Chapter 9
Exploring Cloud-Based Distributed Disaster Management With Dynamic Multi-Agents Workflow System

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ABSTRACT

Natural disaster is one of the important topics in current researches. Disaster Management System (DMS) is a complex system and needs to perform a collection of tasks collaboratively along with the potentiality to change the configurations of the system dynamically. In the research era of workflow model, existing models mainly deal with temporal and static constrains. However they cannot be used to keep pace with an uncertainly dynamic system like disaster management. Considering all these significant DMS attributes we have designed a new dynamically configurable and changeable workflow model with the support of adaptive scheduling, for both successful and failed situations, and implemented in a distributed cloud system to maintain the rescue and reorganization activities of disaster situation. In order to simplify the system architecture, we have used Multi Agent System (MAS) for our design. The proposed system achieves a comparatively higher rate of successful job completion-higher rescheduling success rate and comparatively lower dropout rate.

INTRODUCTION

Natural disasters include hurricanes, floods, tornadoes, limnic eruptions, volcanic eruptions, earthquakes, tsunamis, and other geologic processes are becoming more common. They can cause loss of life, damage properties, destruction of buildings, spread of diseases etc. People also suffer the accessibility of health care and education, as well as food supplies and clean water. Disaster or emergency management is the

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creation of plans through which communities reduce vulnerability to hazards and cope with disasters. Disaster management does not eliminate the threats; instead, it focuses on creating plans to decrease the effect of disasters (Web1, 2017) and (Thomas, 1991). Thus, Disaster management is a complex system and needs to perform a collection of tasks collaboratively along with the potentiality to change the configurations of the system dynamically.

In order to run an efficient Disaster Management System (DMS), it is necessary to maintain proper chain of commands and hierarchical decision making, so that any task performed by the system will be validated, and efficiently evaluated. In a word, DMS needs a dynamic decision making component. The main goal of decision making component is to provide an efficient sequence of decisions which are either independent or mutually dependent as well as feasible to execute using the heterogeneous resources and efficient enough to reduce the processing time and cost of the whole process. However, existing workflow models mainly deal with temporal and static constrains. However they cannot be used to keep pace with an uncertainly dynamic system like disaster management.

Workflow models and WfMS have been discussed in Buhler and Vidal, 2005; Eder and Gruber, 2002; Lis and Korherr, 2006. However, they are not suitable for disaster management concepts because of their inability to use resource management, delegation functionalities and state modeling approaches. Furthermore, a number of current WfMS systems have lack of adaptation during execution. The WfMS for emergency plans has been presented in Shell & Braun, 2009, however their WfMS considered the emergency plans as workflows model and acted similar to business processes. This kind of workflow is useable during immediate action phase of disaster management life cycle. They did not consider rescheduling mechanism for the failed/dropped tasks. Thus, the system behaves as static and pre-fixed domain.

Considering all these significant DMS attributes we have designed a new dynamically configurable and changeable workflow model with the support of adaptive scheduling, for both successful and failed situations, and implemented in a distributed cloud system to maintain the rescue and reorganization activities of disaster situation. If the communication channel can be widen and make faster, the cooperation among several groups, effective resource sharing and collaborative decision making will enhance the performance of DMS to a great extent. Therefore, a collaborative model of workflow using multiple agent based system architecture has been proposed. In Jennings et al., 2001, multi agent systems are successfully deployed in diverse applications for complex and dynamic environments. We believe it can be beneficial to apply the potential of multi agent systems research to minimize the effects of such disasters. DesInventar (Wattegama, 2007) is used to simulate the performance of the proposed workflow model and scheduling algorithms. The proposed system achieves a comparatively higher rate of successful job completion (65.07%)-higher rescheduling success rate (81%) and comparatively lower dropout rate (10%).

The rest of this chapter is organized as follows: section 2 gives the background of the work. Section 3 introduces the MAS based workflow model and adaptive scheduling. Section 4 presents the cloud implementation of the proposed DMS. Section 6 proves the performance of the proposed DMS through simulated data with the state-of-the-art. Finally, section 6 concludes the work of this paper and outlines the future work.

BACKGROUND

Extreme environmental events, like tsunami, tropical storms, flooding, forest, fires, etc. can lead to widespread disastrous effects on our society. The frequency of such incidents in the recent past has focused