Knowledge Acquisition and Dissemination for Emergency Situation

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Abstract

Emergency situation is highly uncertain, dynamic, time pressure in making decisions and involves multi organizations and multi jurisdiction level. This paper presents a conceptual architecture that can be used by emergency response taskforce in assisting the victims of the disaster. Flood disaster is used as a case study. The architecture describes the knowledge and communication for flood emergency response management.

Introduction

Emergency is a condition caused by natural disaster such as earthquakes, floods, storms or man-made disaster resulting from industrial accidents and terrorist attacks with extreme peril to the safety of persons and property. The main goals in emergency interventions are saving human lives and protecting properties. The emergency response operation requires effective and efficient coordination and cooperation among many organizations and various levels. [1] defines an ineffective response operation by the number of lives needlessly lost. On the other hand, inefficient response operation means that the overall cost of saving one lives is overwhelming. This may be caused by many factors such as poor facility, lack or prompt information, missed communication between organizations, unclear responsibility of each organization and inefficient use of resources [2], [4], [6].

Technology can support emergency managers working under stress in terms of supporting crisis decision-making or as a decisional aid to decision managers, managing information overload, supporting first responders, capturing vital information at its source and situation assessment [3], [4]. Emergency management encompassing four main phases: preparedness, mitigation, response and recovery. Failed management in emergency and catastrophic situation resulting from inefficient and ineffective operation drives the adoption of information technology for knowledge acquisition, sharing and communication. Human have to be an integral part of the total socio-technical system, working hand in hand with machine, computers and organization [1]. With the appropriate use of structured information processes and current information technology, the rate and efficacy of organizational and inter-organizational problem solving capabilities in a complex dynamic environment such as emergency situation can be improved.

[8] identifies some of the requirements of an emergency response information system that can provide collaborative knowledge systems to exchange information among relevant communities. He emphasized the needs of a highly flexible, adaptive and structured group communication system. Learning from experiences is an important phase that can help improve future preparedness plan and activities [5]. [2] commented that existing software programs for crisis managements have not successfully met the managers requirements for four main reasons (i) lack of flexibility in representing diverse perspectives in a dynamic situation (ii) lack of familiarity with the systems and knowledge based (iii) programs are designed for single organization use (iv) no existing system includes intelligent reasoning component that can assist managers.

This paper presents a study that has been done on knowledge acquisition and dissemination of information for emergency situation. Flood emergency response management in Malaysia is used as a case study and is presented in section 2. Section 3 describes the proposed architecture for emergency response management and concluding remarks are given in section 4.

Case Background

Flood is the most common natural disaster occurring in Malaysia which includes flash floods, monsoon flood and mud floods. It is usually widespread in large geographical area and involves large number of victims requiring large scale response operation. Emergency response centre (EOC) will be open based on flood level, to control and manage the situation. Flood EOC in Malaysia is managed manually through a multi-organizational team which follows the standard operation procedure for disaster management produced by Prime Minister Department. The standard operation procedure consists of rules and procedures in handling disaster. There are three levels of flood operation, namely the federal, state and district level. A minister from the Prime Minister Department will chair the committee for the federal level while the State Government Secretary will chair the state committee level. For the district level, the District Officer will chair the emergency committee.

There are more than ten organizations (emergency committees) involved in the EOC, namely the Drainage and Irrigation Department (DID), Royal Malaysian Police Department, Malaysian Army Force, Malaysian Fire Brigade and Rescue Department and others. Each of the organization has their responsibility and plays an important role during and after the disaster. DID of the Ministry of Agriculture is assigned the role of the flood control, forecasting and warning services.

Fig. 1 illustrates the mechanism of disseminating real-time flood information on the WWW used by the DID of Malaysia. Sensors were placed to collect rainfall measurement, river and reservoir water levels at strategic locations identified all over Malaysia. Data from these sensors will be automatically collected and send to the State Master Stations in the form of emails. These data will then be emailed to Ministry of Agriculture server. The DID National Flood Monitoring Centre server will extract the email and display the data on the website. Any flood warning messages will be sent through mobile short messaging service (SMS) to the DID top management officers mobile phones. The event will be informed to the flood management committee if it is an emergency situation. Response task force will be formed and response operation will take place until the flood ends.

[7] highlighted problems in the Malaysian flood warning systems and steps for improvements. Overall, the public main concern is the timeliness of the authority responding to flood problems. In order to achieve timeliness, the use of rainfall instead of water level as a triggering mechanism as practiced in the United States for smaller rivers was recommended.

Several issues in management of emergency response such as how right decision be made based on the data/information received, communication and coordination among the rescue organizations involved, alerting the right party and which part should be the first to know and first to inform with regards to flood. A systematic set up of the emergency management has to be formed to improve the current flood response system. Successful operation depends on effective inter organization coordination and this requires dynamic and distributed decision making with shared common goals and distinct role.

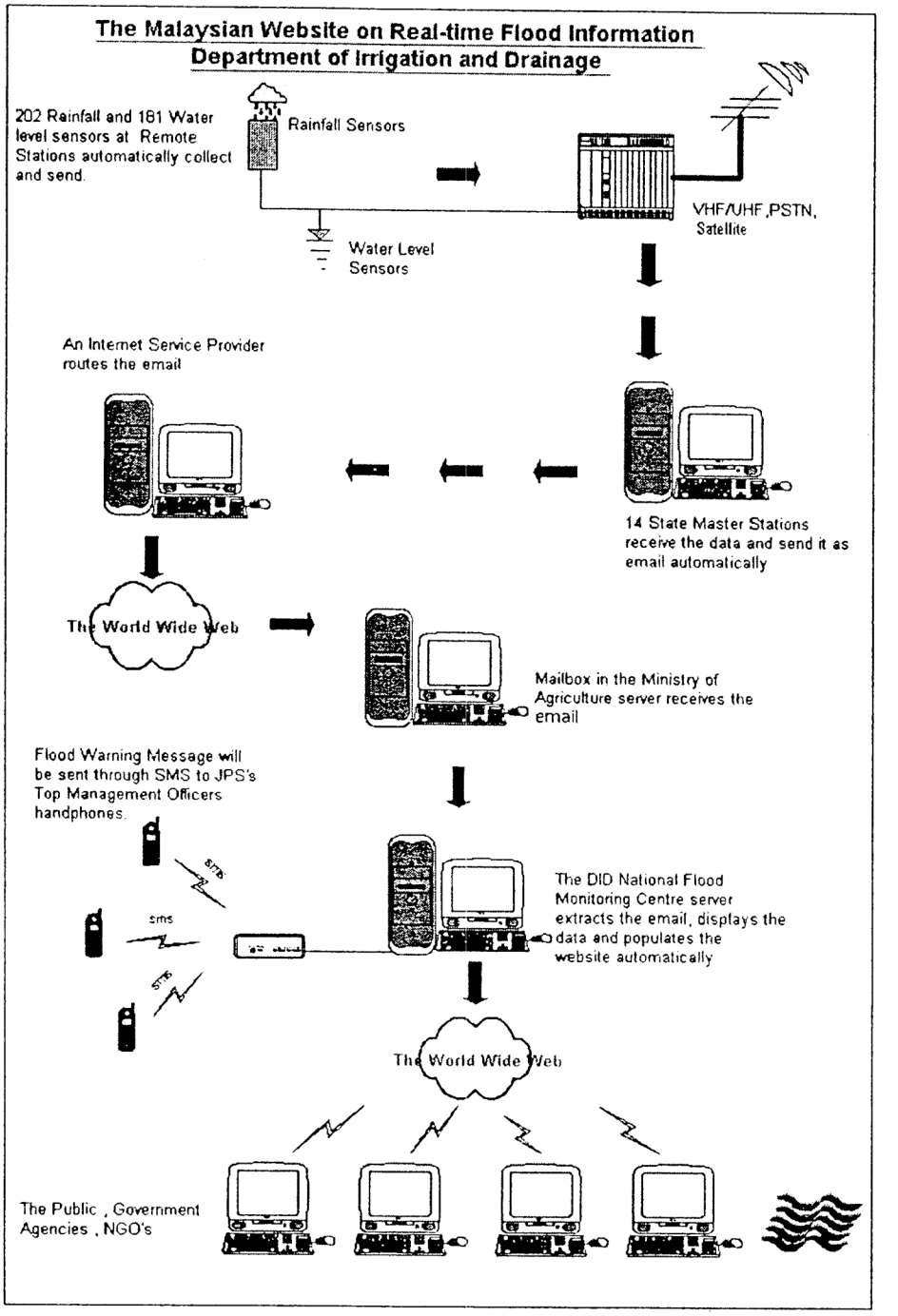

FIG. 1: MALAYSIAN WEBSITE ON REAL-TIME FLOOD INFORMATION

Proposed Architecture

This study has adopted the knowledge engineering step of designing the architecture for emergency response management. Five steps were taken in constructing the conceptual architecture. The first step of the study is focused on the problem domain where knowledge acquisition is conducted through interviews with domain expert, document reviews and site observation study. Next, knowledge conceptualization is performed where formal description of domain knowledge in terms of primitive concept and conceptual relationship were represented using semantic network. The third step involved ontological analysis and knowledge formalization. The conceptual architecture was designed using UML modeling tool in the fourth step. Finally a non-execution testing using UML walkthrough were conducted for model verification.

The ontology is use as the backbone for building structured and reusable knowledge models. In this study, the ontology is a knowledge model representing concepts and relation between concepts in the flood emergency management. It represents the conceptualization and formalization of the knowledge that has been acquired from domain experts. Fig. 2 and 3 show part of the developed ontology.

Flood Analysis	**Flood Location**	**Flood Response**
Report Date	District	Stage
Flood Location	State	Action Plan
Description	Date	Action Line
Report By	Location	Action By
	Station ID	Output
	Stage	

FIG. 2: CONCEPT CLASSIFICATION TREE OF FLOOD ONTOLOGY

Emergency Committee	**Contact Person**	**Emergency Centre**
Chairman	Name	Sector
Committee	Position	Area
Supplies and Assistance Chairman	Organization	Evacuation Centre
Evacuation Chairman	Office Phone	Officer in Charge
Transportation Chairman	Home Phone	Name
Human Resource Chairman	Mobile Phone	Position
Information Chairman		Front Base

FIG. 3: CONCEPT CLASSIFICATION TREE OF EMERGENCY MANAGEMENT

The proposed conceptual architecture of the flood emergency response management is as depicted in Fig. 4. The architecture consists of seven main modules, which are the user authentication, administration and management of preparedness, recovery, response, mitigation and document.

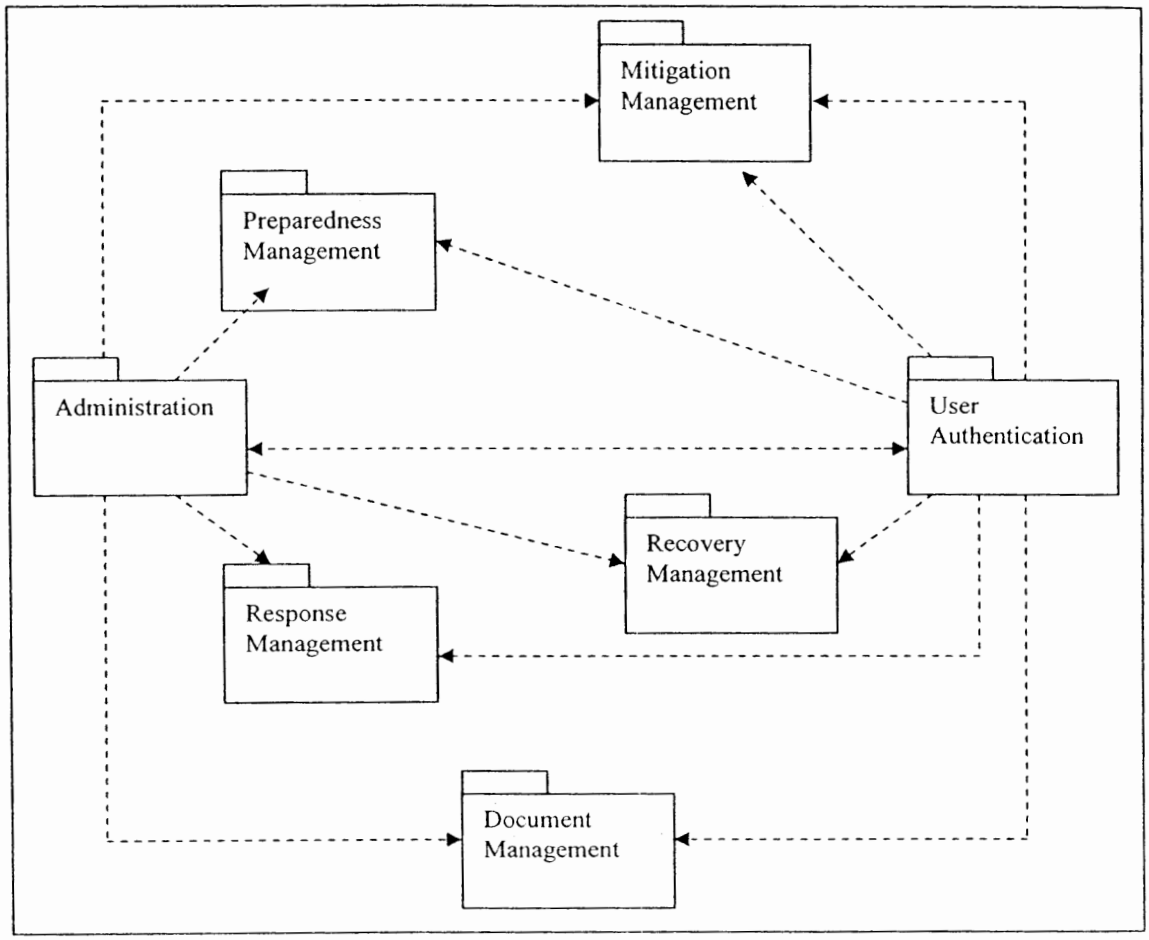

FIG. 4: FLOOD EMERGENCY RESPONSE OPERATION MANAGEMENT ARCHITECTURE

The architecture can be used to implement as a web-based system where information can be obtained and communication can be performed at anytime and anywhere. Intelligent agent based for the purpose of providing autonomous and intelligent component can be incorporated especially in document management module.

Conclusion

Floods are one of the mother's nature unpredictable events. The unpredictability causes the uncertainty in the situation. The situation is continually changing which brings out the dynamic and complexity of the environment. Efficient and structured emergency response management in this environment has to take into consideration the dynamics, uncertainty and complexity of the situation. Emergency response efforts need to be continually upgraded such that it will reduce the impact of the disaster to the citizens.

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