Disaster management system on mobile environment

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Abstract. Disaster Information Management System (DIMAS) is used to reduce risk caused by disaster by manage information about the affected area by a disaster. It also manages aids, volunteers, and refugee data to measure the effect of disaster accurately. DIMAS controlled by the government and operated by admins and field officers to keep data integrity so it can be accounted for future purpose. In this paper, we propose to apply DIMAS to mobile environment because of advantages that can be utilized to simplify the usage of DIMAS like GPS integration, mobility aspect, real-time data capturing, etc. At the result, we hope it can be applied to mobile environment to help the government collect data from the community.

1. Introduction

Indonesia is a country that is often hit by disasters. Based on Badan Nasional Penanggulangan Bencana (BNPB), which is a government bureau to handle disasters, from 2018 until 2019 there are 4,774 disasters recorder happen in Indonesia and affect at least 11 million peoples [1-3]. There are 3 main reasons why Indonesia has frequent disasters:

- Indonesia is surrounded by three tectonic plates of the world. There are Indo-Australian plate, Eurasia plate, and Pacific plate [4]. If the three tectonic plates meet can produce a pile of energy that has a certain threshold. Disaster happens by this reason are tsunami and earthquake.
- Indonesia's position is in the Ring of Fire. Ring of Fire is a path along the Pacific Ocean characterized by active volcanoes and frequent earthquakes. Its length is approximately 40,000 kilometres (24,900 miles) [5]. Disaster happens by this reason are volcano and earthquake.
- Indonesia is a tropical country. Indonesia has only 2 seasons: rainy season and dry season. It can cause hydrometeorology disasters like floods, landslides, tidal waves/abrasions, forest and land fires, droughts and tornadoes [6].

BNPB already has its own DIMAS drove by admins who collect data from field officer [7]. Field officers must fill several types of forms and report it to admins so admins can input the data into DIMAS. All data in DIMAS related to disaster report are open for the public. But because data collection is only done by field officers, it will cause some delay for collected data to be ready for the public. It can also cause delay for decision making related to disaster management like distribution of aid, the evacuation route, and coordination with other bureau and volunteers. That delay can cause an unrecorded event of a disaster and can impact to data validity.
With the capability to collect data by the community, DIMAS can collect real-time data related to disaster and show it to the public with no delay. It can help volunteers other related personnel to make a decision precisely based on condition in the affected area. There is some success example of application driven by the community like Waze and Google Maps. Both applications gather data from the community to determine traffic, public location, best route, place review, etc. Until now, there is no DIMAS drove by volunteers in Indonesia. But there is a record in it by Relawan Penanggulangan Bencana (relawan PB) [8]. It collected data from a community member and show data to the public. But this application no longer exists.

2. Methodology
In this paper, we use a comparative methodology. We compare what DIMAS needs with smartphone features to determine possibilities for applying DIMAS to the mobile environment. As seen in figure 1, we list all features that DIMAS needs for gathering disaster data. We also create a list of smartphone features as comparison materials. After we got all needed features by DIMAS, we compare DIMAS features needs and smartphone features. At the result, we determine advantages and disadvantages by applying DIMAS on mobile environment.

3. Result and discussion

3.1. Spatio-temporal data
Spatio-temporal data is multidimensional data, like points, line segments, regions, polygons, volumes, or other kinds of geometric entities that vary in the course of time [9]. Its records movement of object and history of movement based on location and time. Spatio-temporal data commonly used to record the event that needs to specify the location of objects within a certain period of time, so the history of movement or change of the objects can be recorded. Recorded data can be used to predict the next movement or change, based on the analysis result. For example, spatiotemporal data is used for tracking wind movement and collected data will be analysed to predict the weather. In relation to disaster, spatiotemporal data can be used to record the history of disaster time over time. It can record how fast disaster spread out over the affected area. It also can record the movement of victims, determine the fastest evacuation route, and specify aid distribution.

BNPB has a list of known disasters and collects data based on this list. The spatiotemporal data model which use moving object database can also record unpredictable disaster outside the list. With the capability to record unpredictable disaster, the possibility to apply community as the data source is higher because of [10]:

![Figure 1. Comparative methodology.](image-url)
• Accommodate differences in knowledge about disaster types.
• Collect more types of data.
• Faster in collecting data.

3.2. Mobile environment

Mobile technology growing so fast [11]. People nowadays commonly use mobile devices for daily activities. It used not only for communication purposes, but also for other purposes like entertainment, business, hobby, and education. In Indonesia, 38 million smartphones sold in 2018 [12] and it still growing. With the growth of smartphone, telecommunication service providers expand infrastructure to support it. It is good for their business and also good for expanding the utilization of smartphone feature.

With the purposes of mobile technology that can adapt and utilize to support BNPB, DIMAS can utilize some key feature of smartphone [13]:

• Internet connectivity. This feature used to deliver data from user to server based on TCP/IP so the server can collect real-time data from users. Besides that, it also used to deliver message between users for coordination purpose. All telecommunication providers in Indonesia support internet over their infrastructures like the use of HSPA+ and 4G technology so smartphone user can connect to the internet by using their service.
• A mobile browser. This feature used to access the application homepage so users can input their collected data. User credentials needed here to confirm data source and validity. All smartphone at least distributed with a default web browser so users can immediately use this feature when buying a smartphone
• The ability to download applications and run them independently. This feature used to ensure dependency for data collection is able to be installed or used on the device. This feature depends on how large storage given by smartphone vendor. But usually, the vendor gives some extra space of storage so users can utilize this storage space.
• Support for third-party applications. This feature is used to ensure DIMAS mobile application can be installed and used by users on their devices. Some Operating System (OS) like Android and iOS has its own application market so users can install various application in their smartphone.
• Digital camera. This feature used to take real-time conditions of the affected area and for validity purposes. Images captured by the camera can be documented for report or analysis purposes.
• GPS. This feature used to determine location by users related to the affected area of the disaster.

3.3. Applying DIMAS to mobile environment

There are some points must be concerned about applying DIMAS to mobile environment:

• Community capability to utilize smartphones.
• Support from telecommunication infrastructure.
• BNPB capability to store and validate data.
• Clear and simple data definition to fill in forms.
• Utilization and adaptation to mobile technology.
• Coordination between community and field officer.

Based on the points above, we describe the advantages and disadvantages of applying DIMAS to mobile environment:

Advantages : • Community-Based data gathering, can gather various types and large scale of data. With community support for collecting data, BNPB can collect more detailed data in the affected area by a disaster. The community can provide
various types of data so BNPB can get more data to analyse for decision making.

- GPS, can determine the affected area accurately based on user location. With the help of GPS, BNPB can map the affected area and make a decision based on this information. BNPB can also use it for tracking victims and aid.
- Real-time data collection, can collect data without delay. With community support, BNPB can collect data directly from the user. There is some delay for collecting data if BNPB just collects data from field officer only.

Disadvantages:
- Data validity. With community collecting data, the validity of data is decreased. BNPB must filter all data and determine which one is valid and accurate. Invalid data can cause a mistake in making a decision.
- Infrastructure may fail because of disaster. Without telecommunication infrastructure, the community cannot send their collected data to BNPB. It can because BNPB cannot make any decision to prevent increasing of victims.
- The difference of knowledge about the disaster, can cause lots of data variety. It can cause misunderstanding and confusing in analysing collected data and can lead to the wrong decision.

For disadvantages points above, we propose solutions:

- For data validity, BNPB can use preventive action by designing forms with autofill data so the user only can send valid data to BNPB.
- For infrastructure fail, BNPB can use alternative technology to build community-based infrastructure like OpenBTS [14] so the community can still send data even when infrastructure broken by a disaster.
- For difference knowledge, BNPB can hold seminars or workshops to explain the disaster. BNPB can also make a book and deliver it to the community.

4. Conclusion
Applying DIMAS to mobile environment is highly possible. With the rise of smartphone use in the community, make community to utilize smartphone for DIMAS is a good idea. The community already familiar with smartphone utilization so as long as DIMAS features met smartphone features, the smartphone can be used to collect data from the community. But still, there are some disadvantages in applying DIMAS to mobile environment using smartphone. But we propose some solution to minimize the disadvantages.

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