Ubiquitous Computing for Personalized Decision Support in Emergency

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ABSTRACT

Ubiquitous computing opens new possibilities in various aspects of human activities. The paper proposes an approach to emergency situation response that benefits from the ubiquitous computing. The approach is based on utilizing profiles to facilitate the coordination of the activities of the emergency response operation members. The major approach underlying idea is to represent the operation members jointly with information sources as a network of services that can be configured via negotiation of participating parties. Such elements as profile structure, role-based emergency response, negotiation scenarios, and negotiation protocols are described in detail.

Keywords: Emergency Response, Negotiation, Profile, Service, Ubiquitous Computing

INTRODUCTION

Critical aspects of decision support for emergency situation management incorporate managing and controlling sources of information, processing real-time or near real-time streams of events, representing and integrating low-level events and higher level concepts, multi-source information fusion, information representation that maximizes human comprehension, reasoning on what is happening and what is important (Jakobson et al., 2005; Scott & Rogova, 2004; Smirnov et al., 2007).

Although many research efforts are aiming at investigating the issues above, an efficient complex solution is still required in this field. The paper proposes an innovative approach based on emerging information technologies to contribute into emergency decision support. The
present research considers the emergency situation management that incorporates the following types of operations: first aid, emergency control, and evacuation. These operations can involve autonomous entities like public/governmental organizations, different private organizations and volunteers (referred to as operation members). Particularly, an event of fire is considered as an example of the emergency situation that requires the emergency response operation.

Organization of collaborative environments out of autonomous entities is a focus of approaches aimed at building context aware decision support systems (e.g., Kwon et al., 2005; Burstein et al., 2009), self-optimization and self-configuration in wireless networks (Cordis, 2008), organization of context-aware cooperative networks (Ambient Networks, 2006) and collaborative context-aware service platforms (Ejigu et al., 2008), etc.

This work proposes an approach to developing a decision support system intended for situation management. The approach benefits from certain features of ubiquitous computing and incorporates technologies of context management, intelligent agents, Web-services and profiling. Ubiquitous computing (ubicomp) is a post-desktop model of human-computer interaction that thoroughly integrates information processing into everyday objects and activities. In the course of ordinary activities, someone “using” ubiquitous computing engages many computational devices and systems simultaneously, and may not necessarily even be aware that they are doing so (Wikipedia, http://www.wikipedia.org).

The technology of Web-services is used as a technology allowing the heterogeneous resources (operation members and information sources) to cooperate for a common purpose. This technology defines formal interface agreement (Austin, Barbir, Ferris, & Garg, 2004), however, does not address the semantics of those interfaces. An agent-based service model is used to provide the Web-services with semantics and to turn them into active collaborative components. In different approaches integration of intelligent agents and Web-services has been applied for various purposes, for instance, it served as a basis for distributed service discovery and negotiation system in B2B (Lau, 2007; Moradian, 2010) describes a way to protect sensitive business information against being disclosed, modified and lost. In the presented approach the agents “activate” Web-services when required and make Web-service descriptions sharable via ontology.

In real life situations consideration often must be given to their continuous changes including people movement, traffic situation (traffic jams, closed roads, etc.) that makes the problem quite complex and requires its real-time solving. For this purpose the approach utilizes the technology of context management; at that, the context is constantly updated to provide up-to-date information for situation management.

Application of the profiling technology significantly facilitates the emergency situation management. Dynamic profiles are considered, for instance, in Carillo-Ramos et al. (2007) and Kirsch-Pinheiro et al. (2006). The authors of Thomsen et al. (2009) propose dynamic user profiles that reflect the current situation of the user (e.g., his/her location). In the presented approach the profile is considered as an information source for forming the situation context. The operation member profiles contain such information as available transportation, current geographical coordinates, competencies, preferences, as well as roles of the response operation members. Competencies are described by operation members’ capabilities, capacities, price-list in case of implementation by a private organization, and agility. The preferences determine the constraints preferable for the operation members.

The rest of the work is structured as follows. First, the motivating scenario is described. Then major principles of the proposed approach and main basic approach components like the profile structure, role-based situations in emergency, negotiation scenarios, and negotiation protocols are discussed successively; most important results are summarized in the conclusion.
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