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AN IMPLEMENTATION OF A NEAR REAL TIME DISASTER MANAGEMENT HUB BASED ON CROWDSOURCED DATA

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ABSTRACT. Currently, the use of social media has enabled its users with near real-time update of happenings around the globe. One of the benefits of a socially connected community is that pools of user generated information are abundant during an event of a natural disaster. Studies from recent disaster events such as the Queensland and Australian floods, the Christchurch earthquake and the Japan earthquake have shown that crowd source information could be used and can be treated as the first response point to gain important information of the disaster in terms of crowd, aid and recovery. In this study, we examined the requirement and limitation of implementing a localized crowd source information hub to manage flood disaster in Malaysia. The study considered the implementation based on two factors which are community preparedness and infrastructure readiness with regard on the use of the Ushahidi framework as the crowd source engine. Our implementation studies and testing identified a number of feasibility factors that must be considered to effectively manage disaster situation should the need arise.

Keywords: disaster management; crowd sourcing; social media

INTRODUCTION

Information are crucial to assess situations during disaster time. Furthermore, a clear assessment and judgment call can be established as a result of a clear flow of information. Therefore, a live and dedicated hub to provide a more resilient and proactive response from the community and related parties is needed.

Apart from respective government effort, there have been studies from Bessaleva (2013), Cekada et al (2013), Degrossi (2014), Goodchild (2007), Khun (2007) and McDougal (2012) which indicate that pooled information from citizens during disaster could supply crucial information needed during disaster event. In perspective, the most recent flood incident of Malaysia in 2014 have caused loss of 25 human life with 500,000 of its citizens directly affected. The damage to properties are estimated at RM2.85 billion not including private properties. In terms of information flow and dissemination, it was identified that there were many information shared through the use of social media channels. Although the authorities were also using these channels to communicate internally during the disaster to channel rescue and aid, there was an absence of a dedicated and integrated communication hub to relay useful real time information to them.

Our paper discusses this problem and proposed a crowd based disaster management framework for near real time coordination of information between the public, authorities and

Non-Government Organizations (NGO) during disaster. For the framework requirement, we performed interviews and also on-site field visit at the flood affected site of the 2014 flood in Kuala Krai, flash flood prone area in Penang and also area in Kuala Perlis which is prone to high water tide phenomena. A crowd sourced volunteer information system can provide the point of contact where information could be collected, analyzed and disseminated based on live feeds from the community coming from various communication lines such as phones, social media messaging, location information and other communication media.

MALAYSIA'S DISASTER MANAGEMENT PRACTICE

Since our focus is on the implementation of a disaster management hub, we need to look at the organization, policy and related individuals which will be directly affected by its implementation. First, we investigate the core infrastructure and policy for managing Malaysia's disaster from the MKN 20 document. Secondly, we explore two prominent disaster management portal to find out its usability and information reach. Then, we performed field interview and compiled the requirement based on feedbacks obtained from affected district and community during the Kelantan's 2014 flood. We visited one of the site in Tumpat, Kelantan for our investigation. Based on our investigation through site visit and personnel interviews, we listed the information requirement which is relevant to our study. We also visited other flood prone sites such as Kedah, Pulau Pinang and Perlis to verify on their disaster response conformity in terms of task coordination and flow of command with the MKN 20 document. Lastly, we listed the requirement by identifying the existing infrastructure and procedure and listing out the problems and the requirements which arise from the current establishment.

MKN 20 Document

The Instruction Number 20 or also known as the Majlis Keselamatan Negara (MKN) Arahan 20 is the formal standard operation procedure document which consist of a thorough guide that was produced after the collapse of the Highland Towers in Hulu Klang, Selangor in 1993. MKN produced instruction regarding The Policy and Mechanism for Government Management and Disaster Aid on the 11 May 1997. The instruction have thus been revised in conjunction with the current changes and challenges of disasters ranging from disaster's definition, responsibilities, action, management and flow of command before, during and after disaster.

Based on our findings from on-site interviews, MKN 20 document is extensively used as the primary guide followed by the related authorities on what to do in terms of disaster preparation and management. The document listed 3 levels of disaster management based on disaster's intensity. Disaster management level 1, is classified for disaster that can be handled effectively on a district level with the assistance of limited external party. Disaster management level 2 on the other hand is for a disaster level affecting more than one district in the same state and in need of assistance on a state level with the limited help from the national level. Finally, disaster management level 3, is a national state level management for complex disaster event that is overwhelm for one state to handle on its own such as the 2014's Kelantan flood disaster.

Each disaster level has been assigned special directives of feedback mechanism which specified the course of action to be taken during a disaster event and the parties involved in each level of disaster. During our site visit, we followed through its application on a district level which falls under disaster management level 1 and should the disaster level escalated to level 2 and 3, this level remains activated compared to state and national level since it is the level closest to the disaster where there will always be a constant need for organized security, search and rescue, health and medicine, welfare services, logistics, media and technical

expertise until the disaster ended. Generally, at the district level, the District Officer act as the chair or command centre whereby instructions will then be coordinated through the police department before being dispersed to relevant services.

Online Portal for Disaster Management

There are two very prominent online portals dedicated to disperse information related to Malaysian disaster. The first one is Public InfoBanjir by the Jabatan Pengairan dan Saliran Malaysia. It provides an in-depth portal for current river level, flood relief centres, flood status and map based on flood status. The second one is a much more general portal which presents information on disasters occurring in Malaysia. Portal Bencana by Agensi Pengurusan Bencana Negara under the Malaysia Ministry Office provide a one stop portal for flood, haze, storm, land slide and other types of disaster. Users can use information to get an updated status regarding certain disaster based on feeds from twitter and also content provided by the site.

Although these site provided information which are useful to the general public, our interviews with authorities involved in the 2014's Kelantan flood, the information are not very useful for them when attempting to provide localized aid or search and rescue attempt. There are no live feedback or status update on hot site, rescue status and supplies information related to the current relief sites which are important for coordinating rescue and resources during a disaster level 3. In the following section, we further identified crucial requirement that can be useful for authorities during major disaster.

REQUIREMENTS LEARNT FROM THE RECENT KELANTAN FLOOD OF 2014.

During the 2014's flood, our respondents informed us of the use of a very basic centralized on-site communication centre to relay information and channel rescues. These centres are managed by the district officer and is responsible for managing villages and towns under their jurisdiction. In Tumpat for example, the centre relies heavily on the use of landline telephones to relay information during the disaster. The officers at the centre is responsible to coordinate all the rescue, task management and supplies procurement during the disaster from this site. Once the calls were collected, the personnel at the centre relayed the calls to the respective organization and unit. For example, a call for rescue were relayed to the fire department while a call for medical emergency were relayed to the hospital or the department of public service. Other than the landlines, social media application such as Whatsapp were used to set up ad-hoc group communication channel as their secondary option. The district office is also responsible to manage relief centres which houses the victims directly affected from the disaster. Medical and food supplies are placed within a limited number based on the estimated quantity of would be occupants for each centres. Based on this, we further categorized those identified problems and requirements that could be improved through the implementation of our centralized information hub.

Call and Rescue Monitoring

Distress calls and other related information were received through the district centre of operation but the calls are made through a third-party operative such as the village head, relatives and those who had knowledge about the emergency office number. There is also no proper channel for the district centre to receive real time feedback on rescue status. The information flow goes one way from the ones requiring assistance, into the centre and then dispersed towards the matching rescue team. After that, the status of the operation will be unknown. Also, there is also a shortage of man power to receive and monitor the call centre if it happens after hours. This is because the staff were at home and have no access to the centres as a result of closed or blocked roads from the disaster.

Relief Centre's Availabilities and Status

Another critical requirement is an update of used supplies allocation and relief centres capacity. From previous experience, victims could be assigned to an already full capacity centres since there are no proper tallying of supplies. For resupplying, extra supplies and aid could not be rerouted quickly to centres in need and sometimes routed wrongfully which resulted in an abundance of supplies in one centre while the other centres could be needing it more.

Communication Infrastructures

Communication availability was limited due to the loss of power and telecommunication lines. Bandwidth usage is high and call centres are overwhelmed with the calls coming in. There should be a consideration to provide alternative number for such calls and separate dedicated servers to sustain server loads. Once the landlines are disrupted, the communication would then be reduced to cellular and wireless communication. The reliability on wireless data was apparent on the use of WhatsApp, Facebook and other Internet channels to relay information.

IMPLEMENTATION OF A LOCALIZED CROWDSOURCED INFORMATION HUB FRAMEWORK FOR DISASTER MANAGEMENT

Based on the current flood disaster experience in the previous section, we compiled the list of possible improvements in Table 1 below that can be implemented in our crowdsourced information hub that could assist disaster management effort.

Table 1. Current Practice and Suggested Solution

Existing Practice	Problems	Improvement Suggestions
Call and Rescue Monitoring	• One way communication • No progress monitoring	• Crowd update on rescue request and progress • Centre verification of progress
Relief Centres Availabilities and Status	• No status monitoring	• Crowd update on centres needs • Relief centres verification of status
Communication Infrastructure	• Relies on single landline telephone channel	• Telephone lines • Wifi and 4G/3G network

The improvement was integrated within the framework based on the Ushahidi platform. We proposed cooperation of voluntary information from the crowd and verified at the centre which can be sourced from local authorities as well as member of the public during disaster. We performed the alpha implementation based on our study area which is the Tumpat District Office using our own equipment. The following are the modules breakdown.

Modules

Figure 1, illustrates the overall modules of the framework which consists of disaster prepara- tion, disaster response and disaster recovery.

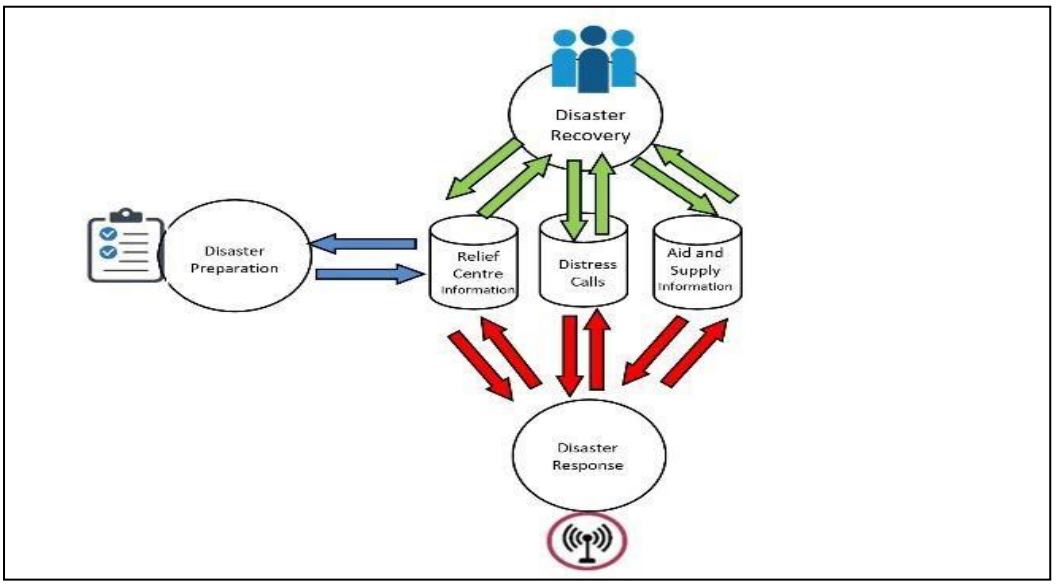

Figure 1. The Crowdsource Core Module

The three tables on the rescue database carries relief center status which will collect information related to relief center that will house victims, aid and supply status which will store information related to aid and supply center which stores medical and food supply and lastly the distress calls status which will store information of calls for rescue which can be relayed to relevant authorities once it is recorded. These three main tables will also directly linked to the following modules.

Module 1: Disaster Preparation Module

The module enables user to update information related to related relief centres that will be utilised to house victims during the actual disaster. It also used to update the inventory of supply and aid in storage. Information such as centres capacity, amount of food, gas, amenities and medical supplies available at each of the centres should be updated at least one month prior to the forecasted heavy rainfall occurrences. Maps of the area displays the current procurement at these centres so that it could be used for the disaster management team to synchronize the rescue efforts based on the available centres and resources. Figure 2, shows an example of the supply centre on the actual map.

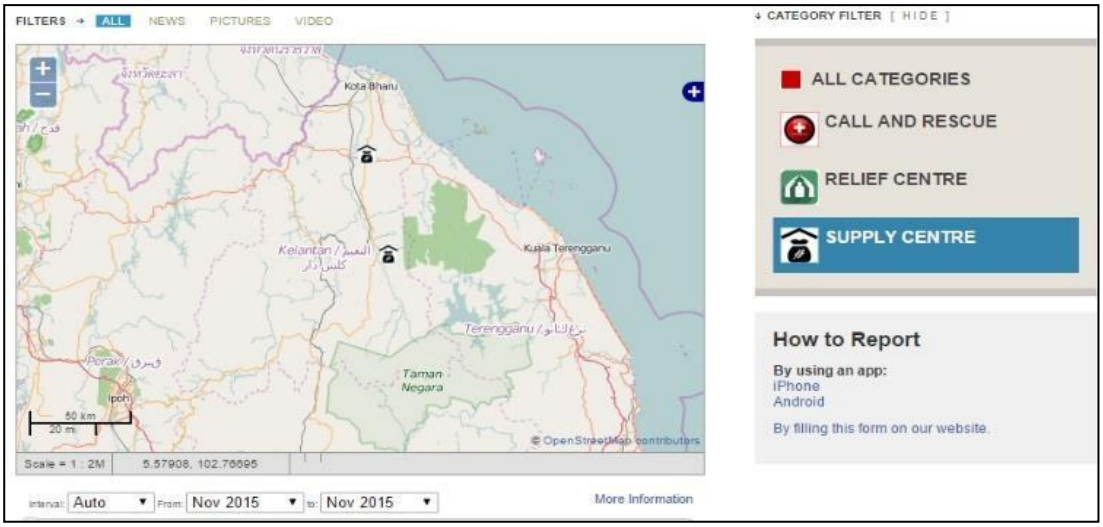

Figure 2. An example of the Supply Centre Information in the System Module 2:

Disaster Response Module

This module is activated during the actual disaster event. Information which was previously stored from module 1 will be actively updated based on its utilization of victim placement and supplies inventory update. The information is used to route supply and aid distribution as well as rerouting victims to the next available centre to prevent overcrowding. Road closure and road availability could also be updated based on the terrain condition in order to make sure only the safe routes are used for transportation. As for rescue and distress calls, each report can be entered and mapped into the system's map. As an added feature to assist in the authorities to visualize the situation, the amount of distress calls received per area will be interpreted urgency level to a particular call. For example, areas which receives 10 calls and above will be mapped as a critical area and the rescue dispatch should give priority to the area, while areas with 2 or less calls will be put on a less critical priority. The relevant party which is responsible for the rescue task will update the information back towards the call centre once a task is finished. Figure 3 shows the map with test data of distress calls to indicate urgency on affected location.

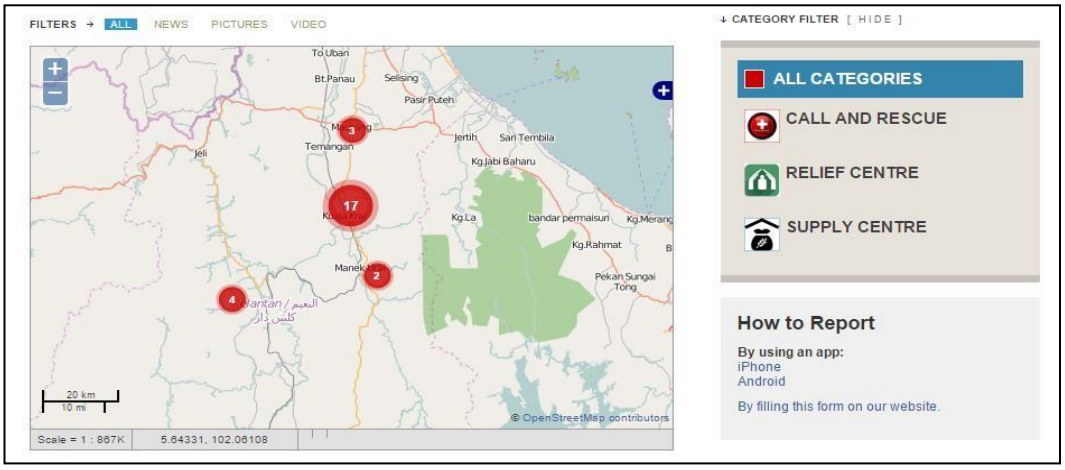

Figure 3. Call and Rescue Visualization to Indicate Urgency

Module 3: Disaster Recovery Module

The third module is utilized after the situation has been stabilized but information is needed with regard to the relief centers and its inventory and occupants. Again, the center of disaster management would be able to use the information gathered in the system to route supply and aid distribution to related relief centres as projected in Figure 4. Additional aid and supply could be mapped based on the most updated record of supplies and road information and condition could be used to effectively manage the recovery attempt. Furthermore, the record for distress call from the previous disaster response could be updated during the recovery period as means to get feedback on rescue status during the period of disaster.

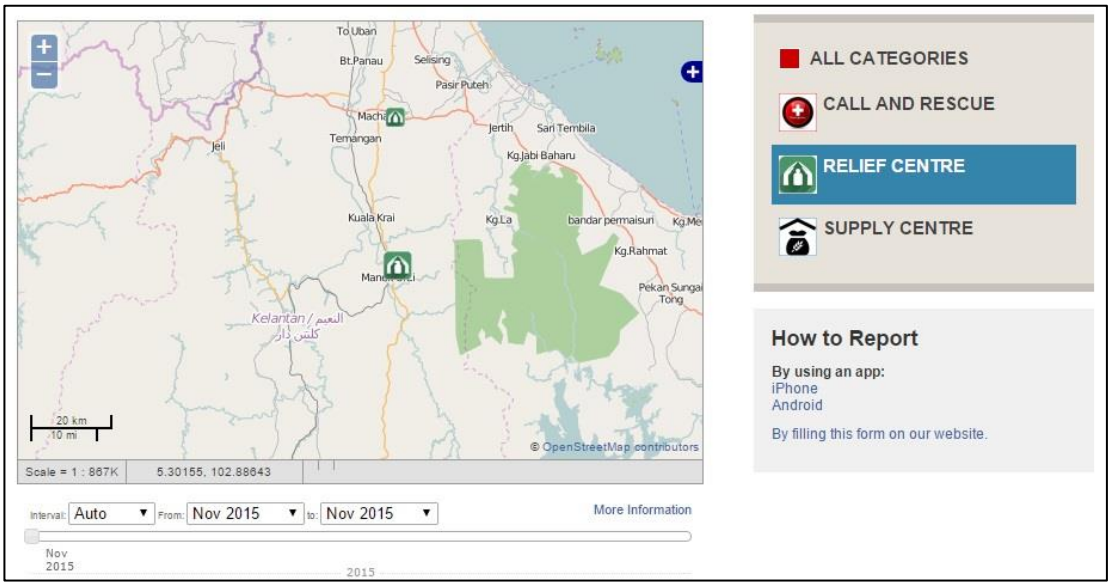

Figure 4. Supply Centre Information Visualized on the map

FEASIBILITY OF IMPLEMENTATION FOR THE INFORMATION HUB

The crowdsource hub have gone through initial testing to ensure that its objective as an information centre that can be used to assist the control centre to visualize and assess the situation and then later on relay critical information to the relevant authorities. This section presented factors that could affect the feasibility of implementing the hub in real disaster situation. We divided the feasibility factors into two main category which is community preparedness and infrastructure readiness. The feasibility study mainly focus on flood prone area in Malaysia.

COMMUNITY PREPAREDNESS

Community preparedness must be weigh in terms of their exposure to the relevant channels and the relevant authorities to report to during disaster. The following are the breakdown of the factors.

Exposure to the Emergency Response Channel

Based on our findings, the local community need to be exposed to the local emergency response channel aside from the general Malaysian number of emergency such as the 999 number. Most locals are unaware of the district office's number or any local authorities' number that can be contacted during emergencies. It is much faster to directly contact the local authority such as the district office and its emergency line during emergency as the help could be relayed faster to the relevant party during disaster. The locals should be made aware of this number through exposure of the number on public transport, billboards and other public location that can be easily seen. Also, with regard to the information hub, the public should also be made aware of such system and portals where information can be shared and exchange.

Personnel Jurisdiction

We have discovered some district offices' personnel in areas which are seldom affected by disaster did not have a clear direction on what to do during disaster time. As disaster can be defined as haze, storm, landslides and other mishaps affecting the district, their personnel should always be informed of their jurisdiction on the matter. However, this attitude is different in areas which are always affected by disaster where the personnel have a clear knowledge of action and what to do and who to report to during disaster.

Training of Personnel

Staff stationed at the centres must be properly trained and exposed to the functions of the information hub. Each function of the hub must be understood in order to enable smooth communication during the time of disaster. The rosters of these personnel must also be properly scheduled in parallel with expected disaster prone seasons.

INFRASTRUCTURE READINESS

Infrastructure readiness weighs the backbone requirement of communication to support the information hub and its maintenance to ensure adequate function and running time during disaster. The hardware and the facilities at the centres must be maintained and checked in a timely manner to ensure it is always ready to function immediately.

Basic Communication Requirement

As the hub requires an active Internet connection, the office or command center housing the system must be have a stable landline of the connection. Factors such as the power source and stable communication support must be weight upon in the location of these centres and its operation room. Other than that, back up Internet connection from the 3G and 4G channels must also be accounted for should the landline were disrupted during disaster. The most

important factor here is to ensure the center of command will always have a constant working channel to provide coordination with its subordinate to relay information during disaster.

Supply of Reserved Communication Support, Power backups and other Peripherals

Taking into account the limited or perhaps power failure, the center of command must have enough reserve of supplies in terms of backup battery packs, backup generators, back up Wi-Fi dongles and even the basic two-way radio communicators. These backups supply must be constantly checked on its functionality and its location must be secured from environmental hazard and also easily accessible when needed.

CONCLUSION

We have presented the findings on the feasibility of implementing a near real time disaster management hub based on crowdsourced information. The hub can be utilized based on gather information from the community and the relevant authorities to visualize the situation and channel relevant assistance effectively during disaster. Our preliminary investigation and requirement analysis are done through on-site interview and visit to relevant disaster site and also phone calls interview. The implementation study based on the requirement are performed on the site and feedbacks from related personnel on-site. Although the focus of the current implementation is based on the 2014 flood disaster, the hub can also be used for other disaster under the MKN 20 jurisdiction that can benefit the community and also nation as a whole. The factors affecting its feasibility must be considered to ensure its optimal execution during any type of disaster.

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