Context Analysis of Volunteered Geographic Information from Social Media Networks to Support Disaster Management: A Case Study on Forest Fires

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ABSTRACT

The increasing diffusion of integrated mobile devices connected with social networks has changed the way geographic information is collected, distributed and used. Several studies have already investigated the impact of social media during crisis events. Although networks of volunteers have demonstrated the ability to curate a large amount of information reliably, this approach faces issues of sustainability and scalability. Therefore, the authors propose a semi-automatic approach to extract volunteered geographic information from social media networks, to evaluate its quality, and thereby to render it useful during any crisis event. The system presented is novel in its approach in that it focuses less on individual pieces of information, and instead uses (geographic) context to determine quality and utility. This paper presents a successful case study on forest fires, but the system architecture is adaptable to different types of crisis events.

Keywords: Disaster Management, Forest Fires, Geographic Context, Social Networks, Spatio-Temporal Analysis, Volunteer Geographic Information (VGI)

INTRODUCTION

In this paper, we present the evaluation of an automated system to extract and process volunteered geographic information (VGI) from social media networks during crisis events. To this end, we conducted two case studies on forest fires in France, both with encouraging results.

The rationale behind our approach is as follows: The development and adoption of integrated mobile devices like smartphones and their connection with social networks has changed the way information is collected, distributed and used. In the past, information flowed only in one direction, from the “top” of administrations and government agencies to the “bottom” of the broad public. The main communication
channels were traditional broadcasting media like newspapers, radio or television. Horizontal peer-to-peer communication was very limited due to the small reach of the available media (word-of-mouth and letters, later slightly improved through telephones and e-mail). This has changed with the emergence of new information and communication technologies, commonly referred to as the Web 2.0 (O’Reilly, 2005). The Web 2.0 services and platforms have given the public the opportunity to share freely various media through general social networks (Facebook, Google+) or more focused platforms, including text (Blogspot, Wordpress, Twitter), images (Flickr, Picasa, Panoramio), videos (YouTube, Vimeo) and maps (Google-Maps, GeoCommons, MapBox), thus enabling every user to seek and provide information and experiences. This development has also had an impact on the vertical flow of information, with public administrations and agencies adopting the new communication channels to disseminate information to and retrieve information from the public (De Longueville, Annoni, Schade, Ostlaender, & Whitmore, 2010; Palen & Liu, 2007; Puras & Iglesias, 2009; Roche, Propeck-Zimmermann, & Mericskay, 2011).

We can expect that these trends continue in the near future. With increasing wireless Internet access and availability of satellite-based navigation systems such as the Global Positioning System (GPS) in consumer communication devices, a related trend is highly likely: That the amount of public VGI will increase manifold during the coming years.

Several studies have already investigated the impact of (geo)social media during crisis events and show the value for relief workers or coordinators, and the affected population. Examples include wild fires in the United States and France, hurricanes in the United States, the 2010 earthquake in Haiti, and floods in the United Kingdom (Al-Khudhairy, 2010; Bressler, Jenner, & Frost, 2012; De Longueville, Smith, & Luraschi, 2009; Hughes & Palen, 2009; Liu & Palen, 2010; Schade et al., 2011; Sutton, 2010).

However, these studies have also shown that until now these newly created information back channels do not yet integrate well with traditional established emergency response protocols. The two main challenges for integration of VGI into disaster response are the large volume of information, and its unknown and potentially low quality. Consequently, in a crisis management context where inaccurate or incomplete information can have dire consequences including the loss of human life, skepticism by practitioners is understandable. Although networks of volunteers have demonstrated repeatedly the ability to curate a large amount of information reliably, this approach itself faces two main challenges: Sustainability and scalability. There is no guarantee that for any given crisis event, there will be a sufficiently numerous volunteer force. Further, it remains doubtful whether the volunteer approach scales well to the expected increase of information volume.

For these reasons, we propose a semi-automatic approach to filter VGI and evaluate its quality, and thereby render it useful during any crisis event. Human supervision of such a system will remain crucial, because VGI is intrinsically heterogeneous and unstructured: It originates from different persons, using different media such as photographs, text, or video, and authors often overcome device and software limitations in imaginative and unpredictable ways.

The system presented in this paper is novel in its approach in that it focuses less on individual pieces of information, and instead relies largely on (geographic) context to determine the quality and utility of volunteered information. The CONAVI system (CONtextual Analysis of Volunteered Information) is a fully operational proof-of-concept system based on prior research (Ostermann & Spinsanti, 2011). This paper investigates the following two research questions related to the evaluation of CONAVI:

1. Is the reality of forest fire events sufficiently represented in social media to be of any potential use at all, e.g. can we detect real world forest fires through CONAVI?
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