Advanced Emergency Response Management in Smart Environments

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INTRODUCTION

Traditional systems for emergency management are mainly focused on the institutional warning response and not fully exploit advanced smart sensors or the active participation of citizens involved in the catastrophic event. In this contribution, we provide a general perspective based on the analysis of innovative systems for emergency response which take into account both the potentiality offered by User Generated Content (UGC) and smart sensors. Such systems are able to select, process and integrate different kind of data in order to increase the reliability and efficiency of a whole situational aware system, localize the critical areas and obtain relevant information for emergency response and improve search and rescue operations. Particular attention will be paid to different kind of data that such systems are able to manage: a) UGC produced by citizens during or immediately after the disaster and shared online; b) data acquired by smart sensors distributed on the environment (i.e. intelligent cameras, acoustic sensors, etc.); c) data acquired by mobile sensors (RGB or IR cameras, gps, etc.) placed on-board to unmanned aerial vehicles (UAV) used to inspect specific areas during or just after the disaster.

BACKGROUND

In the last decade, progress in low cost, high performance computing networks and digital communications on heterogeneous, mobile and fixed broadband networks (Abad et al., 2012; Kim, 2009; Hofstee, 2005; Pande et al.,, 2005) have supported the development of innovative systems for emergency management. In the literature, there are several systems able to monitor and manage rescue operations in the aftermath of a disaster event. These systems can be classified on the basis of different input data and logical architectures into three categories: 1) Traditional Emergency Management Systems; 2) Smart Emergency Management Systems; 3) Social Emergency Management Systems.

Traditional Emergency Management Systems

"Traditional emergency management systems" are those systems that do not make use of sensors to monitor the scene during and after the disaster event (Figure 1). In many cases, the alarm is launched by citizens or public operators through traditional communication systems as landlines or mobile phones.

Today these systems are still in use but - given the rapid technological innovation - present strong limitations. Furthermore, in some cases, the information provided to the rescue personnel may be limited, ambiguous and imprecise since that is spread by people who have experienced emotional shock. In addition, the traditional emergency management systems - given that are not based on sensors able to monitor a certain area or situation - can be activated only after the event happened, through a call from the affected area to the fire brigade or Civil Protection that initiates rescue operations.

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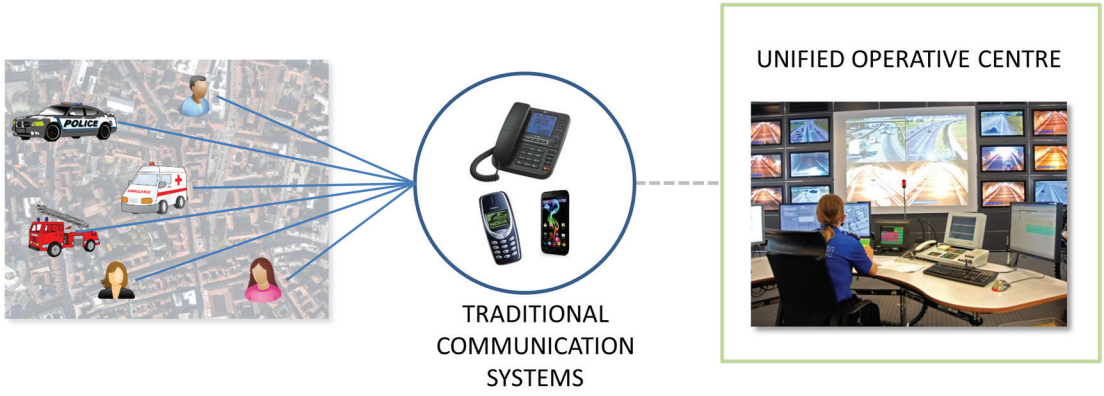
Figure 1. Logical architecture of a traditional emergency management system



Smart Emergency Management Systems

"Smart Emergency Management Systems" are usually based on a network of advanced smart sensors (e.g., mobile or PTZ cameras, etc.) able to automatically monitor a certain location during and after the disaster event and transmit relevant environmental data to a remote control unit (Figure 2).

In the literature, there are several examples of smart emergency management systems. For instance, a software infrastructure developed in 2004, called *CodeBlue,* integrates different devices, such as wearable vital sign monitors, location-tracking tags, handheld computers, and allows wireless monitoring and tracking of patients and first responders (Lorincz et al., 2004). In 2007, an emergency communication network platform, named *Dumbonet,* was designed for collaborative simultaneous emergency response operations (Kanchanasut et al., 2007). It is based on an integration of a Mobile Ad Hoc Network (MANET) and a satellite IP network operating with traditional terrestrial Internet and can be deployed in a number

Figure 2. Logical architecture of a smart emergency management system