victims data.
 - c. Users can log into GIS (Geographic Information System).
2. Need for Coordinator of Logistics and Equipment Unit, Medical Unit Coordinator, SAR Unit Coordinator, Coordinator of Psychosocial Unit:
 - a. Coordinator can determines the members of their respective units who want to deployed to help victims of the disaster.
 - b. Coordinator of this unit can determine needs and equipment information used by each unit member.
 - c. Coordinator of this unit can provide victims addresses for the deployed team forces, except for Assessment Unit Coordinator
 - d. Coordinator can process the data of each unit member, including being able to *insert*, *update* or *delete* members of the unit.
3. Need for the Unit Assessment Coordinato:
 - a. Unit coordinator can insert, update or delete assessment data from his members.
 - b. Unit coordinator process the data of each unit member, including being able to insert, update or delete unit members.
4. Needs for members of the Assessment Unit:
 - a. Members can use android mobile application specifically used to help assessment unit works.
 - b. Can send victims of natural disasters assessment data to the disaster relief victims center through the application *mobile* android.
5. Need for members of the Logistics and Equipment Unit, Medical Units, SAR Units and Psychosocial Units:



- a. Can receive help information notifications from the unit coordinator via SMS (Short Message Service) [3].
- b. Can receive the address of the location of the victims of natural disasters that will be assisted by SMS.

3. Non-functional Requirements

A variety of non-functional requirements of the present system are as follows:

1. Ease of Use

Users are not too difficult in using this system, because this system is made user-friendly and has also been adapted to the needs of the user.

2. Reliability of the System

Supporting a GPS device (Global Positioning System) that allows the coordinates of the locations of disaster victims to be more accurate. Use of SMS Gateway that facilitates the submission of data on assessment victims of natural disasters.

3. Ease of Implementation

On the server side, this system was developed with the PHP programming language and MySQL database to support the implementation of multiplatform Linux and Windows. On the client side, the use of applications mobile on the Android OS is very supportive in doubling the application mobile to be used by members of the unit assessment.

4. System Design

To understand and implement the results of the analysis obtained, we need a system design for processes, databases and interfaces.

• Use Case Diagram

In this system described various use cases that relate to what the system provides for actors so that the actor receives feedback / expected results from the GIS location of the victims of this disaster.

a. System User

This use case diagram explains who uses the SIG for Web-Based Disaster Victims and Mobile Application Locations, unit-members assessment relate directly to mobile application assessment because the unit assessment members use a mobile application assessment specifically designed to send results data assessment of disaster victims towards the SMS gateway server. Fig 1 shows it.

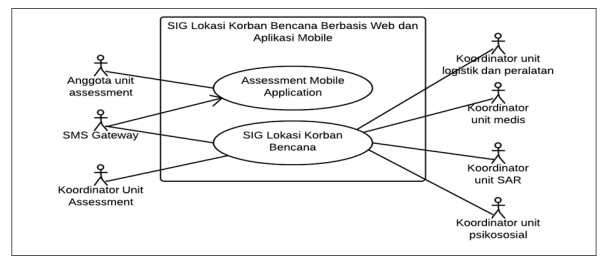


Figure 1. System User Usecase Diagram

b. Mobile Application Assessment

The functionality provided by the application for officers / members of the unit assessment can be seen in the detailed use case assessment on Fig 2.

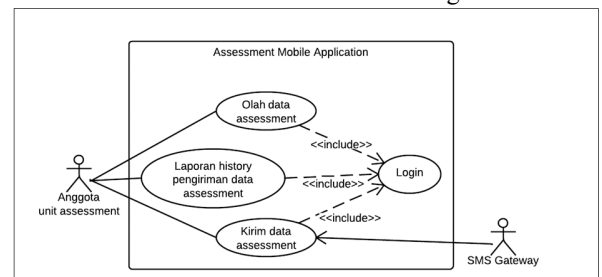


Figure 2. Mobile Application Assessment Usecase Diagram

c. GIS of Disaster Victims Location

Meanwhile, GIS also has its own functional, GIS that provides all the needs needed by actors to the system. All needs provided by the system, as described in the diagram on Fig 3.

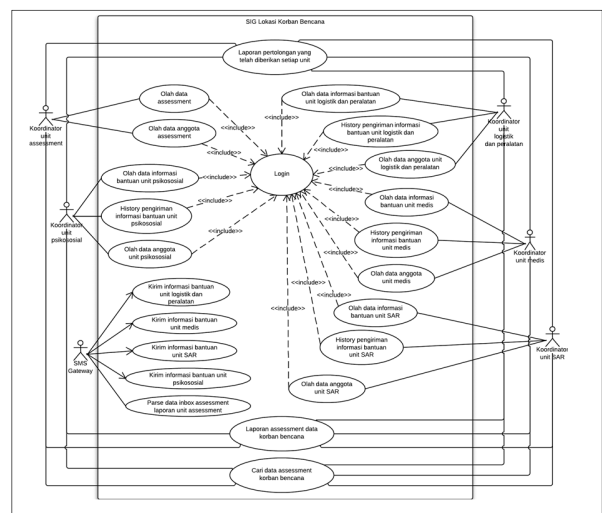


Figure 3. GIS Usecase Diagram

• Activity Diagram

After obtaining use case documentation, then the model of diagram activity can be described according to the results of the use case previous. Diagram activity is the actual business process flow, how the data in each activity can continue.



a. Mobile Application Assessment Activity Diagram

1. Login activity diagram

Unit assessment members are required to login first if the authentication username and password are correct, then the unit assessment members were taken to the main page of the mobile application assessment. It can be seen in Fig 4.

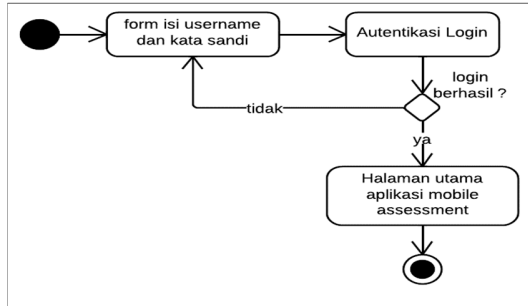


Figure 4. Mobile Application Assessment login activity diagram

2. Data assessment processing, data assessment delivery and data assessment sending report history activity diagram

The three activity diagrams can be summarized into a single activity diagram. Because the three activity processes are sequential and make it possible to become one in the diagrammatic activity diagram. Fig 5 shows it.

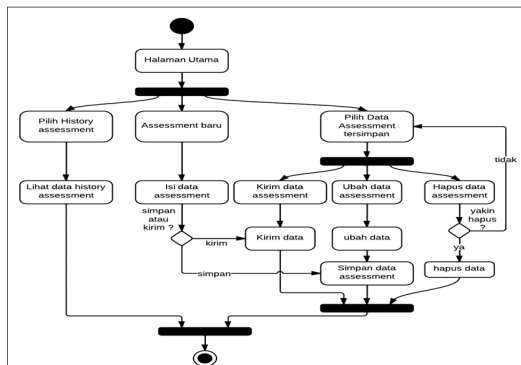


Figure 5. Data assessment processing, data assessment delivery and data assessment sending report history activity diagram

b. GIS of disaster victim activity diagram

1. Login activity diagram

Describes the activity logins diagram in general, that is, the user fills in a username and password which is then checked authentication login, if username and password are correct then the user will be taken to the GIS admin page in accordance with their respective access rights admin. Fig 6 shows it.

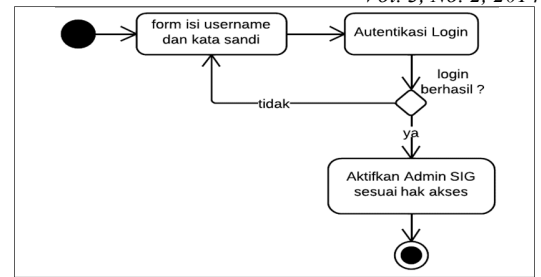


Figure 6. Login activity diagram

2. Aid report that has been given each unit, report assessment of disaster victims data and search data assessment for disaster victims

For activity diagrams outside the login process on GIS, they can be summarized into a single activity diagram. Fig 7 shows it.

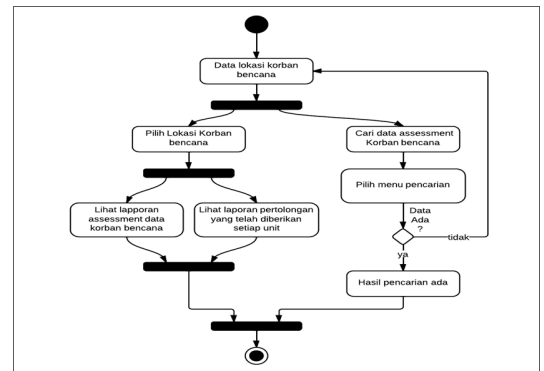


Figure 7. Aid report that has been given each unit, report assessment of disaster victims data and search data assessment for disaster victims activity diagram

3. Data Assessment activity diagram

Coordinator of assessment units has special access rights to add the disaster victims assessment data or to make a change and delete assessment data the assessment unit of an individual assessment. Fig 8 shows it.

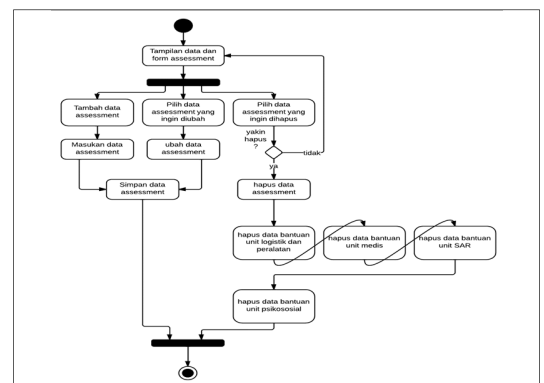


Figure 8. Data assessment activity diagram



4. Data processing of assessment unit members

Assessment unit coordinator can perform some functions on the data unit assessment members including add member units, change unit member data or deletion of assessment unit members data. Fig 9 shows it.

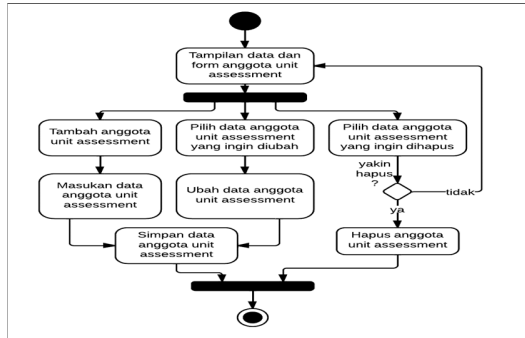


Figure 9. Data processing of assessment unit

5. Help information and deployed psychosocial unit data processing

This activity diagram of help information and deployed psychological unit data processing can be summarized into one activity diagram (Fig 10).

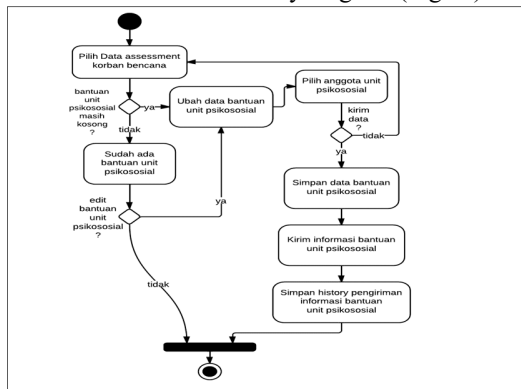


Figure 10. Help information and deployed psychological unit data processing activity diagram

6. History of psychosocial unit information delivery assistance

Psychosocial unit coordinator can see information data assistance sent previously. Coordinator also has a special function, which is to be able to delete data history shipping (Fig 11).

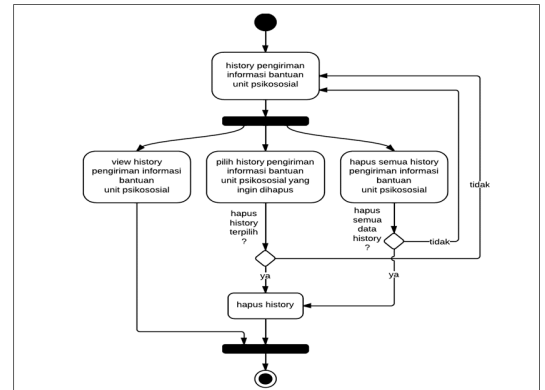


Figure 11. History of psychosocial unit information delivery assistance activity diagram

7. Psychosocial unit member data activity diagram

Coordinator can perform several functions of psychosocial unit member data processing including adding unit members, changing unit member data or deleting psychosocial unit member data (Fig 12).

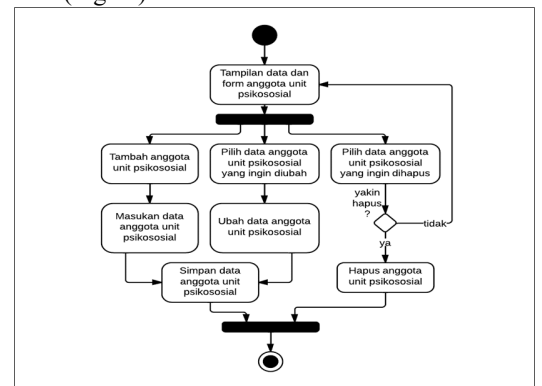


Figure 12. Psychosocial unit member data activity diagram

• Class Diagram

Class diagrams are a way of describing what classes are used to build a system, classes have attributes and methods that are used for the operation of events or events that will be carried out by a class to produce the expected output or return value.

a. GIS Class diagram

Because it uses framework CodeIgniter, the class diagram of GIS refers to the models applied in the system. Method unit coordinator takes care of all unit operations, including sending assistance information and adding members (Fig 13).



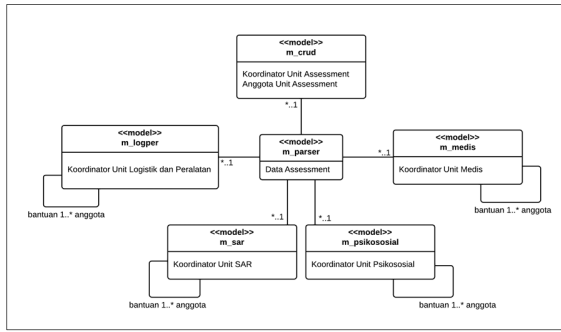


Figure 13. GIS class diagram

b. Mobile assessment application Class diagram

In designing the *class mobile application assessment diagram* using class packages that are used to hold several classes are also defined (Fig 14).

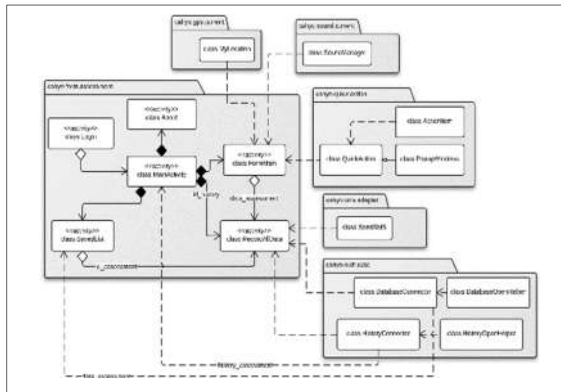


Figure 14. Mobile assessment application class diagram

• User-interface Design

User-interface design for this GIS of disaster victims divided to 2, such as client interface design, applied in-app interface mobile assessment. The other one is on the server side which applied to GIS of disaster victims location.

a. Mobile assessment application UI design

Mobile assessment application UI design of this GIS can be seen on pictures below.

1. Login

When the mobile assessment application is carried out, when the splash screen is now complete /finish then it will proceed to the login page (Fig 15-16).

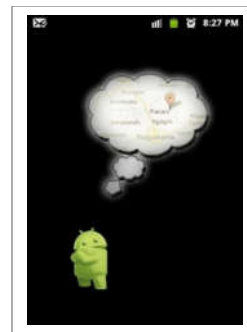


Figure 15. Splash Screen

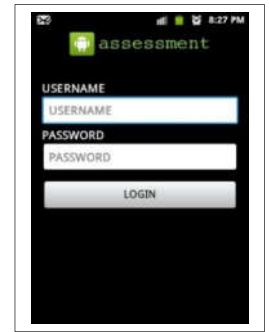


Figure 16. Login

2. Main Menu

There is 3 option menu and 1 menu button, such as saved list, about and exit. Menu saved list used for the data assessment that has been stored in the mobile application, while about menu to view information about application and exit is for exit the application (Fig 17).



Figure 17. Main Menu

3. Assessment Form

Form assessment will appear if there is click event on the button assessment new, page form grouped according to the unity of the forms (Fig 18).

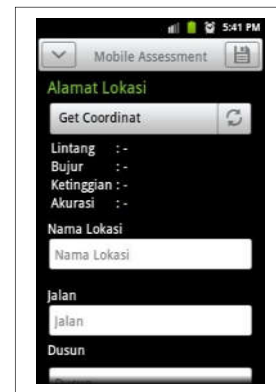


Figure 18. Assessment Form



4. Record all data

Interface record all data will appear when there is an event on click on the button record all data in the assessment form (Fig 19).



Figure 19. Assessment Form

5. Record Saved List

In this interface design, saved data can be changed and then sent to GIS, deleted or changed /edited and stored back into the mobile app (Fig 20).

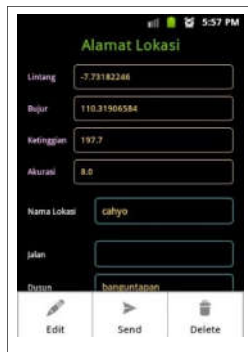


Figure 20. Record Saved List

6. History Saved

Interface of saved history will appear when event click on listview history that is inside the home, saved history is the history of data stored on the data that you have sent before (Fig 21).



Figure 21. History Saved

7. Popup Menu

Popup Menu navigation interface is used as a form of assessment that will be used for the transfer activity of from 1 form to another form (Fig 22).



Figure 22. Popup Menu

b. GIS UI design

1. GIS Main Page

Used to process all data relating to the assessment, members of the unit of data assessment and data assessment disaster victims (Fig 23).

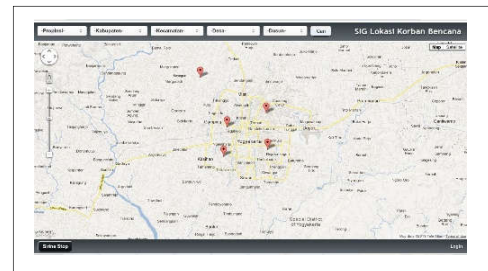


Figure 23. GIS Main Page

2. Login Page

In the login page there are three fields input, including username, password and captcha, captcha is used to avoid phishing brute force random login username and password (Fig 24).



Figure 24. GIS Login Page



3. Disaster Relief Unit Coordinator Page
a. Assessment Unit Coordinator Page

Used to process all data relating to the assessment, members of the unit of data assessment and data assessment disaster victims (Fig 25).



Figure 25. Assessment Unit Coordinator Page

b. Disaster Relief Unit Coordinator Page

Among them are logistics and equipment units, medical units, SAR units and psychosocial units. Can be grouped into an interface design. For a pilot it can be illustrated by the interface of the SAR unit coordinator (Fig 26).

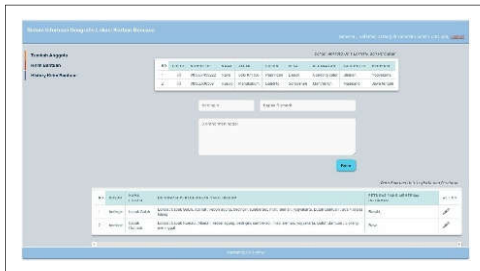


Figure 26. Disaster Relief Unit Coordinator Page

V. IMPLEMENTATIONS AND TESTING

A. System Implementations

Implementation is the stage of implementing the system in carrying out its actual functions. So that it will be obtained as a system that is made with the actual conditions in the field, or successful functions - functions that are made in carrying out system performance. For this reason, several implementations of the mobile application and GIS assessment of the location of disaster victims were carried out, as follows :

1. Implementation of Database

Database used in SIG is MySQL with the PHPMyAdmin interface. In this GIS use 28 tables with the names database database "and add 9 default tables from Gammu SMS Gateway [4].

2. Implementation of SMS inbox handling triggers more than 160 characters

In the inbox table there is a trigger with the name inbox_timestamp, which is used to handle SMS when there

is an SMS more than 160 characters, so that the sms can be received and reassembled into a table called tempinbox.

3. Php script implementation for sending SMS more than 160 characters

Default sending of an SMS is 159 characters in a safe position. However, with this script, the SMS text can be broken down first and then sent in turns. So that if the SMS is received on a mobile device, the SMS can become one return [5,6]

4. Implementation of PHP Script SMS Text Breaker

To obtain assessment data, the server performs a string break against the text obtained from the Gammu SMS Gateway inbox. Each string is saved into an array. And then it is parsed towards the SMS database used in GIS.

B. Testing

1. Assessment Mobile Application Testing

In this test, members of the assessment unit were deployed to the location of the disaster victims for assessment of disaster victims data. The assessment unit member carries a mobile device, which contains the mobile application assessment application and performs the following process.

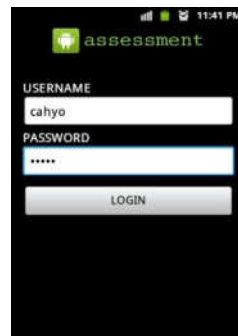


Figure 27. Login Case

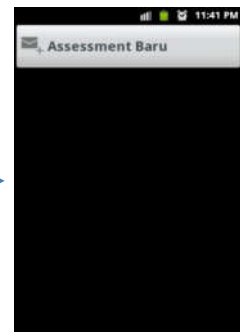


Figure 28. New Assessment Case



Figure 30. Record Data Case



Figure 29. Form Filling Case





Figure 31. Saved Data List Case



Figure 32. Expand Data Case

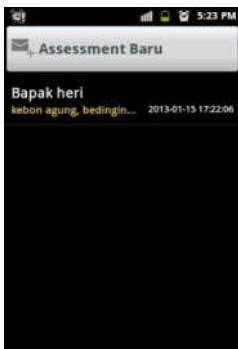


Figure 33. History List



Figure 34. History Expand

Up to this stage, data from the assessment officer has been received at the disaster victim relief center server. The next step is operating GIS to process the data received from the officer of the assessment. Fig 27-34 show the process.

2. GIS Testing

Forward of testing mobile applications assessment, which is where the clerk assessment has sent assessment data disaster victims to a central server help disaster victims, then the data is received SIG, the data will appear and processed into the following (Fig 35).

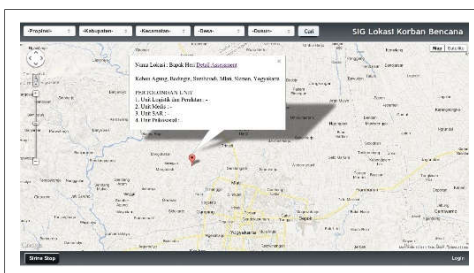


Figure 35. GIS Main Page

It can be seen that there are mapping locations of victims of the disaster, and if the detail Assessment link is clicked, the user will be taken to the assessment result form, the form has 3 pages containing all data from the victim's assessment disaster, detail with the time the data is received and who is the officer who sent the assessment data (Fig 36).



Figure 36. Assessment Detail Form

Up to this stage, the task of the coordinating unit of the logistics unit and equipment, medical unit, psychosocial unit and SAR unit is to determine the decision for information assistance to be sent to each unit member.

If the logistics and equipment unit coordinator succeeds in entering the page of the coordinator of the logistics and equipment unit, then the location and assistance of the logistics and equipment unit will be seen. At this stage the logistics and equipment unit coordinator has not sent assistance to its members, so the assistance data and the officers sent the assistance information are still empty (Fig 37).

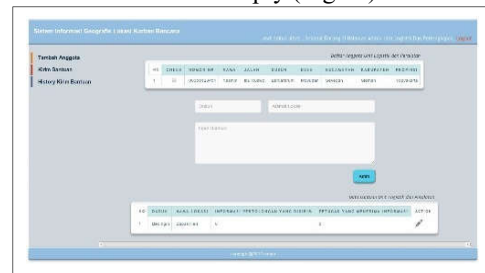


Figure 37. Logistic and Equipment Unit Coordinator Page

Have seen the data on the results of the assessment of disaster victims at that location. Then the logistics unit coordinator and equipment understand the assistance that must be given, the logistics unit coordinator and equipment decide on the assistance that will be sent to the members of the unit (Fig 38).



Figure 38. Logistic and Equipment Unit Help Deployment

If the assistance information data has been sent, then the help information column that is sent and the officer who receives the information in the logistical unit and equipment assistance data table that was originally replaced is information about the assistance sent and the officer who received the information. It can be seen in Fig 39.



Table 1. System Tester Respondent List

No.	Name	Status
1.	Lukman Chakim	IT Operator of BPBD DIY
2.	Sutarno	Member of KSR PMI Unit VII UIN SuKa
3.	M.Arif. Nanang Kosim	Member of KSR PMI Unit VII UIN SuKa
4.	Muh Galang A.S.	Member of KSR PMI Unit VII UIN SuKa
5.	Hasan Basri	Member of KSR PMI Unit VII UIN SuKa
6.	Septian Baskoro A.	Civilian
7.	Abdul Haris	Civilian
8.	Andi Zainul A.	Civilian
9.	Ghurfan Yusuf A.	Civilian
10.	A. M. Afif	Civilian

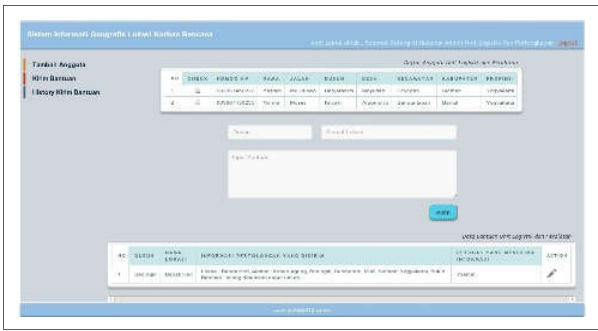


Figure 39. Logistic and Equipment Unit Help Deployment Result

All information assistance sent by the coordinator of the logistics unit and equipment will be received by members of the selected logistics unit and equipment, members of the logistics unit and equipment will only perform the performance according to the assistance information sent by the unit coordinator logistics and equipment. For SMS there is help information entered on Yasmin's cellphone (Fig 40).



Figure 40. Logistic and Equipment Unit help deployment information message (SMS)

Until this point, the sending of help information has been sent successfully. If the psychosocial unit coordinator, the medical unit and SAR unit will send assistance to its members. Then the steps that must be taken are the same as those of the logistics and equipment unit coordinator.

VI. CONCLUSIONS

The testing of this system involved 10 respondents, 5 people from the members of the disaster relief unit and 5 other people from the general public who understood information technology. Testing this system is focused on system functionality and how the system works (Table I).

Some inputs can be drawn from the results of system testing by members of the disaster relief unit. The application is developed not only on Android, but can be used in the Java blackberry, iPhone or other operating systems, so that users are facilitated in implementation.

The web-based disaster victim location system and this mobile application can be applied by conducting regular training and also given internet support and operational costs.

Some inputs can be deduced from the results of testing the system by the general public who understand information technology is the addition of mobile browser features and important numbers. In terms of interfaces made to be more attractive and minimize the filling form.

The results of the system testing on members of the disaster relief unit have been calculated, and the percentage of 90% of members of the disaster relief unit agrees with the system according to their needs and can help aid disaster victims.

In contrast to the results of the functionality / usefulness of the system to assist in disaster relief, 70% of members of the disaster relief unit feel constrained and troubled in implementing the system, because the system requires several technologies that disaster relief units must procure, so the system can run properly.

While the results of the system test on the general public who understand information technology are 100% of the general public agreeing on the usefulness of the system. 50% of the general public understands, there must be a bit of hassle and obstacles in implementation.

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AUTHORS PROFILE

- Puji Winar Cahyo is an bachelor alumny of Informatics Department of Islamic State University of Sunan Kalijaga. He is from Sleman, Yogyakarta, Indonesia. He is 29 years old right now.
- Naufal Asyhab is a bachelor student of Informatics Department of Islamic State University of Sunan Kalijaga Yogyakarta. He is from Ngawi, East Java, Indonesia. Currently active in community (Gamelan – Gamedev Yogyakarta) and as indie Game Developer.
- M. Taufiq Nuruzzaman is currently a faculty member at the Department of Informatics, Sunan Kalijaga Islamic State University.

