Harnessing Social Media in Response to Major Disasters

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When a nation faces major disasters, collaboration and coordination among government agencies, professional responders, and local communities are needed to effectively respond to large-scale emergency situations. New emerging Information and Communication Technologies (ICT), specifically new social media like Twitter, may greatly empower nationwide disaster response by providing a social space where people gather and share information, express opinions and emotions, coordinate disaster relief activities. For example, in 2001, a local farmer community used a grass roots computer network at the height of the foot and mouth disease crisis in the UK to exchange information, talk to each other, and provide emotional support [2]; People used Twitter for real time situation updates during 2007 California Wild Fires [1]; the 2009 Red River Floods, and the 2009 Oklahoma Grassfires [5].

To better understand the potential of social media in facilitating disaster response, we have conducted a sequence of studies on how Chinese netizens used online social spaces in response to major disasters.

After the 2008 Sichuan earthquake, we studied how people in a popular Chinese online community, the Tianya forum, coped with the catastrophe, and how they used the online forum for disaster response and recovery [4]. In this study, we generated a classification scheme to categorize disaster-related discussions in the online community and identified four major roles an online community may play during disaster response: Information sharing, seeking, gathering, and integrating; opinion expression and exchange; emotional support; and action proposing and coordination.

Continuing our exploration, we examined how Chinese netizens used microblogging in response to the 2010 Yushu earthquake [3]. We conducted content and network analysis on data collected from a popular Chinese microblogging site, Sina-Weibo. We adapted our classification scheme from the previous study to the new social media context, emphasizing situation update and action-related functions. The microblogging trends revealed the shift of attention and activities during different phases of disaster response. And the investigation on the information spreading process shed light on how disaster-related information was disseminated in social networks.

A recent expansion of our works was the investigation of the use of microblogging during the 2010 China floods. Different from previous studies that focused on individual catastrophes that developed in a short period of time and affected a particular geographic area, this study examined how microblog users responded to numerous flood related events such as severe storms and rains, floods, landslides, and dick breaches in 28 provinces in China during a four month period. Especially, we studied how people allocated their attention among different events and activities when they were easily overwhelmed by information from various sources, such as people's own experience and observation, traditional media such as TV and news papers, and the Internet. Several factors that may affect people's attention allocation were identified.

In this article, we will discuss several issues raised regarding harnessing social media in response to major disasters.

INFORMATION GATHERING AND DISSEMINATION

Social media can be used to gather and disseminate situation updates which provide factual information about what was happening in disaster-affected areas. With carefully designed system functions, we can even utilize the "wisdom of crowds" to integrate and validate information from various sources.

Figure 1: User-reported earthquake locations from the Tianya forum (The epicenter is marked by a red triangle)

During the 2008 Sichuan Earthquake, the first earthquake-reporting message on the Tianya forum was posted at the

same minute when the earthquake happened, about 40 minutes faster than news reports. Within 10 minutes, the forum users reported feeling of the earthquake from 22 different cities in China.[4] Figure 1 shows a map mashup of those cities. The forum administers set up a survey "Did you feel it" within the first hour after the earthquake occurred and quickly gathered thousands of responses (Figure 2).

Figure 2. Earthquake survey on Tianya: "Did you feel it?"

During the 2010 Yushu earthquake, thousands of earthquake-related microblog messages were posted on the Sina-Weibo every day. According to our content analysis of a 5% random sample of the earthquake-related messages, 25% of the posts were situation updates [3]. Figure 3 shows the category distribution of those microblog messages.

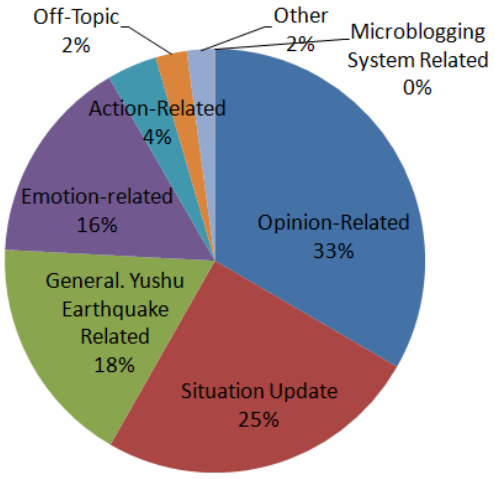

Figure 3. Category Distribution of Microblog Messages

Some of those messages were from primary sources, such as local residents, reporters or rescuers in the earthquake-affected area. The content of those messages mainly contains people's experiences or observations about what was happening in the earthquake area, including extent of damage, official death/injury reports, status of rescue efforts, advice for rescuers and reporters, road conditions and weather reports. Such situation updates are very valuable to improve the situation awareness and to support decision making of government authorities and relief agencies. But most of the messages were from secondary sources – people forwarded messages that they received from primary sources or authorized information sources, such as the national television. Information from secondary sources is also valuable as it improves situation awareness of the whole Weibo community.

Although social media have been proven to be useful sources of situation update, better approaches are needed to effectively identify, validate, and integrate situation updates.

First, it is not easy to identify situation updates from primary sources which are most valuable for government authorities and relief agencies. The reasons are information overload and the probably low signal-to-noise ratio in social media data. For example, our study showed that most situation update messages on Sina-Weibo are from secondary sources and there is no system support for identifying primary sources. To address this challenge, system administrators may develop a verification process for primary sources of disaster-related information, or set up filters for primary sources based on geographic information attached to the messages.

Second, there is a lack of effective approaches to judge the information credibility in social media. On the one side rumors may spread quickly in social media, causing panic in the community. On the other side, people may doubt authentic reports if the sources of the reports are not specified or if they do not trust the information sources. In order to clarify rumors and resolve doubts, human moderators are often needed to evaluate the authenticity of information, judge information quality, and identify rumors. At the same time, we can add automatic mechanism that compare information from different sources, or detect conflicts in the information.

Third, special design features are needed to organize, synthesize, and analyze situation-related information so that people can easily retrieve and make sense of the situation. Social media is a valuable information source during disaster response as everyone can contribute disaster-related information to the community. However, it is hard for people to gain a big picture over the disaster events when facing large amount of fast-updating and heavily redundant information. Additional tools or functions are needed to remove redundancies, track fast-developing disaster events, and summarize or synthesize incoming information. A successful example is the "Did you feel it" survey developed by Tianya administrators after the 2008 Sichuan earthquake. It provided a relatively accurate map of the affected regions immediately after the earthquake. A systematic exploration of such design features is needed to augment the value of social media in disaster response.

Fourth, we should be aware that information gathered from an online community might have a highly skewed distribution over different events, affected by the

importance of an event, people's personal interests, geographic location, and other events happened in the same time period. Make the problem worse, the information dissemination in a social network might be hindered by the fact that only certain types of information can pass certain links in the network (e.g in a microblogging system, a person forwards cooking-related posts from her/his friends, and forwards work-related posts from her/his colleagues, but not vice versa). Further research is needed to understand the diffusion on disaster-related information in social media.

COORDINATION OF RELIEF ACTIONS

There have been anecdotal evidences that online social spaces can be used as platforms to organize or coordinate rescue or relief activities. For example, during the 2008 Sichuan earthquake, a relief foundation posted a request for donations on the Tianya forum. It explained the donation methods in detail and provided information about the foundation's cooperation with authorities and its direct participation in the earthquake relief. In the same discussion thread, the organization reported on the amount of donations received each day and updates on the donation distribution procedure. The thread quickly gained attention and trust from the online community members. The foundation received over 6.3 million dollars from over 660,000 online individual donors within 10 days after the earthquake happened. In both online forums and microblogging systems, we observed many help requests on the most needed rescue materials, such as medicines, tents, rescue equipments, etc., sent by relief organizations and volunteers. There were also people trying to organize relief activities. For instance, some volunteers posted their travel plan and contact information so that other people can join them or send rescue materials to them.

However, there is still a lack of systematic evidence on the effectiveness of using social media as a coordination platform for disaster response. Because the total amount of action-related information is much less than other types of disaster-related information, we face the challenge of improving the visibility of such information. During the 2008 Sichuan earthquake, only 10.7% of the disaster related discussion threads on the Tianya forum were action-related. During the 2010 Yushu earthquake, only 4% of the microblog messages on the Sina-Weibo were action-related, much lesser than information-related or opinion-related messages. Although many people helped to forward or spread those messages, the action and coordination-related messages may quickly "sink" or "fade away" before they can reach the targeted audience because tens even hundreds new posts could be created every minute in a highly active social media space like Tianya or Sina-Weibo. To address this challenge, automatic information filtering mechanisms might be useful to quickly identify posts about donation channels, needed materials, and volunteering activities. Such information then can be highlighted or broadcasted in the system to attract more attention.

Besides the visibility problem, action coordination is particularly problematic in microblogging systems where it is hard to create and share conversation threads among community members. Conversations between two individuals can be held by replying to or forwarding other people's messages in microblogging systems. However, it is very hard to hold a conversation among more than two persons or to publish or share a conversation with others. New design features or add-on applications are needed to facilitate the coordination activities in social media.

EMOTIONAL SUPPORT

After a disaster happened, people often use the online social space as an outlet of their personal emotions: sorrow, anger, empathy, etc. Over 14% disaster-related posts on the Tianya forum during 2008 Sichuan earthquake and 16% disaster-related microblogging messages on the Sina-Weibo during the 2010 Sichuan earthquake were emotion-related. However, in our studies, we didn't find many interactions among community members to give comfort to or receive comfort from others. The main reason might be that the online communities were not directly connected to the victims who need the emotional support most. Even though, it is still important for online community members to express and share their emotional feelings.

OPINION EXPRESSION

Online social spaces also play an important role in in forming public opinions and social norms during disaster response. They may also function as feedback channels for government agencies or disaster response professionals to identify problems in the disaster response process. Nature Language Processing technologies and analytic tools can be adopted to detect, extract, and summarize public opinions and feedback on disaster response.

In summary, social media have shown great potentials in disaster response in respect to situation update, action coordination, emotional support and opinion expression. However, further researches are needed to gain better understanding about the information diffusion process in online social platform and about reaction of and interactions among online community members when facing major disasters. Additional design features or add-on tools or applications are needed to augment the value of current social media systems in disaster response.

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