Social Media-Based Identifier for Natural Disaster

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Social Media-Based Identifier for Natural Disaster

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Abstract. This article proposes a conceptual framework design tool to implement Secure Place Locator (SPL) that can help the process of Disaster Management (DM) through utilizing social media, in which this software can inform disaster site and safe point for casualities evacuation in real time with Geographic Information System (GIS) aid. The discussion is limited to the system design, with design methodology tool as an adaptation of the model development System of Design Life Cycle (SDLC), which includes the following stages: problem identification and selection, initiation and planning, analysis, and design. The analysis of formulated design is expected to handle disaster evacuation quickly and appropriately, this device will have a significant impact in the evacuation process (recovery) of victims by discovering a safe point of evacuation in order that help is given on target and evenly. The benefit of SPL implementation is that SPL can map position, quantity, density, and incident in the disaster site, so that DM process can be performed quickly and accurately.

1. Introduction

In the last decade, social media such as Facebook, Twitter, WhatsApp, and Instagram are very popular among the people. Social media is increasingly used for communication and sharing among users. Information disseminated through social media can quickly spread widely in seconds, and then the users can view and know events beyond distance and time boundaries, although it has been well-known that some of the information conveyed in social media is not the actual event (hoax). In the recent years, many disasters occurred in Indonesia, especially flood disasters which ultimately became one of trending topic spreading on social media. This drives the social media users to upload information about the condition of flood affected area in images or just “Update Status” from where the disaster took place. This interaction process can trigger many responses from the other users; in consequence, people make such information reference in determining attitudes and decision-making to help the victims of disasters to track and monitor the disaster event [1].

Although the role of social media does not have a significant effect in preventing disaster, the information appears on user’s accounts may become new information that people can refer to. This phenomenon is a new challenge in the process of disaster problem solving and the process of environmental recovery. In recent years, social media emerged as a potential resource to improve the management of crisis situations such as disasters triggered by natural hazards [2]. As an illustration, Figure 1. showed environmental condition after the flood in Garut, Indonesia in October 2016, emerging in various social media.

Figure 1. Environmental condition after flash flood in Garut (https://twitter.com/hashtag/prayforgarut)

This article discusses a conceptual framework design tool (*software*) to implement Secure Place Locator (SPL) that can help the process of DM through utilizing social media, in which this software can inform disaster site and safe point for casualties' evacuation in real time with Geographic Information System (GIS) aid so that it provides significant effect in the evacuation process/ disaster victims recovery. GIS is a computer-based information system that combines map elements (geographic) and attribute data information that are designed to process, manipulate, analyze, demonstrate and display spatial data for planning, data processing and related to the field of research [3, 4]. Meanwhile GIS web is a technology that enables users to access spatial information via Internet [5]. Based on the above definition, GIS can be used as an information system for DM properly.

2. Methods

Figure 2 illustrates a conceptual methodology of device design used in this article applies a structured approach and an adaptation of development System model of Design Life Cycle (SDLC) [6], which includes the following stages: problem identification and selection, initiation and problem solving planning, analysis and design. Given that this article only presents a conceptual model, the discussion is limited to analysis and design phases.

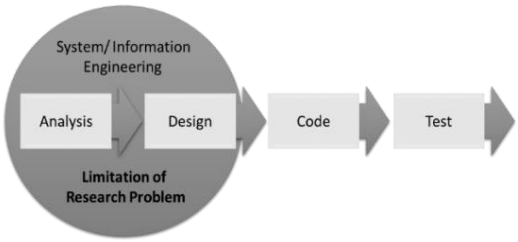

Figure 2. Limitation of Research Problem

3. Results and discussion

Disaster is a natural incident occuring beyond human control. Disaster can happen due to meteorological incidents such as landslides, flood, fire, heat wave, hurricane, storm, tornadoes and winter storm or geological incidents such as earthquakes, landslides, tsunamis, and volcanoe, or human activities such as building, bridge, or collapsed tunnel, chemical or radiological waste, dam failure, nuclear power accident, and wagon accident [7].

3.1 Problem description

Disaster is unpredictable thing when and where it will happen. Nonetheless, human beings can make planning or DM to minimize losses and damages that may emerge. There are four important phases in the process of DM, namely prevention, preparation, response, and recovery [7]. One of the important factors in disaster risk reduction is adequate data and information management system. Without having properly managed regular management information system, nothing will be able to give a good performance benchmark in DM [8]. The support of information system can be realized as an effort after the disaster happens: recording population, existing infrastructure is expected to be informed quickly and accurately, and can also be used for decision-making as the following steps [9]. Fast and accurate access and application of spatial data is essential for decision-making when disaster response occures.

Good decision making is an assessment, judgment, and action selection based on a systematic analysis and based on accurate data. The fast-good decision making will reduce the risk of human victims; it will minimize the amount of disaster damage, and save the cost of disaster recovery too. In this case, the existence of Spatial Data Infrastructure (IDS) will improve the availability, access and application of spatial information to support decision-making [10]. For example, in the distribution of post-disaster logistics management, management information systems of post-natural disasters can provide information to community and agency that will submit assistance dealing with distance, route, direction and the list of natural disaster post logistical needs. The information system can be used to manage the logistics data that disaster posts owned. Logistic management includes data management of incoming logistics, available logistics, and data usage [11].

There are many developed approaches dealing with DM one of which is social media that is widely used by people. Social data media have emerged as a new source for detecting and monitoring disaster events [1]. This technology is widely used in computers integrated with mobile devices or gadgets. One benefit of this technology is that information can be conveyed quickly and spread widely among the people. The process of data collection can be conducted by selecting information related to disasters in a region conveyed by people through social media. Then it is integrated with technology such as *Volunteered Geographic Information* [12]. In order that the system can work well, it is necessary to involve the role of community as a source of information to produce information, which in turn is adapted into the process of DM in information system form of DM. In this phase, social media experiences shift functions from personal communication media into data and information media which can be processed into useful information for the benefit of humanity.

3.2 Problem solving approach

DM is a discipline that deals with risks and way how to decrease disasters. This field includes preparation, support and reconstruction done by community and government when a disaster occurs. DM can be stated as a continuous process that covers all involved components (individual, group, and community) to reduce the risk caused by a disaster [5]. It is no room for doubt that illustrating the mapping of disaster location required community involvement, one of which is utilizing information from volunteers [12]. This is due to the given information initially obtained from the disaster victims or those who stay in disaster location. Previous research showed that Ushahidi was created as a model of technological application that utilize SMS, MMS, and text-based online interface combined with geo-tagging in mapping. Another model is GeoCoomons that utilizes information obtained not only from volunteers but also from the government involvement [12]. Therefore, the information truth presented in the information system of DM need to be clarified. In this regard, the active role of the government is very important in this technology. The government has authority and function as the operator of information to ensure the accuracy and reliability of information [13, 14]. All stages of information delivery to interested parties in DM need to be supervised and controlled by the government, to result more accurate information.

3.3 Analysis and Design

Disaster can be classified into two major groups, first of all is disaster caused by nature and secondly is disaster caused by human activities. Table 1 presents the disaster based on the causes.

Table 1. Disaster based on its causes [7]

Meteorology	**Geology**	**Human/ Social actions**
Erosion, Flood, Fire, Heat waves, Hurricane, Storm, Tornado, and Winter Storm	Earthquake, Shifting Land, Tsunami, and Volcano	Building, Bridge, Collapsed Tunnel, Dangerous chemicals Leakage of radiology garbage, Dam failures, Nuclear accident, and Train accident

Table 1 shows a basic reference of disaster groupings used in this study. Furthermore, by paying attention to the stages in DM process consisting of prevention, preparation, response, and recovery, the discussion in this article is limited to the design of information systems of SPL for the stages of response and recovery tool that can produce information for the public accurately and punctually [7]. Circulation of SPL data and information illustrated by Figure.3.

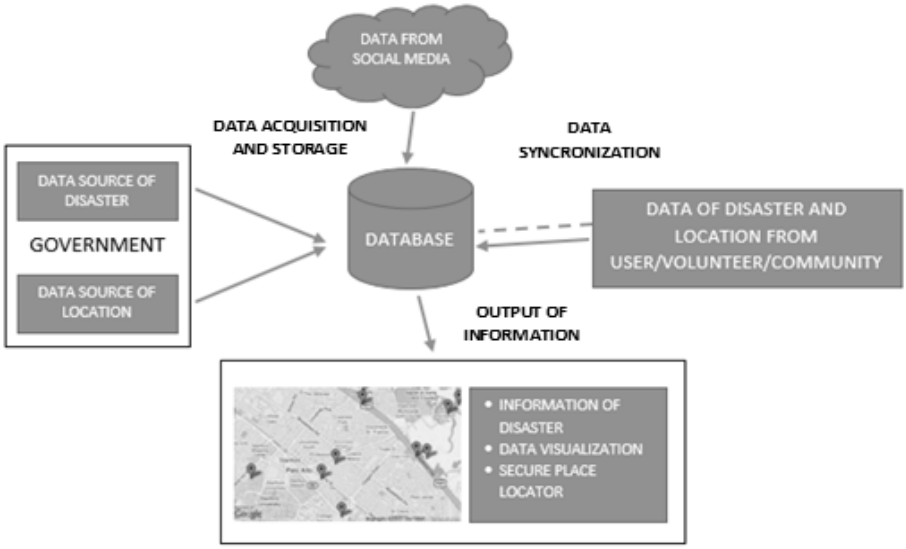

Figure 3. Data and information Circulation in SPL

Twitter is designed to become the main source of data used in SPL. This data will be processed and become a reference of happening disaster information based on the current events location. Henceforward, the data is compared with area database existing in the SPL, if there is a location compatibility between both of them, disaster information will be displayed through GIS based-application. In addition to twitter, the data is obtained from people who directly report disasters through SPL or report safe evacuation point. This information will be a reference for people who will submit assistance to victims of natural disasters, so that the assistance is given to the targeted victims.

The process that occurs in SPL can not be separated from the flow of data and information on disasters and evacuation. The process is shown in Figure 3. which describes the flow of data in forming an information in SPL.

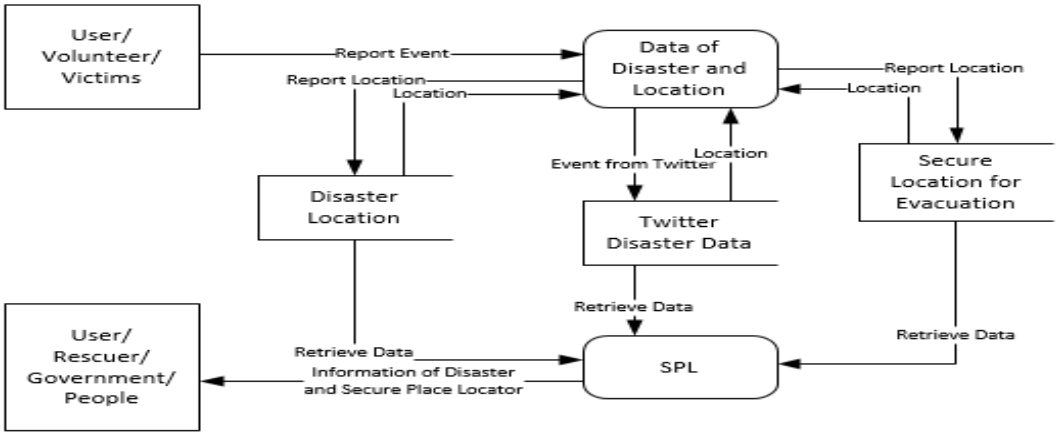

Figure 4. Context Diagram Level 0 in SPL

In supporting SPL tool the data was divided into four tables as presented in Table 2.

Table 2. List of table and attributes

Table Names	Data Dictionary
location	Id, district, latitude, longitude
Twitter	Id, text, date, user_ id, status Source, username, longitude, latitude
Disaster	Id, incident, date, location, longitude, latitude, district, victims, conditions
Evacuation	Id, secure_ point, district, longitude, latitude, team

The data dictionary in Table 2, presents entity relationships between data in SPL tool as shown in Figure 5.

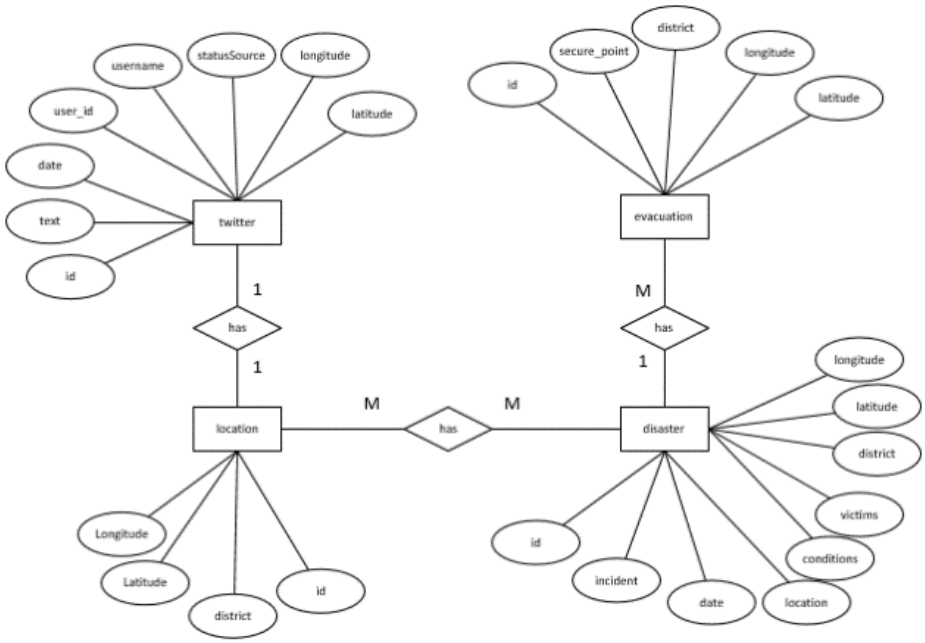

Figure 5. Entity Relationship Diagram for SPL tool

After finding relationships between data, the 'inside table' is made by MySQL application that consist of attributes previously described in Figure 5, the presentation of each table can be seen in Figure 6.

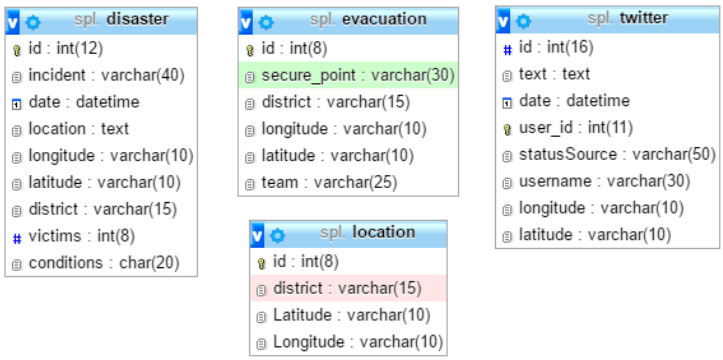

Figure 6. Tables belong to SPL tool in MySQL

GIS is a device that can be used to manage (input, management, process, and output) of spatial data or geographically referenced data [3, 15,16] Some capabilities of GIS-based SPL design in DM cover the following points:

(a) Layout Mapping. This capability allows one to find where the location of a region, object, or other thing on the earth is. This function can be used to find the location of a house, to look for route, and important places and the other things on the map.
(b) Quantity Mapping. By looking at quantity dissemination one can look for places that match the desired criteria and used for decision making, or finding the relationship between these places
(c) Density Mapping. By density mapping someone can easily devide a region into easily understandable and unifrom units, for example by giving a different color on areas that have a certain concentration. Density mapping is generally used for a big amount of data such as population census.
(d) Incident mapping. SPL is also used to monitor what is happening and what decisions will be taken by mapping what is available in an area and what is outside the area.

4. Conclusion

In response and recovery process at the stage of DM, SPL can provide reliable contribution by presenting interface disaster report that is happening. In addition, SPL can provide information such as evacuation points in the disaster region and safe point for disaster victims and any parties that will hand assistance in the recovery and evacuation of disaster victims. With the support of social media, SPL can provide real-time information about the locations of disaster that is happening today.

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