Supporting Crisis Management via Detection of Sub-Events in Social Networks

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ABSTRACT

Social networks provide the opportunity to gather and share knowledge about a situation of relevance. User-generated content is getting increasingly important during crisis management. It facilitates the collaboration with citizens or involved parties from the very beginning of the crisis. The information captured in the form of images, text or videos is a valuable source for identifying sub-events of a crisis. In this study, the authors use metadata of images and videos collected from Flickr and YouTube to extract crisis sub-events. The authors investigate the suitability of clustering techniques to detect sub-events. In particular two algorithms are evaluated on several data sets related to crisis situations. The results show the high potential of the proposed approach. In addition, the authors validate the idea of sub-event detection for the authors' future research based on a survey conducted among practitioners. Their responses show the potential of using social media in combination with sub-event detection during emergency management.

Keywords: *Clustering, Crisis Management, Information Retrieval, Metadata, Sub-Event Detection, User-Generated Content*

INTRODUCTION

In crisis management a large number of different actors work together for handling the crisis situation (Hiltz, van de Walle, & Turoff, 2010). This collaboration would not work without knowledge sharing between the involved parties. It is essential to gather and share information during a crisis to gain several perspectives for enabling clarification and stabilization of the situation. Hence, consulting social media platforms turns out to be an interesting instrument, not only for information sharing but also for communication and collaboration, as stated in (Yates & Paquette, 2011).

There exist two aspects where social media can support crisis management. First, social media is used to involve citizens. People use

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existing social network platforms because they are familiar with them for documenting (standard) situations. So, they can apply these platforms in any situation they are involved in. This aspect is especially of importance if it is not possible to be at the scene from the very beginning and/or when sudden new situations emerge. Social media platforms have a high value in crisis management, given that people increasingly use social media platforms to document the situation they are engaged in Palen (2008). Second, social media platforms can also be used as collaboration and documentation tools for first responders, enabling knowledge sharing and information gathering. For example, during emergency response of the Haiti earthquake, social network platforms were used for collaboration (Yates & Paquette, 2011). Collaboration in this paper is restricted to the spreading of information about a crisis situation by different people and via different social media infrastructures. At the practical level, different organizations may collaborate to make use of the information collected from people and to coordinate their actions to efficiently cope with the emergency.

Therefore, the data directly collected from response teams or any sensors in the field is an important source (Lachner & Hellwagner, 2008). Independently of the origin/purpose of the used social media platforms, such information is worth using for gaining an overview of the situation. Clearly, the amount of data collected (especially for a large scale crisis) is overwhelming. Data overload (especially for unstructured data, like e-mails) is one of the most challenging problems within crisis management (Turoff, Chumer, Walle, & Yao, 2004). To help the first responders to deal with the situation at hand, automatic processing/analysis of the collected data is valuable.

In this contribution, we describe a general framework for analyzing data collected from social networks for supporting crisis management. We use in particular Flickr and YouTube information to detect sub-events (i.e., special hotspots) related to a crisis situation.

Events are often described as a whole (e.g., concerts, festivals like in Becker, Naaman, and Gravano (2010), or soccer games), not considering the different aspects an event has. However, events can be segmented into sub-events, describing important facets of that event. Hence, sub-events show situations which are of particular importance.

The same is true for a crisis situation. Crisis situations contain different *sub-events* (or *mini-crises* (Yates & Paquette, 2011)) on which crisis management has to focus on; e.g., at different places a crisis has different consequences. Considering an earthquake, at one place some buildings may collapse, whereas in another place a fire may break out. These sub-events need special attention in crisis management to stabilize the situation, as sub-events describe dominant threats in a crisis.

Hence, we specify an event via time and location (Yang, et al., 1999) describing the parent context in which sub-events occur. Concluding, the event describes the crisis context, like the *UK riots 2011*, and sub-events define more refined parts, e.g., *looting in Hackney London*. Thus, detecting such sub-events as soon as possible helps in efficiently managing the situation. Sub-event detection aims at identifying potential and dominant threats of a crisis.

Collaboration with those people that have information from the very beginning is vital. Therefore, the broad acceptance of social media, also in crisis situations, in the public enables this collaboration and makes the application of sub-event detection a powerful tool in the context of automatic analysis.

We study clustering techniques for their appropriateness (i.e., possibility to identify known threats of an incident) in sub-event detection which is applied for analyzing data in existing social media platforms. Based on our previous work (Pohl, Bouchachia, & Hellwagner, 2012), we evaluate two different clustering techniques: Self-Organizing Maps (SOM) and Agglomerative Clustering (AC). Additionally, we evaluate our idea of sub-event detection by conducting a survey among practitioners from various fields. The survey shows if we should