DisasterBox: Designing Social Media for Disaster Relief

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ABSTRACT

Natural disasters are a period of uncertainty and instability for those affected. It becomes important for members of the public in a disaster zone to access up-to-date information about their environment. Currently, solutions are only set up for information from official sources to flow through existing infrastructure to members of the public. This approach has been criticized for being incomplete and slow to respond. The authors propose an integrated communications solution that would leverage the networked potential of localized actors, whether they are affected members of the public, aid workers, or official agencies sent to provide support.

Author Keywords

Crisis information; information system design; crisis informatics

INTRODUCTION

After natural disasters, affected individuals and disaster response agencies are turning to social media to communicate and share critical information (Hughes et al., 2014). To help with disaster relief efforts, various social media companies like Google, and Facebook have launched products that help their users in times of disaster. Google has 'People Finder' that facilitates searching for missing loved ones while Facebook has 'Safety Check', a service that allows users to broadcast that they are safe. Recognizing that the trend of searching for information online and using social media to share experiences is unlikely to cease, the authors of this poster have turned to a design proposal to examine the issues and challenges with social media use in disasters.

The idea behind our design, named DisasterBox, is to create a centralized social media tool that would be a place to map,

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share, comment, and communicate about users' information needs. There has been a large body of work conducted in the domain of crisis informatics that consistently notes that affected individuals have strong information needs related to the rapidly shifting nature of their situation (Barrenechea et al., 2015; Denis et al., 2012; Hughes and Palen, 2009; Liu et al., 2008; Meum, 2014; Palen et al., 2010; Sarcevic et al., 2012; Starbird et al., 2012; Vieweg et al., 2008). Currently, individuals in a disaster have to rely on many different information sources to gather pertinent information (Virtual Social Media Working Group and DHS First Responders Group, 2013). Visiting one location for updates and information will streamline information seeking and free up time and cognitive resources for other disaster recovery tasks. Both emergency services and affected individuals can benefit from this. Emergency services can use their resources more efficiently and effectively. For example, updated maps help ambulances know where it is safe to travel. Affected individuals can request for help more quickly (e.g., ensure that the responding emergency services has the supplies that they need).

DESIGN RATIONALE

In disaster situations, affected individuals pull together to share information and resources (Barrenechea et al., 2015). Affected residents volunteer their time, expertise, and information to help others and work together to solve problems. Therefore, to create a system that has the most potential benefit, our system is centred on allowing individuals to share information. DisasterBox acts as an emergency social media channel and venue for the distribution of information.

Researchers emphasize the importance of integrating e-participation or crowdsourcing in emergency management systems (Barrenechea et al., 2015; Denis et al., 2012; Hughes and Palen, 2009; Liu et al., 2008; Meum, 2014; Palen et al., 2010; Sarcevic et al., 2012; Starbird et al., 2012; Vieweg et al., 2008). Crowdsourcing empowers citizens to help each other, which is especially valuable when resources are limited or overtaxed. Crowdsourced data moves nimbly during changing circumstances,the default state of natural disasters. More importantly, official aid is usually from outside of the affected area. Aid workers and policies may not be aware of local peculiarities or be tailored to accommodate them. The importance of local networks to help fill the gaps and provide truly relevant information to affected citizens is also closely studied (White and Palen, 2015). Current crowdsourcing

tools for disasters exist in the form of Google Crisis Maps, Google Person Finder, or Facebook Safety Check.

Having crowdsourced information also helps improve the accuracy of the information being disseminated through feedback provided by individuals. Whether through interactive mechanisms that allow for accurate content to be promoted or simply with a positive reply. Message-and-reply functions afford users the ability to clarify instructions and it also allows individuals to provide the most up-to-date information as situations occur and change (Hughes et al., 2014). Local networks have proven importance in the being able to help and provide truly relevant information to affected citizens (White and Palen, 2015). The desire to share information and help the community solve problems exists during a crisis, but a way to enable the capacity to participate in the immediate aftermath has not been built.

However, these tools are dispersed and offer no integration with official organizations or sources, creating a bubble of communication artificially separate from relief efforts. There has also been previous work focusing on using mobile ad-hoc networks to help disaster victims communicate through tweeting (Al-Akkad et al., 2014) but the space of creating a more integrated communications solution, where users can also find information from public and official agencies along with being able to communicate with each other, is still relatively unexplored. Other work (Meissen et al., 2014) focuses on using a single text message to help warn users of an impending disaster but it is not very flexible towards helping users adapt to new situations. DisasterBox will bridge the gap between official announcements and crowdsourced data, allowing all of its users, official and affected resident, to synthesize information efficiently.

Hurricane Sandy was a disaster where affected residents could still access the internet even while they lacked running water. However, relying on continuous internet access for communication is precarious. To ameliorate the risk of network failure, DisasterBox will be deployed on a resilient node based networking system independent of existing internet service providers. The strength of this approach is that even if there is a broad failure of communications infrastructure, the distributed network would remain intact. As a result, even when telecommunication infrastructure is down, DisasterBox is able to provide access to both the crowd's knowledge and vetted information resources.

PROPOSED SOLUTION

DISASTERBOX
Designed to be durable, cheap, and versatile, DisasterBox is encased in a 5 gallon paint bucket. These buckets are easily available, rugged, and water tight. Additionally, they can be easily modified to be deployed in a variety of scenarios. A battery pack at the bottom of the container is connected to a voltage converter that changes the power supplies 12.1v to 5V, and provides 2.1amps of power to Disasters Boxes computer. A Raspberry Pi B+ computer is responsible for running the stack of programs which make up DisasterBox's software component. The computer, is connected, via USB, to
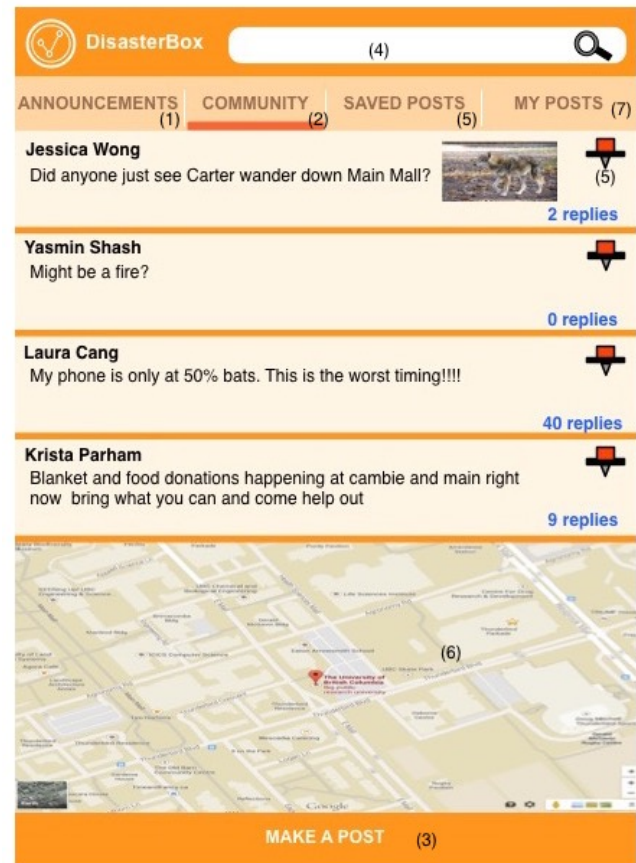

Figure 1: The interface a user would see when viewing posts made by other DisasterBox users.

1. The "Announcements" tab contains information from a curated list of aid agencies (e.g., Red Cross).

2. The "Community" tab contains information from other DisasterBox users int he area. Users have the option of attaching pictures to their posts.

3. Users can make a post alerting others of a problem or potential access to aid/supplies.

4. Users can search all posts for a certain term or location.

5. Pinning a post allows a user to see the post under the "Saved Posts" tab to review later.

6. Users can search for posts that were made near a certain location.

7. Users can view posts that they have made along with any replies other users have made to the post.

a wireless adapter equipped with a range extending antenna. These units should achieve an effective range of 1200 feet (365.76M), per unit.

The Raspberry Pi B+, is a micro computer that can run OpenWRT, a stripped down Linux based operating system designed to be run on wireless routers (OpenWRT Project,

Unit	Price ($)
12 volt battery pack	33.97
Bucket	3.99
Raspberry pi	34.99
Power converter	6.00
Wireless adapter	15.00
Coax cable	3.00
Micro SD 8GB	3.95
Total Cost	99.61

Table 1: DisasterBox Cost Estimate

2011). In order to allow the units to run a distributed network, the B.A.T.M.A.N networking protocol handles communication between the nodes. These two frameworks are the foundation on which the rest of the programs (or stack) operate. DisasterBox essentially runs on a series of interlinked servers which stores and exchanges information using MongoDB, a NoSQL database. As MongoDB has integrated sharding capabilities it is more likely that performance is consistent as MongoDB is inherently doing the load balancing for DisasterBox. MongoDB can also be easily used to build a distributed database thereby enabling better fault tolerance and is more fail-safe (MongoDB, ND). Using this technology, DisasterBox can run as an application on devices that can connect to Wi-Fi. Once users access a DisasterBox node, they are prompted to create a user name and with a user name, the user is then able to post to the social network that runs on the stack.

Initially posts are stored locally, however as nodes connect to each other they exchange missing pieces of their databases. As a result each node (or DisasterBox unit) has a complete copy of the databases of the nodes that it is touching. Because each nodes is its own server, even if multiple nodes are destroyed, or fail, copies of the data contained on them are preserved on other nodes that have connected. The independent mesh network architecture allows it to avoid many of the pitfalls of other systems. DisasterBox's network structure allows for data to flow rapidly through the networked nodes, without having to worry about whether paths are blocked or operating.

In a disaster, citizens will be able to log onto the social network using their Wi-Fi capable consumer electronic devices. This initial login will help in verifying user identity and allow site moderators to keep track of user activity. After connecting to a DisasterBox node, they will first be shown announcements from verified official sources. They can then search, send, and respond to posts from other users. This integrated social network speeds the ability of citizens to gain access to essential information, not just official information, through real-time updates from their neighbors about the conditions of their local environment. In addition relief/emergency organizations using DisasterBox will be able to quickly identify activity hotspots that will be displayed using an interactive map.

USER EVALUATION RESULTS

We performed a user study evaluating the usability of our prototype and collected qualitative feedback from N=18 participants (8 male and 10 female) aged 21 - 36. All participants were recruited from UBC as well as the general population and were all comfortable with mobile devices and all but two reported interaction on social media at least daily.

We asked users to perform 2 common tasks to facilitate a slightly more guided exploration of the available features of the system. Task 1 ("Make a Post"), considered the *simple task*, required a minimum of 2 actions to complete. Task 2 was the *complex task* where users were instructed to "Search and Reply" to a previously existing post; this task required 4 actions at minimum.

All users were able to successfully complete both tasks. After some time spent freely interacting with the system, we conducted an interview to determine the successes and shortcomings of our prototype. We report these findings.

The top use cases reported by our participants was for accessing available help and resources (13 people out of 18). Other purposes that participants would have for this application are (in decreasing order): finding loved ones (7); providing help and information (i.e., posting known safe areas, answering people's questions, helping look for lost people) (6); and seeking information about the status of the infrastructure (i.e., finding safe routes out of the danger zone, determining the seriousness of the disaster) (6). Some representative responses are as follows:

"I'd want to search for information, supplies, and where the traffic is" - P8

"[I could foresee using this application (or something like it) to]... find a safe point, find family and friends, and communicate a meeting place" - P2.

The application was likened to other social networks when describing concerns that users had.

"...[I]t must have an advantage over other social networks, like maybe have more trustworthiness; maybe a medical pre-registration so we could verify medical personnel" - P17.

"I would value some information verification since this is serious and not just for showing off or sharing like on other social media" - P5.

Overall, when asked to rank our prototype on a 5-point Likert Scale from Very Confusing to Very Intuitive, 17 participants selected Neutral or better (4 users reported Neutral).

FURTHER STEPS

After our initial assessment, we are planning additional studies and system improvements as we work towards a full implementation. Based on feedback from our user study, we have several planned features to implement. Adding to the interactive map is a priority due to the importance of location based information during a natural disaster. P15 wanted to directly the manipulate the map as a browsing strategy, which was a planned but currently unsupported feature. Participants 11, and 12 wanted to increase the informational content on the

map, in particular, they suggested supply stations and refuges as landmarks to include.

Safety is also an area deserving further investigation. We will investigate what combination of tools and moderation can best balance speed and openness while fostering a constructive community.

CONCLUSION

DisasterBox is a technology grounded in theory and practice. It connects concepts in how individuals use information in a crisis scenario (Hughes et al., 2014), the power of the crowd (Hughes and Palen, 2009), and resilient networks (Al-Akkad et al., 2014). There is a need to aggregate and connect agents during a disaster to maximize relief efforts and our social media tool, DisasterBox, aims to fill that niche by connecting all invested parties. It allows for individuals affected by a disaster to communicate with each other through posting information and/or photos. Official organizations can also make their own posts. The purpose of DisasterBox is to consolidate and connect information and affected residents after a natural disaster. DisasterBox aims to facilitate this improvement by empowering affected residents and streamlining information transmission.

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