Past and the Future: The Potential of Smartphones During Disaster Relief

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The current landscape of technology has given people the ability to share opinions and even their own location to the rest of the world within a matter of seconds. That may sound trivial in an everyday context, however, the gravity of this feature becomes apparent when applied during periods of disaster. This report examines the evolution of communication services as well as the outbreak of social media applications and their impact on disaster relief. This article looks at several natural disasters and how responders were able to adapt to conditions by using information gathered from smartphones and crowdsourcing applications. Finally, we'll also examine how future responder methods will handle massive disasters by relying on data gathered by all of those in need, immediately.

Disaster Relief: 1990s and onward

We will begin by first analyzing how disasters were reported on in the past. Only until recently has it been easy to gain instant information about disasters occurring in any region (Baoquan, 2015). In the past, News networks and reporters were the mediums responsible for delivering information through television sets or newspaper articles. Reporters would stand near the site of a storm and try to capture and estimate the damage done. From there audiences could guess the storm's impact and alert loved ones accordingly. The efficiency of this process was limited. Telephone lines would inevitably drop and one could not alert others until they were in a safe place, leaving their safety status up in the air.

This process began to change most notably during the attacks of 9/11. In 2001, wireless coverage had just started to gain a significant pull as there were between 118 and 128 million wireless subscribers who owned cell phones (Reardon, 2011). During the attacks, many families were extremely concerned about loved ones who were in the Manhattan area and could not directly contact them if those loved ones did not have a cell phone. Additionally, cell networks were quickly overloaded in the New York City area and even extending to the rest of the East Coast.

Despite the overload of cellular networks, the potential for mobile phone calls was noticed when several calls were able to get through from passengers aboard Flight 93. On September 11th, United Airlines Flight 93 was hijacked by al-Qaeda. However, passengers on the flight attempted to regain control of the plane and even reach out to loved ones by using cellular phones they had brought with them. The phone calls allowed the passengers to describe the events as they were happening to loved-ones moments before the tragic collision. It is important to note that at this point in time cell phones were not yet capable of text or video messaging. The extent to which people could communicate using these mobile devices was limited, however, powerful.

From this point on, the boom of text messaging and social media took over. The scenario described on Flight 93 and other disasters could have different outcomes if instead of being able to communicate with one person at a time, you could communicate with millions.

Smartphones and present day methods

On January 12th, 2010, a 7.0 magnitude earthquake devastated Haiti. Over 230,000 lives were lost and the country's most populous areas suffered massive destruction. In response to the disaster, the international community proceeded to do extensive research into the process and management of response and rescue missions (Gao, 2011). This research went after how best to obtain data coming directly from Haitians. Among the sources from which this data could be polled from at the time were Twitter, Facebook messages and even blogs (Heinzelman, 2010) Using metadata and location updates from these crowdsourcing tools, engineers were then able to update real time map plotting software such as Ushahidi (www.ushahidi.com) with locations needing assistance. In response to these maps, first responders integrated them into their workflow to provide more efficient assistance for survivors in need.

Running concurrently to the Ushahidi development mentioned was the study of geographic position from SIM cards. In another pursuit of improved response, another team of engineers focused their efforts to aiding the cholera outbreak of 2010. Due to the damaged waterways and sewage pass ways, cholera brought upon a massive epidemic to people in Haiti. The engineers sought to monitor the spread of the disease but figured out that SIM cards provide access to users' geographic locations. This technique allowed researchers to get accurate estimates of the population of people flowing in and out of areas at different dates before and after the earthquake's impact. If this research had been confirmed before the impact it would have allowed responders to gather the necessary number of resources to treat people in those areas at a much more optimal rate. The process of physically surveying patients would have been bypassed by the monitoring of SIM card locations (Bengtsson, 2011).

The techniques discussed here so far have shown how current technology has changed the landscape of disaster relief. Furthermore, the events discussed have already occurred more than five years ago.

Since 2011, the percentage of adults in the U.S. using mobile phones has increased to over 91% (Rainie, 2013). In the past five years the number of active twitter users has increased to 307 million monthly active users. Along with this growth is the use of data mining and machine learning to analyze the millions of Internet users on a day-to-day basis. Due to these new purposes, sites like Twitter are being redefined as news sources rather than a standard social network.

Figure 1. Wireframes for the proposed application interface for MERV: Management for Emergency Response Volunteers, the Cayenne Team's capstone project.

In the case of disaster relief, applications of the future are expected to utilize Twitter among other social media platforms to deliver powerful estimates and monitoring of hurricanes, earthquakes, blizzards and other emergencies (Buzzelli, 2014). Through the use of data mining and machine learning, information contained in forms such as tweets can be processed to gather users' location and severity. Pictures concerning disasters submitted through blogs in addition to Twitter also contain metadata filled with timestamps and geographic locations. Additionally, populations can be monitored as well by looking at post numbers or trending keywords and searches (Starbird, 2010). The amount of informational content at this point in time is almost endless and updates by the second. All that is left to optimize Disaster management is to engineer applications that can process all this information and output useful model and predictors.

Concluding Thoughts

Over the course of our research, the Cayenne Team looked at the development of mobile phones and Internet technology and its effect on disaster aid. Beginning with the mass adoption of mobile phones in the early to mid 2000s, connectivity within the public has only increased. Today's world is as connected as ever and new technologies are constantly arising. A field that can greatly capitalize on this is disaster aid and management. In the next decade, the processing of information has amazing potential to make response superior and more efficient than what we have seen before. Our capstone project hopes to capitalize on this potential by once again pushing the connectivity and efficiency of volunteers and responders.

The Cayenne Team envisions making an impact by developing an application that optimizes communication between response organizations and potential responders (Figure 1). This application would be most aimed at mobile users and allow all parties to organize relief tasks according to responder's experience and skills, as well as allow efficient group communication for use during response efforts.

References

Baoquan, Y. (2015). A study of smartphone based disaster information reporting system under disaster environment. *International Journal of Smart Home, 9*(1), 45-52. doi: 10.14257/ijsh.2015.9.1.05

Bengtsson, L. (2011). "Improved Response to Disasters and Outbreaks by Tracking Population Movements with Mobile Phone Network Data: A Post-Earthquake Geospatial Study in Haiti." *PLOS Medicine.* doi: 10.1371/journal.pmed.1001083

Buzzelli, M. M. (2014). Information and communication technology: Connecting the public and first responders during disasters. *Journal of Emergency Management, 12*(6), 441-447. doi: 10.5055/jem.2014.0207

Gao, H. (2011). "Harnessing the Crowdsourcing Power of Social Media for Disaster Relief." *IEEE Intelligent Systems, 26*(3), 10-14. doi: 10.1109/MIS.2011.52

Heinzelman, J. (2010). "Crowdsourcing Crisis Information in Disaster Affected Haiti." United States Institute of Peace *Special Reports* series. Retrieved from http://www.usip.org/publications/crowdsourcing-crisis-information-in-disaster-affected-haiti

Rainie, L. (2013). "Cell Phone Ownership Hits 91% of Adults." *Pew Research Center Fact Tank.* Retrieved form http://www.pewresearch.org/fact-tank/2013/06/06/cell-phone-ownership-hits-91-of-adults/

Reardon, M. (2011). "Can We Count on Cell Networks in Disasters?" *CNET.* Web. Retrieved from http://www.cnet.com/news/can-we-count-on-cell-networks-in-disasters/

Starbird, K., Palen, L., Hughes, A. L., & Vieweg, S. (2010). Chatter on the Red: What Hazards Threat Reveals About the Social Life of Microblogged Information. In *Proceedings of the 2010 ACM Conference on Computer Supported Cooperative Work* (pp. 241–250). doi: 10.1145/1718918.1718965