Disaster Box ASIS&T 2015 Poster

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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. We propose an integrated communications solution that would leverage the networked potential of localized actors, whether they are affected members of the public or official agencies sent to provide support.

Author Keywords

Crisis information; information system design; crisis informatics

INTRODUCTION

Disaster box is a project that grew out of a design competition. Assigned to design a systems that would enable information and communication in a disaster the authors developed a distributed network infrastructure and social networking platform. Disaster Box Development Group recognized the need for rapidly deployable parallel communications infrastructure that was low cost and easy to use by civilians in areas affected by disasters. Our poster will outline the design principals used by the DBox group, the technologies involved, and the opportunities for research into information, space, and disaster opened by our technology.

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). Crisis information behavior is not one-way. It has been observed that individuals tend to become involved in their communities during crises, volunteering their time, expertise, and information to help others and work together to solve problems (Barrenechea et al., 2015). Consistently, in disaster situations, affected individuals pull together to share information and resources.

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. 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.

Crowdsourced data changes more rapidly than official announcements which helps both individuals affected by a disaster along with any aid organizations. As many aid organizations are from outside a disaster stricken area, the policies and workers may not be aware of local peculiarities or have protocols in place to accommodate them. Having crowdsourced information also helps improve the accuracy of the information being disseminated as it allows individuals to agree to the accuracy of information 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). The desire to crowdsource information and solutions during a crisis is there, but the capacity has not been built accordingly. Local networks have proven importance in the being able to help and provide truly relevant information to affected citizens (White and Palen, 2015).

PROPOSED SOLUTION

We propose a design solution that will support the most important information needs of the populace in the disaster zone. Unlike other suggestions (see introduction) which focus on improving current social media, our system will act as an emergency social media channel, operating independently of existing internet. The strength of this approach is that even if there is an internet failure, our distributed network would be resilient and provide continued connectivity. Furthermore, by targeting residents in the affected area, fewer resources must be spent on filtering communications to isolate ones from users in the geographical vicinity of the event.

Our system will support finding all appropriate information from official sources and emergency response authorities (i.e. Red Cross), as well as relevant peer information and issues. Peer information includes updates about specific local condition, but also supports a check in function for individuals to post their own location and status as well as search for / report on missing loved ones.

To this end, our disaster information management system will: Be lightweight and quick loading for unstable internet connections. Be easy to use without previous instruction and be be usable by people who need the most help are not able to access the technology quickly (elderly, young children, special needs). Clearly display of all the information. Be both mobile and desktop compatible. Alert members of the public of its presence using available broadcast channels. Provide filtering tools to help users find information relevant to their location and information needs.

DISASTER BOX

Box description and contents

The foundation of disaster box is its container. Selected for its durability and low cost, a simple 5 gallon paint bucket, is durable and water tight. At the bottom of the bucket, is a battery pack that is connected to a DC converter that changes the voltage from 12.1v to 5V, and provides 2amps power to the Raspberry Pi B+. The Raspberry Pi serves as the central nervous system of Disaster Box, handling the DB stack. The Raspberry Pi, is connected to a wireless adapter with an antenna to boost its range. We estimate an effective range of 1200 feet, per unit.

Stuff on the box

The Raspberry Pi B+, is a micro computer with an ARM7 processing unit that allows it to run a set of computer programs that allow it to serve as an open networking platform. OpenWRT, a stripped down Linux based operating system is the foundation on which the rest of the programs (or stack) operate (OpenWRT Project,). To handle the demands of a distributed network, the B.A.T.M.A.N networking protocol handles communication between the nodes. On top of these two frameworks runs Disaster Box's social platform, a disaster social network. This application stores messages in MungoDB a NoSQL database, with integrated sharding capabilities that allows for the multiple copies of the database to be reconciled into a cohesive knowledge base across nodes (MongoDB,). Using Ruby, these are displayed in an application interface on users' devices with the ability to connect to WiFi. Once users access a Disaster Box node in they are prompted to create a user name, and are able to post to a social network that runs on the stack.

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. Table 1. Disaster Box Cost Estimate

Initially posts are stored locally, however as nodes connect they exchange missing pieces of their databases, so that each node has a complete copy of the databases of the nodes that it is touching. Because each nodes is its own central server, even if multiple nodes are destroyed, or fail, copies of the data contained on them are preserved on other nodes that have connected. Additionally this structure allows for data to flow rapidly through the networked nodes, without having to worry about whether paths are blocked or operating. Thus a post in one neighborhood is passed from one node to another.

In a disaster, citizens will be able to log onto the social network using their consumer electronic devices with WiFi capabilities. After connecting to a Disaster Box node, the 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, but real-time updates from their neighbors about the conditions of their local environment.

The development of these this technology has been split between two teams. The first team focused on developing the social networking tool is based in Vancouver, BC and the University of British Columbia. A second team based in Columbia, SC at the College of Information and Communications of the University of South Carolina. This team has been focused on the development of the physical infrastructure of disaster box, networking components and lower levels of the Disaster Box stack.

FURTHER STEPS

The Disaster Box development teams are currently building prototype units, and engaging in component testing. Once units have been developed, field testing will begin. This testing could proceed along 3 phases. First, a passive test, where the network is deployed in a scenario, where there is neither disaster, or stress on the communications networks. This test would check network range, connectivity, and network use in optimal conditions. The second testing phase would see the network deployed in situations where communication networks are strained. For example, after a during a major sporting event, where traditional network infrastructure becomes overburdened. Finally, a trial deployment to an area recently affected by a disaster would allow for Disaster Box to be tested in conditions that closely resemble Disaster Box's intended deployment scenario.

CONCLUSION

Disaster box is an example of a technology founded in research and theory. It connects concepts in how individual 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). However, disaster box has a unique capability to further research into human response to crisis, and information's role in mitigating the impact of a crisis.

Current research in social media relies on post event keyword based searches of stored data (Imran et al., 2014). With the advent of services which use machine learning it is possible to extract a relatively accurate body of messages to work with (Imran et al., 2014). However, because of the nature of the system, Disaster Box provides the potential to capture all social media based communication in an effected area, allowing for the highest quality corpus for researchers to analyze. Disaster Box is not only a solution for disaster communication, but will also help responders and researchers understand these events.

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