Chapter 5

Artificial-Intelligence-Based Service-Oriented Architectures (SOAs) for Crisis Management

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ABSTRACT

The complexity of crisis-related situations requires the use of advanced technological infrastructures. In order to develop such infrastructures, specific architectures need to be applied such as the service-oriented architectures (SOAs). The purpose of this chapter is to indicate how SOAs can be used in modern crisis management systems, such as the ATHENA system. The chapter underlines the need for a detailed study of specific biological systems, such as the human brain’s hippocampus which follows the current, intense attempts of improvement of the current artificial-intelligence-based systems and the development of a new area in artificial intelligence. A number of conclusions are drawn on how biologically inspired systems can benefit the development of service-oriented architectures.

INTRODUCTION

A large number of crises either in the form of natural disasters or terrorist acts have indicated that there must be an organised collaboration of search and rescue services. This collaboration can be realised through the provision of automated ways that will coordinate the work of search and rescue teams. These ways will provide flexibility in the adaptation to the specific conditions and requirements of a crisis. This flexibility is expressed through the efficient use of resources and the clear identification of the different roles that dominate the system (Domdouzis et al., 2016). The necessity of these automated ways can be shown by the fact that natural disasters can cause alterations in the normal functioning of society and these alterations can result to human, economic and environmental effects. These effects require emergency response in order to satisfy critical human needs (IPCC, 2012). There are a number of factors that need to be considered during crises. The first factor is that there must be communication and coordination with community planners and first responders. Also, the concerns of the public during a crisis must be

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heard while a more comprehensive understanding of the public’s values and concerns must be developed. Useful, timely and accurate information must also be provided to the public. Steelman and Caffrey (2013) emphasize the need for pre-crisis communication and preparation so that the citizens will comprehend crisis risks (Steelman & McCaffrey, 2013). Veil et al. (2011) suggest that during a crisis, the public has to know about the risks that they may face. The provision of information to the public will ease uncertainty. Also, there must be comprehension of the public’s concerns. Specifically, public opinion must be monitored so that a relationship of credibility and trust to be developed. Crisis communication must be characterised by honesty and openness. Another best practice is the development and maintenance of strong relationships with credible sources. Messages of self-efficacy to the public should also be provided (Veil et al., 2011). The use of new technologies for the monitoring of crises has been studied since the mid-90s. Thomsen (1995) and Heath (1997, 1998) have shown that online databases, web pages and other online tools can help corporations to adjust policies before the occurrence of a crisis. Also, it is evident nowadays that the use of Social Media is necessary and as a result, public participation is considered necessary for the resolution of a crisis (Baron, 2010). A survey that was realised by the American Red Cross revealed that 69% of citizens believe that emergency responders should monitor Social Media in order to arrange the quick transfer of help and 74% of citizens expect search and rescue services to answer social media-based call for help within an hour (Bulldog Reporter, 2010).

Service-oriented architecture (SOA) is an approach that addresses the requirements of distributed computing. Business operations that are realised in a SOA include a number of invocations of different components, often in an event-driven or asynchronous way. The development of a SOA, a highly distributable communications and integration backbone is needed. This is provided by the Enterprise Service Bus (ESB) which is an integration platform which uses Web Services standards in order to support a variety of communications (Papazoglou & Heuvel, 2007). In the case of environmental crises, SOAs enable integration of real-time, heterogeneous geospatial data. Furthermore, they allow geospatial data filtering and the introduction of new services so that natural phenomena can be simulated and decision making mechanisms to be improved (Vescoukis et al., 2012). In a SOA, software resources are packaged as ‘services’ which are self-contained modules that provide business functionality and they are independent of the state of other services. Services are described in a standard definition language and communicate with each other. SOAs are designed in such a way so that they overcome distributed computing challenges related to transaction management, security policies and application integration. SOAs are focused on developing efficient and effective applications that users can easily interconnect and maintain. SOAs provide flexible architectures that unify business processes through the modularization of large applications into services. A client can access a SOA service in order to create a new business process. SOAs create a collection of services that can communicate with each other using interfaces to pass messages from one service to another or to coordinate an activity between one or more services (Papazoglou & Heuvel, 2007).

Especially in the field of Crisis Management, service-oriented architecture can provide a number of benefits, such as better organisation of the Crisis Management technical platform, better clarification of the roles of the software developers of the platform, the re-usability of the different elements of the platform and the definition of the service inputs and outputs. Also, SOA offers the ability to adapt to business requirements in an agile manner. This agility is shown by the fact that new services can be added and new business requirements can be fulfilled. Furthermore, SOA allows modularization, thus complex problems can be broken into smaller segments (Kawamoto & Lobach, 2007). This is very important for large crises as modularization can allow the better handling of different aspects of a crisis from ap-
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