Interaction Design Principles for Web Emergency Management Information Systems

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ABSTRACT

The interaction design for web emergency management information systems (WEMIS) is an important aspect to keep in mind due to the criticality of the domain: decision making, updating available resources, defining a task list, and trusting in proposed information. A common interaction design strategy for WEMIS seems to be needed, but currently there are few references in literature. The aim of this study is to contribute to this lack with a set of interactive principles for WEMIS. From the emergency point of view, existing WEMIS have been analyzed to extract common features and to design interactive principles for emergency. Furthermore, the authors studied design principles extracted from a well-known (DERMIS) model relating them to emergency phases and features. The result proposed here is a set of design principles for supporting interactive properties for WEMIS. Finally, two case studies have been considered as applications of proposed design principles.

Keywords: Design Methodologies, Emergency Life Cycle for Decision Support, Human-Computer Interaction, Interactive Principles, Models for Communication and Information Interaction

INTRODUCTION

The management of information and resources is a crucial activity for the agencies and organizations managing emergency situations. The scope of Emergency Management Information Systems (EMIS) is to support the activities usually performed by emergency workers: they are focused on the organization of available information and resources (Van de Walle & Turoff, 2007). Emergency management is a collaborative and multi-organizational endeavor (Waugh & Streib, 2006) and, therefore, EMIS have to provide communication channels and collaborative tools for teams that are not only geographically distributed but also functionally independent. By functionally independent we mean that different teams might have different goals, perspectives and operation protocols. Nowadays, many agencies and organizations for emergency management use web-based EMIS.
(WEMIS) as a support tool for the cooperation and the coordination in different emergency phases. WEMIS employ Internet protocols and facilities for the communication during coordination activities. Eventually, they do not require an installation procedure and they have a high portability: all devices with an Internet connection can access to them. In this way, also people that work in direct contact with the emergency area, as firemen or policemen, can use them with mobile devices and communicate with coordination offices.

In this paper, we focus on WEMIS that make it possible to efficiently communicate and share information. More specifically, our interest lies on the design of the interaction with WEMIS. Emergency workers have to manage complex situations where short time decision making is fundamental: victims and damages depend on the emergency solution strategy. For this reason, users need a quick and trustworthy interaction with the system: they have to know exactly the next task to perform, which kind of results and consequences to expect, and which information and status have to be updated. In other words, the WEMIS has to support at some level situation awareness (Endsley, 2000) by providing accurate, timely and appropriate information at each stage so that each user can understand the situation (situation assessment) and decide how to react properly. Considering emergency management as a team work, we should transcend the concept of situation awareness to move onto activity awareness which is the “awareness of project work that supports group performance on complex tasks” (Carroll et al., 2003). Even though no system can guarantee situational or activity awareness, a good interaction design can help to support it by ensuring that users will have the right information at the right time and in the right form both concerning the situation as well as the performance of other cooperating teams.

The design of the interaction with the WEMIS is therefore a cornerstone as systems should support users in developing their tasks without interfering with their usual protocols or imposing any kind of burden (Carver & Turoff, 2007). Moreover, the adoption of this kind of systems is not straightforward as many factors influence their real usage in emergency situations (Aedo, Diaz, Carroll, Convertino, & Rosson, 2009). For instance, the subjective impressions of users about their personal capability to use the system, the degree of control, the support from other colleagues or from the organization, have a strong influence in the final decision to use a system (Mathieson, Peacok, & Chin, 2001). The interaction design process for WEMIS needs to address all these issues properly: a possible approach could be the participatory design where users and stakeholders are actively involved.

There are some design principles like those defined in (Turoff, Chumer, Van de Walle, & Yao, 2004) but until now, interactive design models have not been specifically defined for the emergency domain and in particular for WEMIS. The aim of our work is to contribute to this lack to guarantee a quick and trustworthy interaction among users and systems improving the entire emergency management. Our proposal is a set of formal interactive principles that designers could apply during the design process of WEMIS.

In the first section, we present a survey about existing WEMIS to find out common characteristics and design aspects. In the second section, we categorized WEMIS features into twenty-three different classes relating them with emergency supported by the framework proposed by Chen, Sharman, Rao, and Upadhyaya (2008). In the third section we present our main contribution, a set of interactive properties for WEMIS. We relate features’ classes, as previously defined, to a set of design principles extracted from a specific design model for the emergency management domain: DERMIS (Turoff, Chumer, Van de Walle, & Yao, 2004). In the fourth section these principles have been formalized using the PIE model (Dix, Finlay, Abowd, & Beale, 2004), obtaining a number of formal interactive properties fulfilled if our design principles are employed. Finally, two case studies have been considered as application of proposed interaction design principles.
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