Chapter 45
Processing Big Data for Emergency Management

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ABSTRACT

Emergencies are typically complex problems with serious consequences that must be solved in a limited amount of time to reduce any possible damage. Big data analysis leads to more assured decision making and better decisions can mean greater operational efficiencies, cost reductions and reduced risk. In this chapter, we discuss some issues on tackling emergency situation from the perspective of big data processing and management, including our approach for processing social media content. Communications during emergencies are so plentiful that it is necessary to sift through enormous data points to find information that is most useful during a given event. The chapter also presents our ongoing IT-system that processes and analyses social media data to transform the excessive volume of low information content into small volume but rich content that is useful to emergency personnel.

1. INTRODUCTION

During a disaster, life-saving decisions are often made based on the most current information of a situation and past experiences in similar circumstances. While that's a tried-and-true approach, the availability of complex, computer-generated data streams is changing the ball game for emergency service providers. Hence effective management of emergencies and disasters is a global challenge in big data era. A systematic process with principal goal to minimize the negative impact or consequences of emergencies and disasters, thus protecting societal infrastructure, is called effective emergency and disaster management. It is imperative throughout the world to increase knowledge of emergency and disaster management, for the purpose improving responsiveness. All the above aims may be accelerated by big data analysis.

Big data may be characterized as having four dimensions: Data volume, measuring the amount of data available, with typical data sets occupying many terabytes. Data velocity is a measure of the rate of data creation, streaming and aggregation. Data variety is a measure of the richness of data representation – text, images, videos etc. Data value, measures the usefulness of data in making decisions

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(Akerkar 2013a). Variability, which represents the number of changes in the structure of the data their interpretation, is a newly added characteristic.

The management of such big data is perhaps one of the key challenges to be addressed by informatics. The wide variety of data acquisition sources available in times of emergency creates a need for data integration, aggregation and visualization. Such techniques assist emergency management officials to optimize the decision making procedure. During the outburst of an emergency, the authorities responsible must quickly make decisions. The quality of these decisions depends on the quality of the information available. A key factor in emergency response is situational awareness. An appropriate, accurate assessment of the situation can empower decision-makers during an emergency to make convenient decisions, take suitable actions for the most affective emergency management.

This chapter is divided into six sections. Section 2 presents various kinds of applications of big data in emergency cycle. Essential smart technological research approaches are discussed in section 3. Various research issues, concerning with big data, are elaborated in section 4. Section 5 describes key challenges and steps for processing social media contents. This section is underlining our approach for emergency management utilizing social media data. The chapter concludes in section 6.

2. BIG DATA AND EMERGENCY CYCLE

Big data is the technological paradigm that enables useful analysis of vast quantities of data to be achieved in practice. Big data is the collection of scientific and engineering methods and tools for dealing with such volumes of data, and addresses not merely the storage but also access to and distribution, analysis, and useful presentation of results (such as visualisation of analysis of the data) for huge volumes of data. Big data is becoming a critical part of emergency communication. Emergency communication does not involve only intentional, explicit exchange of messages – for example first responders talking over a voice connection, or an announcement of a text message warning to citizens threatened by an approaching natural disaster. To be more precise, emergency communication also involves the monitoring and understanding of the complete body of public, openly available communication – such as messages and content being publicly exchanged on social media. Thus, individuals may be reporting their condition to loved ones or making specific requests for help, but a complete analysis of all communications can reveal valuable information of general scope, such as a disease outbreak.[1]

Usually, emergency cycle consists of three phases. “Prevention” and “Preparedness” are conducted *before* an emergency occurs in order to eliminate or reduce the probability of an emergency and to build emergency management capacities. “Response” activities provide emergency assistance to save lives, preserve property and protect the environment *during* an emergency. “Recovery” is the process of returning systems to normal levels *after* an emergency. Big data has been used in all phases of the emergency management cycle as shown in the following Table 1.

Open initiatives and new applications for big data constitute a genuine opportunity to provide decision makers with powerful new tools for tracking and predicting hazardous events, protecting vulnerable communities, understanding human factors and targeting where to optimize programs and policies. For several “data deficient” countries and communities accessing big data can increase credibility and value of meteorological forecasts and warnings. Turning big data sets – satellite images, in situ and mobile sensor observations, online user-generated content, environmental data archives, weather and water forecasts, and climate model results, etc. – into useful and actionable information and integrating this complex