Real-Time Data Visualisation in Collaborative Virtual Environment for Emergency Management

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ABSTRACT

A collaborative virtual environment (CVE) is a shared virtual environment used for collaboration of many participants that may be spread over large distances. CVEs have been widely used in emergency management, especially for education, training and assessment. This paper describes the design and implementation of a prototype system that facilitates emergency management via a CVE using real-time spatial information. In particular, a method for automatic integration, modeling and visual simulation using real-time data from multiple online sources is proposed. Moreover, strategies are presented for using CVE-based scenarios for carrying out training, and testing preparedness measures. A novel technique has also been developed for real-time situation monitoring. Based on a system development (SD) research approach, the performance and functionality of the system was tested and evaluated. The use of real-time data acquisition and simulation was deemed to improve the processes of emergency management by increasing engagement, enhancing training and supporting decision-making of first responders and emergency managers.

Keywords: Collaborative Virtual Environment (CVE), Emergency Management, Geographic Information System, Geovisualisation, Real-Time Data

INTRODUCTION

Information and communication technology (ICT) plays an important part in enhancing emergency managers’ and decision-makers’ capabilities to deal with emergencies. The availability and quality of information are central to effective emergency management. ICT also enables emergency management organisations, fire service personnel, first responders, homeland security and the general public to conduct necessary activities in any phase of an emergency in a faster and more effective way. Information critical to emergency management
includes: spatial information of hazard areas; weather and climate conditions; location, status, scale of incidents happening; estimated losses and casualties; evacuation route and responders information (Chen, Sharman, Chakravarti, Rao, & Upadhyaya, 2008). The importance of effective and efficient emergency management implies the use of recently developed tools and technologies to access information. Novel technologies are being applied to handle various kinds of information. These include: Internet, wireless technology, Geographical Information System (GIS), direct and remote sensing, emergency management decision and support systems, hazard analysis, modelling and warning systems, and wireless sensor networks (Rao, Eisenberg, & Schmitt, 2007). These emerging tools and technologies can enhance communication capabilities, and make the usage of information more comprehensive, ready-to-go, user-friendly and affordable.

An essential property of information is its spatial attribute, which may refer to the location of an incident, real-time position of a vehicle or evacuation routes in the context of emergency management. Such information is often categorised as geospatial information and can be manipulated by GIS. GIS technology is important for emergency management because it enhances management capability by digitally capturing, storing, analysing and manipulating spatial information, and it takes effect in all phases of emergency management (Figure 1). For example, in the emergency prevention and mitigation phase, decision-makers can evaluate the consequences of potential earthquake incidents based on spatial information, such as land use, terrain slope, soil condition, and other geologic data (Alparslan et al., 2008).

Another property of information is its time attribute. In emergency management, time has been highly emphasised due to its limited and critical nature during an emergency. It is particularly important to deliver up-to-date data as quickly as possible, as timely provision of information can greatly help in the decision-

Figure 1. Emergency management using geo-spatial information: Toxic spill in Williamstown, Victoria (adapted from SpatialVision, 2010)
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