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DESIGN AND DEVELOPMENT OF TETOS APPLICATION FOR LOCATION DETECTION IN SUPPORTING DISASTER VICTIM SEARCHING BASED ON GLOBAL POSITIONING SYSTEM (GPS)

Muhammad Lulu Latif Usman[1]
Indorama Engineering Polytechnic
Purwakarta, West Java, Indonesia 41152
zarkuz.mail@gmail.com[1]

Asep Adang Supriyadi[2], Aris Poniman[3]
Indonesia Defense University
IPSC Sentul, Bogor, West Java, Indonesia 16810
aadangsupriyadi@idu.ac.id[2], arispk2007@gmail.com[3]

Muhammad Nugraha[4], Nopi Rahmawati[5]
Indorama Engineering Polytechnic
Purwakarta, West Java, Indonesia 41152
nugraha@pei.ac.id[4], nopiraa01@gmail.com[5]

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Abstract

Indonesia is a country with a high level of disasters where during 2005-2015 there were 11,648 hydrometeorological disasters and 3810 geological disasters. In terms of technology, Indonesia is using mobile devices with high growth according to data from the Ministry of Communication and Information. One of the ways to increase the use of mobile devices in assisting disaster management in Indonesia can be developed in the location-based discovery of disaster victims. The location in a mobile device uses a Global Positioning System (GPS) where the existing data is in the form of Latitude and Longitude data. The aim of this research is that the application is expected to assist in the discovery of disaster victims based on the last GPS location. This study focuses on developing a disaster victim search application based on the Android operating system. Development uses the Agile Model by using Black-box Testing and White-Box Testing techniques, where the type of testing uses Unit Testing, Integration Testing, and Acceptance Testing with qualitative data. The results of the research obtained an application in the form of a prototype where there are several corrective inputs obtained from Acceptance Testing. This study is then expected that the application can be applied in disaster management systems in Indonesia which of course can be supported by binding rules so that the data obtained can be utilized optimally.

INTRODUCTION

Indonesia is a country with high disaster risk with a world risk index of 10.24% (United Nations University, 2016). The biggest factor is the high risk of disaster because Indonesia is located on 3 Tectonic Plates (Eurasian Plate, Pacific Plate, and Pacific Plate) and the 'Ring Of Fire' where 90% of earthquakes occur (James, 2008). In a study, it was found that most disasters occurred due to hydrometeorological and geological disasters (Djalante et al., 2017) where during 2005-2015 11,648 hydrometeorological disasters and 3810 geological disasters occurred in Indonesia (National Disaster Management Agency, 2016). Tsunamis that have occurred in Indonesia from 1600-2012 have occurred as many as 172 incidents where 90% occurred due to tectonic earthquakes, 9% volcanic activity, and 1% landslides (National Disaster Management Agency, 2012). The large earthquake that occurred on December 26, 2004, in the Indian Ocean with an Mw Magnitude reaching 9.1-9.3 (Ammon et al., 2005; Park et al., 2005; Stein & Okal, 2005) became a point of transformational change from emergency management to emergency management. risk reduction and from genuine response to the disaster to comprehensive management of mitigation, response, recovery, and reconstruction (Djalante et al., 2017)

From the technological side, Indonesia is one of the countries where the use of technology, especially cellular devices, can be considered high. Utilization of mobile devices (non-smartphone) according to the Ministry of Information and Communication (Ministry of Communication and Information, 2014; 2015; 2016; 2017) in Indonesia in 2013 as much as 83.7%, 2014 as much as 83.2%, 2015 as much as 84.3%, 2016 as many as 84, 4%, 2017 as much as 53.85%. Cellphone users (non-smartphones) have increased from 2014-2016, but there has been a significant decline from 2016 to 2017 where cellular phone users fell 30.55%. This is due to the presence of smartphone-based cellular users with a percentage in 2017 of 66.31% (Ministry of Communication and Information, 2017). The time intensity required for the Indonesian people to operate a smartphone is categorized as high (Gifary, 2015).

The high growth in the use of mobile devices and high operating incentives can be utilized in disaster management in Indonesia. The high number of disasters in Indonesia will also have an impact on the high risk of victims from the disaster itself. By taking advantage of the high utilization and the intensity of the use of mobile devices, it is hoped that it will be able to detect the last location of the victim. Facilities that can be used in cell-based location search are GPS where the cellular GPS data can be transmitted in the form of Latitude and Longitude. In the research carried out, it is expected to be able to produce a prototype application that is expected to be able to assist in the search for disaster victims using GPS technology on mobile devices. This study uses a qualitative method where the development model uses the Agile model with testing using Unit Testing, Integration Testing, and Acceptance Testing.

METHODS

Several studies have been used as review literature, including research by Simon (2019). Simon (2019) aims to find factors that affect the amount of activity space for homeless people, both male, and female. The monitoring was carried out using a combination of the Global Positioning System (GPS) situation from Tunisia for one week and using the interview method. This study uses Standard Deviation Ellipse or SDE data, Minimum Convex Polygon or MCP, and Daily Path Area or DPA. The difference in research is in the function or implementation itself where the research carried out is focused on mitigation management while this research is based on the homeless activity space. Besides, this research is based on the calculation of

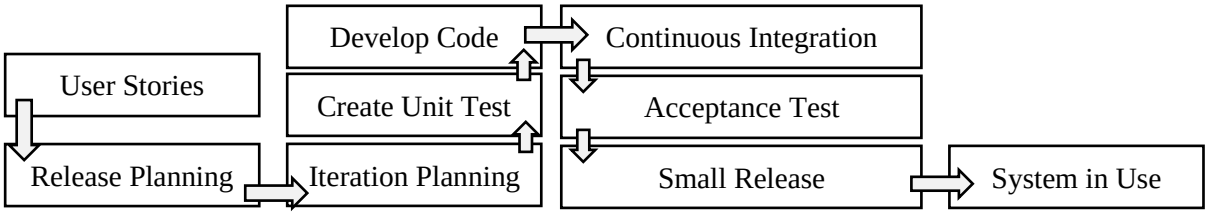

Figure 1. The Agile Model Steps
Source: (Huo et al., 2004)

the movement of the homeless, while the research carried out is oriented towards application development. To develop a system that can provide notification to ambulances. The data given is information about the accident in the form of GPS and Global System for Mobile Communications (GSM) data which is the location of the accident which is then stored on a server database. The difference in the research carried out is in the function wherein this study focuses on traffic accidents while the research carried out is on disaster mitigation. Besides, this research uses desktop-based applications, while this research, uses mobile-based applications which are more flexible and have high mobility.

In this study, the application was developed with an agile model where at the development stage: User Stories, Release Planning, Develop Code, Create Unit Test, Iteration Planning, Continous Integration, Acceptance Test, Small Release, and System In Use (Huo et al., 2004). For more details, the Agile model steps can be seen in Figure 1.

The test used to test the feasibility of an application uses the Black-Box Testing and White-Box Testing techniques. Black-Box Testing is a functionality test where testing is based on the results of program input and execution. White-Box Testing is a test based on written source code information (Liu & Kuan Tan, 2009). The types of testing carried out in the study, Unit Testing, Integration Testing, and Acceptance Testing (Jorgensen, 2018). Unit Testing is done using the White-Box technique by reviewing the source code. Integration Testing is done using the Black-Box Testing and White-Box Testing techniques by reviewing data integration online both in source code and in the results of the user interface. Unit Testing and Integration Testing are carried out independently by researchers.

Acceptance Testing is done by testing with users using the Black-Box Testing technique. Acceptance Testing is carried out by conducting interviews with purposive sampling or subjectively selected sources based on research information needs (Tongco, 2007; Guarte & Barrios, 2006). The purposive sampling method used is expert sampling where the resource person is an expert in a certain field (Etikan, 2016) wherein this case are experts in the field of disaster in Indonesia. The resource person is a member of the National Search and Relief Agency (Center for Data and Information Division) and the National Disaster Management Agency (Center for Data, Information, and Public Relations Division). The question instrument refers to ISO 9126 (2000) by taking the points of mobile application development (Zahra et al., 2013), including extensibility, adaptability, efficiency, usability, portability, security, data integrity, and suitability. For data analysis, the model developed by Huberman and Miles (Miles & Huberman, 1994; Huberman & Miles, 2012) consists of data reduction, display data, conclusion drawing/verification.

RESULT AND DISCUSSION

Design Application

The application created is an application based on the Android operating system with development using the Kotlin language. The development uses Android Studio as software that is supported by Google as the Android operating system license holder. The application has been developed into two applications where the first application is used by users or in this case study is the public and the second application is used by a helper where in this case study is a disaster management institution both governmental and non-governmental institutions (independent). For more details, the design application can be seen in Figure 2 and Figure 3.

Implementation

User application design is used for prototypes, in the initial steps of application login, if registered in the application, the user can log in, but if not registered, the user must register by entering the Single Identity Number or *Nomor Induk Kependudukan* (NIK), Name, Address, and Email. After logging in, the application will ask for permission to access the GPS service if it has not been granted access rights to the GPS service. The application will update the location data on the Application Programming Interface (API) server every 5 seconds by sending Latitude and Longitude data to Firebase. For more details, the prototype user interface can be seen in Figure 4-7.

The design of the helper application used for the prototype, in the initial step is the application login, but there is no registration feature because it is assumed that the user for the helper has been specifically registered. After logging in to the application, a list of registered user names will appear which can then be clicked. When clicked on the user the application will display the location that was last updated on the user application into google maps that can be read by the helper application. Applications are developed using Android Studio tools as the official Integrated Development Environment (IDE) for android applications. In addition to using Android Studio as a development tool, JavaScript Object Notation (JSON)-based database problems are used by using the Firebase online server. The data stored in firebase

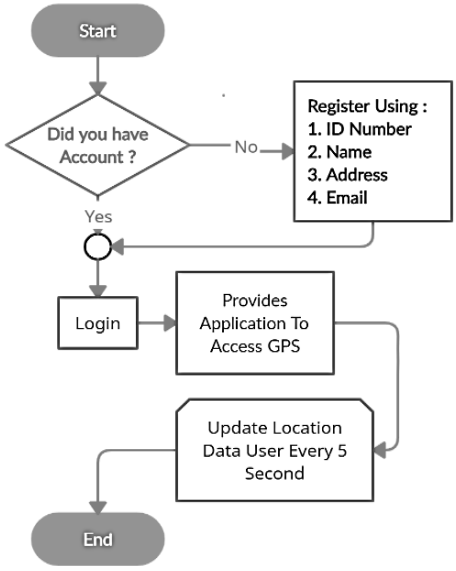

Figure 2. User Application Flowchart
Source: Proceed by Authors, 2021

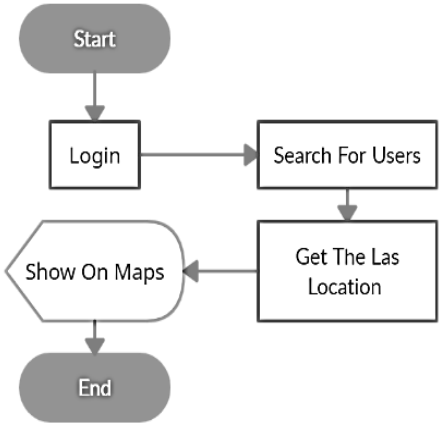

Figure 3. Helper Application Flowchart
Source: Proceed by Authors, 2021

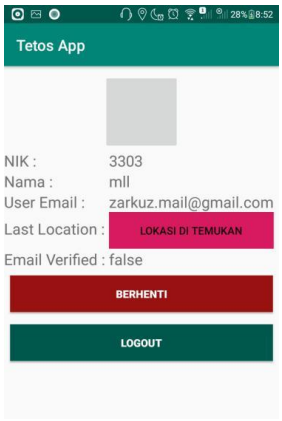

Figure 4. User Application
Source: Proceed Author, 2021

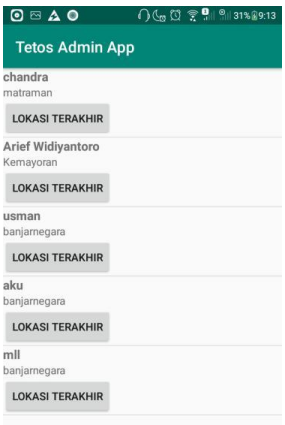

Figure 6. Helper Application- List User
Source: Proceed Author, 2021

Figure 5. Helper Application-Detail User
Source: Proceed Author, 2021

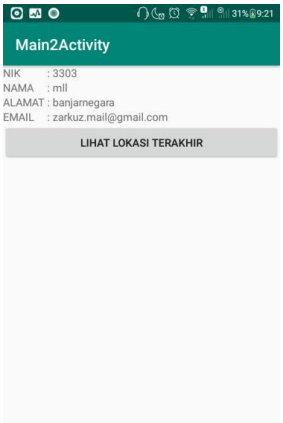

Figure 7. Helper Application–Last Location View
Source: Proceed Author, 2021

consists of NIK, Name, Address, Email, Time, Latitude, and Longitude. NIK, Name, Address, and Email data are stored on Firebase when the user registers with the application. Time, Latitude, and Longitude data stored in Firebase will be stored in Firebase when the user clicks the start button which then the application will automatically send the data to Firebase. For application demos, there are still demo applications where there are still start and end buttons to authorize the examiner regarding location data. Latitude and Longitude data on Firebase can then be accessed and then displayed in the form of a map where the application uses the Google Maps API as a data viewer for Latitude and Longitude data for easy reading.

Testing

The application made is a prototype product that will be carried out by Unit Testing, Integration Testing, and Acceptance Testing to find out whether the application concept developed can solve problems related to the search for disaster victims in Indonesia or not. Application implementation is developed by performing Unit Testing and Integration Testing. Unit Testing is carried out until all source code does not have a red indicator (error) on the Android Studio tools. Integration Testing is carried out until all the source code for data retrieval on Firebase does not have a red indicator (error) on the Android Studio tools and the data in Firebase can be displayed in the Android application. The Acceptance Testing obtained has the following results.

Extensibility

Extensibility, when tested by experts, found errors during the application installation. This problem appears on the Xiaomi note 8 brands, but on other devices, with the same brand, the installation can be done properly. In extensibility testing, it is recommended that the application is in the form of .apk so that it can be uploaded to the google play store developer which is free. The results of the test concluded that extensibility can be accepted by experts even though it cannot be installed on one device, but it is indicated because there is permission from the device which is indeed interfering with the application.

Adaptability

Adaptability when tested by experts found that the application has adapted to changes that occur in the system. Changes that are tested on the user's location movement,

where each user movement will send a location change in the form of latitude and longitude coordinates every 5 seconds. These changes can then be seen from the admin application and regular applications via user accounts. The results of the adaptability test can be accepted by the examiner where the data changes can be accessed by the user and the admin.

Efficiency

Efficiency when tested by experts, it is found that the application that has been made is efficient. In finding victims using latitude and longitude coordinates, it is efficient in finding missing victims. The coordinates are then displayed in the form of a map using a digital map from google, namely the google map. However, some things need to be considered how inaccessible the internet is. The test results can be concluded that the application can be said to be efficient in helping search for victims where the internet condition factor is ignored because it is outside the predetermined problem boundaries.

Usability

Usability when tested by experts found improvements in appearance, where the display is still considered not optimal in making it easier for users. For a display that needs to be added, it is recommended to add an icon in the textbox so that users understand the function more easily. The icon used is following the contents of the textbox content itself where the icon used is a general icon that is usually used by applications in describing a certain part. Besides, it is also recommended to add a user's photo to the user's profile page to validate the user. The results of the test can be concluded that the display still needs improvement to make it easier for users to understand the functions of the application.

Portability

Portability when tested by experts can function where the data opened is following the registered data. The data that has been registered will then be stored on the Firebase server then the data will be displayed by the device. From this sequence, the data displayed is following the registered data stored on the Firebase server. The results of the test can be concluded that portability is acceptable.

Security

Security when tested by experts, data security can be said to be safe because it uses a login system. However, there are still some inputs, including the required login option using social media. Social media is considered more valid than registering using only email. Social media will also make it easier for users to register. The social media in question can be in the form of Twitter, Facebook, or Gmail. In addition to using social media for the login process, it is hoped that you can use email validation where users cannot log in before being validated using email. The results of the test are obtained for the level of security that can be categorized as safe but still have to add a login option to make it easier for users to register.

Data Integrity

Data integrity when tested by experts found that the integration was using Google Map and Firebase. Google map is integrated to display latitude and longitude coordinates in the form of a map user interface. Firebase is used to store user data for shared access. However, the integration is still getting input because the validation via email is not running properly on the device. Validation on the link sent in the email cannot change the status from not yet valid to valid. The results of the test concluded that data integration can be done on Google Map and Firebase, but integration with an email to validate still needs to be improved.

Suitability

Suitability when tested by experts was obtained from the side of the discovery

that the victim was able to walk and it was easy to understand the last location using the google map. To make it easier for users, it can also be added that the map display variant can be changed as in the google map. In addition to the addition of input for the application, other functions can be added besides sending other locations, there are also other functions such as chat or social buttons. This is because if the application to the user can only send coordinates, then the user's needs are not very important, so other functions are needed to increase the level of importance from the user's side. The results of the test concluded that the suitability for the user was following the application's purpose, but in terms of importance, it was still lacking because it could only transmit latitude and longitude coordinate data.

Results should be clear and concise. Discussion should explore the significance of the results of the work, not repeat them. Avoid extensive citations and discussion of published literature.

CONCLUSIONS, RECOMMENDATION, AND LIMITATION

The results of the truth interview show that the application has been declared appropriate but with some input. These inputs are in the form of additional features for the application, improvements to the user interface, or publication methods for application trials. These inputs can then be used as material in conducting further research and developing related applications. Implementation can be done by developing applications through official government agencies, in this case, National Disaster Management Agency, and then it can be supported by the government by making supporting regulations and outreach to the public.

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