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**Design and Evaluation of Mass Evacuation Support Systems
Using Ontologies for improved Situation Awareness**

A dissertation presented in partial fulfilment of the requirements for the degree

of

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Abstract

Large-scale emergencies, such as tsunamis, are managed by several teams, e.g. emergency managers, military, police, fire services, health care professionals, etc. Close co-ordination within and between teams is essential since the failure of a single link can risk the whole operation, for example, the mass evacuation of a city or region. Decision-making in such emergencies is necessarily complex as the situations are dynamic, unfolding rapidly, and invariably stressful. Computerised decision support systems can facilitate and improve co-ordination and decision making by presenting, structuring, processing, and interpreting huge amounts of information in a short span of time.

However, the power of such systems is enhanced even further if they are designed to improve the situation awareness (SA) of individual managers, their shared situation awareness (SSA), and team situation awareness (TSA). The goal is to ensure that team members have a comprehensive understanding of the situation, not just for their individual roles but also for the roles of their colleagues. The aim of the thesis is to design a computer based information system to support SA, SSA, and TSA of emergency managers for effective decision making and collaborative task performance. The thesis describes elicitation of the information requirements for various emergency management roles during a mass evacuation using a cognitive task analysis technique. Based on the requirements, it explains the design and development of a computer based system dubbed Situation Aware Vigilant Emergency Reasoner (SAVER) using ontologies for situation assessment and reasoning.

It is demonstrated that ontologies can be used to classify the SA information since they can model the situations in detail and allow the inference on rules and axioms. Ontology based reasoning successfully provided the automatic situation assessment according to the SA levels. The thesis also details the evaluation of SAVER by measuring SA, SSA and TSA of emergency managers using Situation Awareness Global Assessment Technique (SAGAT) in simulated mass evacuation scenarios. The evaluation demonstrated the superior performance of the computer based system for improving SA, SSA and TSA of emergency managers. Moreover, the user interfaces of SAVER were also evaluated positive for the human computer interaction (HCI) parameters such as usability, ease of use, understandability, learnability, functionality, etc.

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List of Publications

- Javed, Y., Norris, A. C., & Johnston, D. M. (2012). Situation Awareness and the Design of Emergency Management Systems for Mass Evacuation: A Literature Review. (Under review). *Elsevier: Decision Support System and Electronic Commerce*.
- Javed, Y., Norris, A. C., & Johnston, D. M. (2012). Improving Situation Awareness for Mass Evacuation Decision Making Prototype SAVER (Under review). *InderScience: Special Issue in An Interdisciplinary Approach to Crisis Response and Management*.
- Javed, Y., & Norris, A. C. (2012). *Design, Implementation and Evaluation of an Emergency Management System to enhance Situation Awareness*. General Sir John Kotewala Defence University Annual Symposium 2012, Ratmalana, Srilanka.
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- Javed. Y, Norris. A. C., & Stockdale. R. (2008). *Key IT-based Capabilities for Disaster Management and Problems in implementing related promising technologies(Short paper & poster)*. In Proceedings of 2nd Australasian Disaster Management Conference 2008. Wellington , New Zealand.