Chapter 12
Spatial Relations in Contextual Information for Mobile Emergency Messaging

Alaa Almagrabi
Latrobe University, Australia & King Abdulaziz University, Saudi Arabia

Seng W. Loke
Latrobe University, Australia

Torab Torabi
Latrobe University, Australia

ABSTRACT

Responding to a disaster is a process that should take the least time with high-level information. It requires human decisions that could delay the whole process, thus putting more lives at stake. However, recent technological developments improve this process by facilitating decisions within the domain. Discovering the spatial relationship can help to clarify the spatial environment for the domain. In this chapter, the authors give an overview of using spatial modelling and spatial relations for context-aware messaging with emphasis on emergency situations. They utilize various existing spatial relations recognized within the field of spatial computing such as RCC8 and Egenhofer relations. The RCC8 and Egenhofer relations are examined besides a range of spatial relations using English phrases in Mona-ont emergency ontology. The Mona-ont emergency ontology is used to describe emergency scenarios. The Mona-ont emergency ontology is employed by the Mona Emergency System (MES) that generates alert messaging services to actors within a disaster area. The authors demonstrate the validity of the Mona-ont spatial relations in describing a (fictitious) flood situation in the Melbourne CBD area. They also prescribe the structure of such context-aware messages (i.e. their content and target description) for the MES system.

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1. INTRODUCTION

Disasters are unavoidable, though modern science can predict the upcoming event, but the key to avoid such unfortunate episodes are yet to be discovered. The development of advanced technology for disaster management can offer benefit by decreasing the period of decision making (Bonham-Carter, 1994). Emergency management rests on three pillars: knowledge of history, an understanding of human nature expressed in the social sciences, and specialized technical expertise in response mechanisms (Canton, 2006). Emergency systems submit to the procedures that we establish in place in order to help us successfully deal with disasters (Berry, 1996). Advancement in technologies, changes in geographic scenarios and political differences, have made it mandatory for the deployment of an enhanced emergency management system. The evolving threats, the realities of global climate change and social, economic, and political environments demand further innovative approaches and management (Haddow, Bullock, & Coppola, 2010)

During disasters, many lives can be lost because of inefficiently managed rescue operations. In the case of any disaster, besides the government controlled rescue workers, many private or NGOs (Non Government Organizations) get involved in the rescue operation. Every rescue team operates using it's own independent communication system. This can slow the deliverance of protection to the victims, thereby creating complications in the entire operation. Emphasis should be put on coordination among all the different rescue teams. Usually, the rescue teams are monitored and controlled by a single leader. However, in order for the system to operate effectively, the system needs to be spatially aware about the individual contexts of personnel and systems, and the existence of other systems and their relations to each other. In their study Holzmann, and A. Ferscha, (2010) stated that spatial awareness is defined as follows: "Spatial awareness allows the system to determine and use it's spatial properties to relate these properties to the spatial properties of other systems". Spatial awareness requires spatial contexts to be acquired via sensors, for such contexts to be represented and interpreted, and shared among diverse networked systems, as in context-aware applications (Dey, 2001) & (Salber, Dey, & Abowd, 1999)

Also, the level of abstraction of the representation of spatial context is important. For example, some systems using location information might only be concerned with high-level information like rooms and buildings instead of geographical coordinates. Many researchers have been addressing such symbolic representations of locations (Ferscha, C. Holzmann, & S. Oppl, 2004). For example, "left" or "near" can be a replacement for numeric angles or distances can be discovered, as in (Kortuem, Kray, & Gellersen, 2005). However, one of the fundamental problems of representing spatial data within a building is the need for it to be formally defined and standardized (Ekholm, & Fridqvist, 2000) . Furthermore, space can be formalized in a logical language using an ontology. An ontology is used to represent a particular situation or domain by determining the concepts that represent the domain and the relations between these concepts. Ontology allows knowledge to be shared and reused (Blomqvist & Öhgren, 2008).

The aim of this chapter is to review work on describing spatial modeling and spatial relationships especially with their usage in emergency systems in mind. The chapter will discuss the methodology to describe spatial relationships for context-aware messaging and apply it to an example emergency scenario. Furthermore, the chapter defines the spatial relations for our Mona-ont emergency ontology that operates in our Mona Emergency System (MES). The MES aims to disseminate alert messages to the user in the time of disasters using context information. In addition, we use selected existing spatial relations used and identified in the literature (e.g., RCC8 and Egenhofer relations[1]), with an interpretation for these notions, to describe the Mona-ont spa-