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Additional Information

# Crowdsourcing as a way to increase situational awareness of C&C Centers for emergency response

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## ABSTRACT

Rescue operations in most disasters are heavily dependent on accurate situational awareness. Having accurate and complete information is the key for making good decisions. A large amount of such information is contextual, that is, it is variable and needs to be taken from the disaster scenario by different means. While "Be safe! Stay away! Let professionals do the work!" is the typical approach of rescue operators with regard to people, there are also advantages of public engagement considering that *Citizens generally have a better knowledge of the stricken area and know the daily routines of their family, friends and neighbors. This means that they can help in describing affected areas as well as in localizing possible victims.* Inspired by the last sentence, we propose a framework based on these concepts and describe the set of actions that would make it possible. The framework named PENSAD stands for "Public Engagement to increase Situational Awareness in Disasters".

## Author Keywords

crowdsourcing; situational awareness; emergency management

## ACM Classification Keywords

H.5.3 [Group and Organization Interfaces]: Computer-supported cooperative work.

## General Terms

Human Factors; Design.

## DESCRIPTION OF THE PROPOSAL

There is a wide range of attitudes of citizens affected by disasters. The most common and natural is the "run for your (and your family) lives". In a hazardous situation, people try to escape from danger as quick as possible. Although

this is not a straightforward action, once they are out of risk they become spectators. In contrast, the other extreme attitude is that where people attempt to work as rescuers themselves, working side by side with rescue operators. This is particularly true when victims are close members of the family. This attitude is counterproductive, except in the absence of official responders.

We are interested in those people who are willing to help but do not engage directly in rescue operations. We value the work of citizens playing the role of information providers or "human sensors", which can be considered an intermediate role of engagement. On one hand, they do not get involved in rescue operations, but on the other hand they are willing to help by playing an active role as information providers to improve rescue operations.

In the 21st century, any public-oriented policy must be leveraged by an IT technological infrastructure that enables the capabilities of distributed and mobile computing. Smartphones and tablets are the natural way to get citizens involved in emergency management.

In this work we describe the set of actions we should develop to support the transfer of information between the members of a crowd and the Command & Control of Emergency Response Centers. They are:

- A1. Creation of an emergency response private cloud that provides computing resources enough to serve all the requests effectively. Such cloud would provide computing and storage services to the different applications. The cloud will host a distributed architecture where information providers and processors cooperate to produce an improved situational awareness of the emergency.
- A2. Development of a suite of Personal Safety Assistants (PSAs) that, running on citizens' mobile devices, can act as a source of people- and location-aware information from a damaged area. Such information can be sent to Command & Control via the PSA in different scenarios:
  - The civil defense authority sends selective warning messages to people in a threatened area

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- A citizen uses his or her device to request help
  - The authority sends an information request to people in a specific area in order to get contextual information.
- A3. Development of a context management server able to store, analyze and transform information coming from the PSAs.
- A4. Development of a dashboard where all the context of the emergency is available for decision makers. The context may be raw data, that is, just shown as they were captured, or can be processed using different data fusion techniques to provide more elaborated knowledge.
- A5. Technical actions must be complemented with political and social actions aimed at fostering a cultural change in the society. New policies aimed at changing the view of citizens as passive targets of rescue actions need to be defined. Such policies should recognize the value of the crowd in the increasing of situational awareness, and enforce the participation of citizens as active information providers.
- A6. Education of citizens in the new policies and practices, in order to make them sensible to their role of crowd members, with their rights and responsibilities. Educative actions can include drills, training sessions or even courses at different school levels to enforce a responsible behavior in every type of disaster. The PENSAD proposal is the first step towards more resilient societies. However, an isolated initiative is not enough. There is need for more elaborated initiatives that provide persistence to the modernization efforts. To achieve this, we propose the following mid-term action:
- A7. To create, in the mid-term, a true community of practice in the Emergency Management domain, as suggested by [6]. Such a community would integrate citizens, researchers and practitioners, along with authority, to develop a number of programs to increase the resilience of the society before a disaster.

This represents a significant advance due to several reasons:

- The situational awareness of the response teams increases with information sent from eventually thousands of devices held by citizens. The citizen-device pairs become a kind of human sensors generating information that can be fused at the command and control systems to get a better picture of the requirements at any point of the response. A typical case is that of some evacuation path that gets unusable due to some building collapse; having this information is very valuable

to update pre-recorded maps with contextual annotations.

- The smartphone acts as a surrogate for the citizen, storing a profile that includes details of the owner's health, family, friends, etc. This way, improved rescue actions can be dispatched which prioritize citizens with special medical needs, and citizens can be tracked to inform their relatives about the situation, and many similar context-sensitive services.
- Unlike traditional broadcast media such as TV and Radio, mobile devices are bi-directional, that is, they can not only push relevant information about the context of the emergency, but also receive relevant information for the owner's safety. This opens new possibilities for the delivery of personalized information from the Command & Control to the citizens as mentioned above. Specifically, having citizens located is a very valuable asset in order to establish rescue priorities, distribute response forces according to the actual needs, and anticipating to any new scenario the emergency can lead to. Also, personalized messages can be sent to the citizens' devices, making the interaction more friendly and close to the sentiments of the affected persons. And more interesting, personalized safe evacuation routes can be calculated in real time from the current location of a citizen. This way, efficient evacuation policies can be implemented from fresh information.

PENSAD is planned to cover all the above put in one framework. This work is part of a joint project between the research groups in Brazil and Spain. The project has been submitted to a Cooperation Program that sponsors collaboration between Brazil and Spain.

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## **INTEREST AND BACKGROUND**

Our interest in the workshop is to get feedback and possible partners in this research project. Two of the authors participated in the CSCW2014 Workshop on Structures for Knowledge Co-creation Between Organisations and the Public and intend to participate on this workshop at GROUP 2014. We are about to start a project to developed the framework described and it will be important to receive some feedback from the participants.

**Marcos R.S. Borges** is a full professor of Computer Science at the Federal University of Rio de Janeiro, Brazil. He earned his doctorate in Computer Science from the University of East Anglia, UK in 1986. From 1994 to 1996, he was a visiting research scholar and a member of the Object Technology Laboratory at Santa Clara University, California, USA. Professor Borges has also served as Visiting Professor University of Paris, France (2001) and at the Polytechnic University of Valencia, Spain (2004-2005). His research interests include Emergency Management Systems, Computer-Supported Collaborative Work, Group Decision Support Systems and Collective Knowledge. Since 2004he has been working in the emergency management domain and has published the results on this topic in international conferences and journals such as the Journal of Decision Systems, International Journal of Information Technology & Decision Making, Reliability Engineering and System Safety, Group Decision and Negotiation, Information Systems for Crisis Response and Management and Journal of Loss Prevention in the Process Industries.