



Review

Twitter as a tool for the management and analysis of emergency situations: A systematic literature review



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ABSTRACT

The importance of timely, accurate and effective use of available information is essential to the proper management of emergency situations. In recent years, emerging technologies have provided new approaches towards the distribution and acquisition of crowdsourced information to facilitate situational awareness and management during emergencies. In this regard, internet and social networks have shown potential to be an effective tool in disseminating and obtaining up-to-date information. Among the most popular social networks, research has pointed to Twitter as a source of information that offers valuable real-time data for decision-making. The objective of this paper is to conduct a systematic literature review that provides an overview of the current state of research concerning the use of Twitter to emergencies management, as well as presents the challenges and future research directions.

1. Introduction

An emergency situation occurs when there is an interruption in the normal dynamics of the economic, cultural, social or political life of a location (Hagar, 2011). These situations produce both an increase in communication and complex information scenarios, which are difficult to manage (Laylavi et al., 2017). Furthermore, these situations present a challenge for the responsible authorities and emergency services, since they may present physical dangers for the people who provide information, as well as a high demand in the active management of them. Understanding what is happening during and in the aftermath of an emergency situation is essential for the reduction of human and economic impacts of the incident. Therefore, access to timely and accurate information is essential to make timely decisions and to take immediate actions (Alexander, 2015; Laylavi et al., 2017; Kim, Bae, & Hastak, 2018; Li, Zhang, Tian, & Wang, 2018).

Traditionally, newspapers, radio and television were the responsible media for the dissemination of information regarding an emergency situation. These media provide only one-way communication in which information was usually produced by official organizations (Schneider & Check, 2010). Nowadays, the use of communication devices is growing significantly, thanks in large part to technological advances and the new Information and Communication Technologies (ICT). These advances have caused that the current communication devices are becoming more and more accessible to the society, generating a

new communicative space in which communication is bidirectional or multidirectional, that is, they allow an active communication between sender and receiver (Avvenuti, Cimino, Cresci, Marchetti, & Tesconi, 2016; Capriotti & Ruesja, 2018; Han, Min, & Lee, 2015; Kamboj, Sarmah, Gupta, & Dwivedi, 2018; Martínez-Rojas & Rubio-Romero, 2017; Wang, Gao, & Yang, 2017; Wu & Shen, 2015). In this context, mobile phones, Internet and social networks symbolize this new channel of information, which assists in the generation of situational awareness. This concept refers to having an accurate perception of the situation, ability to quickly recognize a change in that situation, understanding the impact of any change and being able to project the situation in the near future (Alcaide, 2013). Nowadays, in most cases, the first news about an emergency situation appears on social media channels rather than traditional new sources (Kim & Hastak, 2018; Laylavi, Rajabifard, & Kalantari, 2016).

Focusing on the social networks, Twitter is one of the platforms which presents a greater potential in providing information in the management of emergency situations due to the ease of use and its instant nature (Simon, Goldberg, & Adini, 2015; Williams, Terras, & Warwick, 2013). This social network has around 313 million active users monthly, 1000 million unique monthly visits to sites with embedded Tweets and 82% active users on mobile devices (Twitter, 2018). Twitter allows users to quickly share information and the interaction with other users, who may not be connected to your network, through specific topics, *hashtags*. The hashtags allow to search for information

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on specific topics (Aladwani, 2015).

Once the user posts a tweet, it is expanded instantly to a large community, providing some advantages but also some drawbacks. The strengths of this social media include: audience increase, instant communication, real-time information, direct support for response efforts (Aladwani, 2015; Gao, Barbier, & Goolsby, 2011; Landwehr, Wei, Kowalchuck, & Carley, 2016; Schneider & Check, 2010; Schulz, Thanh, Paulheim, & Schweizer, 2013; Yates & Paquette, 2011). Nevertheless, Twitter also presents limitations that make the use of these data difficult in the context of an emergency situation: no verified information, rumor spread, imprecision in data, irrelevant information (Carley, Malik, Landwehr, Pfeffer, & Kowalchuck, 2016; Castillo, Mendoza, & Poblete, 2011; Hughes & Palen, 2009; Kapoor et al., 2018; Laylavi et al., 2017; Stieglitz, Mirbabaie, Ross, & Neuberger, 2018; Thomson et al., 2012).

Nowadays, there is a growing interest in this research line since data from Twitter might represent an interest in all phases of an emergency situation, namely, from the initial to later phases. In the literature there are proposals focusing on the early warning phase or the planning phase (Carley et al., 2016; Landwehr et al., 2016). In this regard, some public institutions are present in the social network in order to provide alarms and offer new information through the network (Ai, Comfort, Dong, & Znati, 2016; Basher, 2006; Chatfield & Brajawidagda, 2012). On the other hand, many proposals focus on the use of social media for disaster response in order to coordinate resources and identify the needs of the affected people (Gao et al., 2011; Muralidharan, Rasmussen, Patterson, & Shin, 2011). Therefore, Twitter is becoming an essential media for sending alerts, identifying critical needs, and focusing the response. Additionally, there is a growing interest in the use of Twitter not only for the communication of information, but also for knowledge discovery of Twitter data (Williams et al., 2013). This research line takes advantage of already published data by applying data mining and information retrieval approaches, which provide improvements for the management of emergencies from another perspective (Sotsenko, Jansen, Milrad, & Rana, 2016; Zheng et al., 2013).

The main objective of this article is to review the existing literature where Twitter data are used to support the management of emergency situations. For this purpose, a methodological approach based on a systematic literature review is proposed, which provides an overview of the current state of research, as well as presents the challenges and future research directions.

After this introduction, the remainder of the paper is structured as follows. Section 2 is devoted to explain the methodological approach to analyze the current state of literature. Section 3 details the results according to different analyzed variables. Section 4 summarizes current state and challenges while Section 5 provides a research agenda for practitioners and researchers. Finally, Section 6 presents the conclusions.

2. Review method

This section outlines the methodological approach that will provide an overview of the current state of research regarding the use of Twitter for the management of emergencies.

For this purpose, the systematic literature review is proposed, which is a means of identifying, evaluating and interpreting all available research relevant to a particular research question, or topic area, or phenomenon of interest (Kitchenham, 2007). The review follows the guidelines developed by Kitchenham (2007), dividing the research into three phases: (i) planning the review, (ii) conducting the review, and (iii) reporting the final review results itself. Fig. 1 graphically summarizes the objectives of each of these phases, that are addressed in next sections.

2.1. Planning phase

Prior to address a systematic review it is necessary to confirm the need for such a review (Kitchenham, 2007). Then, in this phase, it is necessary to set the research questions that the systematic review will address as well as to define the criteria regarding both literature sources and keywords search.

2.1.1. Research questions

In the first phase, it is necessary to draft clear and concise research questions which drive the entire systematic review methodology. As the objectives of this article are; to analyze the use of Twitter in emergencies, to explore technologies and to identify use cases, the following questions have been selected:

- Q1. How much Twitter activity has there been regarding emergency situations?
- Q2 Which journals and conferences lead this research topic?
- Q3. What are the main objectives addressed by the authors?
- Q4. What are the application domains where Twitter has been applied?
- Q5. What are the applied methodologies?
- Q6. What are the limitations of current research?

To address Q1 and Q2, the number of documents published per year and the journal/conferences that published them are identified. Regarding Q3, Q4 and Q5, the scope of the study is analyzed, as well as the use case and the applied techniques applied by authors. Finally, Q6 points out the main limitations and disadvantages of the analyzed proposals.

Additionally, in this initial phase, the criteria in relation to the literature sources and keyword search are established. For example, the analysis may include documents written only in English language or published in a given database. Next section details the criteria concerning the search process that will allow us to analyze the proposals using Twitter information for emergency management.

2.2. Conducting phase – data collection search process

In this section, firstly, the search process is described and secondly, the qualitative process for document filtering is detailed.

The following digital libraries have been selected in this review since they are identified as relevant to the domain of information and communication technologies and social science: IEEE Xplore,¹ Scopus,² ScienceDirect³ and ISI Web of Science.⁴ These databases enable to search through different fields such as title, author, Keywords, abstract, references, etc. as well as to select research domains, publication years, type of documents, etc. The way of performing the search on these databases is different depending on the database itself and the operators and fields we used. For example, ScienceDirect allows to perform a search considering, at the same time, the “Title/Abstract/Keyword” while IEEE Xplore or ISI Web of Science allows a more exhaustive search by taking into account different fields for each term we want to search.

In this work, we focus on the title, abstract and keyword as searching fields. By using these fields we make sure that we will obtain a large number of documents as a result of the search, which goes beyond the scope of this work. Therefore, in order to obtain adequate results concerning the objective of this work, we consider “Twitter”, “emergencies”, “emergency and management” as terms to perform the

¹ <https://ieeexplore.ieee.org/>.

² <https://www.scopus.com/>.

³ <https://www.sciencedirect.com/>.

⁴ <http://wos.fecyt.es/>.

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