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A Survey on Disaster Management Systems

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Abstract: ***Mobile software technologies have been used to build disaster response system to incorporate with natural emergency situations. In this paper we conduct a survey on various disaster management systems in different environments. A mobile client is used to catch a various types of user's contexts and a best message is being communicated using user preferences. Our disaster management system uses the latest mobile technology to deliver the instructions. Here the messages are delivered to the client's mobile using a filtering approach. In this article we overview all the traditional approaches in disaster management and present a new approach for a context aware disaster management system.***

Keywords: disaster response, disaster recovery, mobile software, collaborative filtering approach

I. INTRODUCTION

Emergency situations [7] will happens often. But people in emergency situations cannot give much more attention to received messages. So the instructions should be in a most customized format [2]. So as to deliver these messages in a timely manner is the main challenge facing in constructing a disaster management system [4]. Various disaster response centers rely on manual exchange of information and processing .The main goal of this work is to design a better disaster response system [3] based on context aware method and also information operations are exchanged using mobile software technologies [5].

In emergency situations, people can often pay only less attention to the instructions and messages that are received, therefore only the messages which are most appropriate for each individual in his or her own context are most effective and valuable.

For example, this can be implemented to the places nearby a dam. The people nearby those places will get instructions such as level of water rise in the dam, rescue centers near to dam etc..Another fact is that people are having different types[8] of mobile phones. Some may have smart phones while others having basic phones. All these cases are real scenarios. So this demands to develop a disaster management system using context basis.

The contexts of users in emergency to customize and suggest most targeted instructions. But it is difficult for a computer to analyze the user contexts and decide what instructions may be more valuable for an individual in a specific emergency [5]. The predictions and instructions are given to users using different approaches.

II. DISASTER MANAGEMENT TECHNIQUES

a) Intelligent systems for human behavior Analysis and personal Following Large scale Disasters.

A Disaster Behavior Analysis and Probabilistic Reasoning System (DBAPRS)[1] are developed to analyze and simulate people's evacuation behaviors during the Great East Japan Earthquake and the Fukushima nuclear accident..

However, based on the training model, DBAPRS can simulate and predict movement of population in various cities throughout Japan in an effort to inform future disaster relief and management. The data and results obtained by this system have significance value because they precisely reflect the behavior of people facing the huge, composite disasters[1]. It will

contribute to various research fields such as disaster prevention and management, civil engineering, intelligent transportation, urban management, and so on.

Here the advantage is that they have demonstrated that the system can predict accurate prediction of large population mobility in severe disasters is possible. Then, on the basis of DBAPRS results, there observed that in regions continuously impacted by the earthquake and tsunami, large numbers of people sought immediate refuge in nearby cities or government shelters.

There were several limitations noted within this system and this study. The dataset of population movements used was created from mobile devices and didn't incorporate data from some particular portions of the population

Analysis and result: DBAPRS is an intelligent system which stores and manages daily GPS records in Japan over a one-year period..The limitation of this system was difficulty in analyzing movement patterns predicted by DBAPRS for use in places outside of Japan in places not affected by this disaster. However, the actual performance of DBAPRS was sometimes difficult to fully evaluate.

b) A Context-aware Disaster Response System Using Mobile Software Technologies and Collaborative Filtering Approach

Here the proposed system[2] designs a context-aware disaster response system that analyzes the contextual information of public users and disaster environment, and then delivers customized instructions in an appropriate format to the mobile handsets of the public users in a timely manner.

When a disaster is detected, the disaster response team will compose a set of general disaster response messages and instruct the disaster response system to send to the users who have previously registered in the system database.A collaborative filtering[2] approach to determine the most preferred message for the user based on the preference of the user's group. After then, customized response message will be sent to the response presentation module, which determines how these messages can be properly displayed on the mobile device based on the device capabilities, such as the screen resolution, orientation and touch-screen support.

Skyguard system uses two ways to detect a disaster, either by users who can report disasters on the mobile client applications or by various sensors on the mobile devices, which report the disasters when "seeing" the related phenomena, e.g. smoke, speed, and location. During the course of a disaster, these sensors can capture and send contextual information about the disaster to the disaster response team periodically.

Analysis and result: The proposed system is used to improve the disaster response system by categorizing and analyzing the context information of mobile application users and using that to customize the context-ware and targeted instructions. The main demerit is Sky guard doesn't consider the privacy issue when storing and investigating the preferences and feedback of the mobile users.

c) A Model-Based Systems Engineering Approach to Capturing Disaster Management Systems

This paper designs a framework for defining and capturing disaster management systems (DMS)[3]. Recognizing the management of disasters as complex adaptive systems (CAS), whose performance cannot be improved through the isolated optimization of their constituents. Here in this paper proposes the adoption of model-based systems engineering (MBSE) to capture the behavior of such systems, also the structure responsible for systems nature. A modeling language (SysML) to implement MBSE is used. The approach proposed here effectively introduces a new paradigm in disaster management studies that is aimed at reducing the aforementioned complexity

In capturing the high-level interrelationships between the constituents of the DMS, a MBSE methodology will also encourage a holistic approach to problem solving by enforcing traceability. For example, one will be able to trace the potential

impact of a proposed procedural change in the preparedness phase of one type of disaster (disaster X) on its emergency stage, or even on the preparedness phase of a different type of disaster (disaster Y).

A holistic approach to capturing the DMS may first focus on its behavior, and on the user of the system .

The approach then should seek to identify a plausible physical structure which could generate this behavior Depending on whether the modeling effort focused on desired or on actual behavior, the resulting model will be either the ideal or the currently existing DMS. However, whether ideal or actual, the model should then be used for benchmarking or assessment studies.

Analysis and result: A framework for defining and capturing disaster management systems was proposed. Using a model-based systems engineering approach, and the systems modeling language, both structure and behavior of the system were captured in a single modeling environment. The main disadvantage is that the DMS is an example of a complex-adaptive system, as it has the ability to evaluate itself, and take any necessary preventive or corrective measure.

d) Design challenges for an integrated Disaster Management Communication and information system.

This paper sketches requirements and innovative technology for an integrated disaster management communication[4] and information system, addressing in particular network, configuration, scheduling and data management issues during the response and recovery phases.

Apart from communication and information management, optimization and simulation, decision support, visualization, geographic information systems (GIS), and simulation and training are mentioned. One of the findings is that maintaining communications is the first challenge[4] during a disaster. Commenting on the state of the art in communications and information management, experts stated that the following major requirements were not yet met in a satisfactory way:

- Integration and linkage of information
- redundancy of links
- Fast data access
- Hot spot communication

To implement the described system architecture, several IT research disciplines need to work together to provide an effective, yet easy-to-use system that helps emergency services cope with disasters. Application and information flow designers must consider fast-changing working environments, and resource management is a challenge given the chaotic nature of disasters.

Analysis and result: The system is it sketched an integrated communication and information system for disaster response and recovery, addressing in particular networking, service and device configuration, data management, and resource scheduling. The proposed systems main demerit is it doesn't provide necessitating solutions for encryption, authentication, and data integrity

e) Policy Based Migration of Mobile Agents in Disaster Management Systems

This paper presented and analyzed policy based migration approach in the domain of disaster management systems[5]. The operations are designed for target machines are migrated with mobile agents with more emphasis on reusability concept in code. Here they used a case study of deploying mobile agents in disaster management systems using efficient distributed information searching and retrieval technique.

A policy-based approach in that deriving the migration strategy of mobile agents which is composed of number of subtasks or operations. Policies consist of rule based statements which are set of preconditions, actions and post conditions. The proposed system also presented design architecture of earthquake management system to highlight the efficiency which can be obtained

by deploying software agents in such kind of disaster management applications. The evaluation of proposed architecture using two mobility approaches defined as Generic mobility approach and Policy based operations mobility approach.

Analysis and result: This policy based architecture be used for regulating the activity execution and movement pattern of mobile agents. The model can also be used to regulate mobile agents by restricting

Their movement to certain locations or controlling the execution of some specific activities on source and target machines. The Main demerit is that it doesn't define the mechanism for collaborative behavior among group of mobile agents.

f) Disaster Management in Malaysia: An Application Framework of Integrated Routing Application for Emergency Response Management System.

One of the critical phases in Disaster Management System is response phase[6]. In response phase, connectivity analysis such as a navigation service to help emergency rescue (ER) units reach at disaster area on time is necessary. Today a commercial navigation system is not appropriate to be used by ER units. The location information that is vital was not fully utilized in disaster management, specially in doing many-task analysis at a time Thus, the real goal of GIS technology in managing spatial data including real-time data of ER units may influence the quality of the service.

The proposed system will present the framework of integrated routing application for emergency response units embedded with context-aware. Spatial DBMS is a main component of this system, that allow maintenance of data (spatial or non-spatial) into multiple and integrated model (such as medical model, fire department model, police model, etc). Spatial DBMS manages moving object data model that contains simple feature of vector data.

Analysis and result: The research hypothesis is that a Spatial DBMS (with an appropriate spatial schema, indexing techniques, and operations) can drastically improve the effective management and analysis of moving objects in route analysis. The integration of context information into the model should provide further flexibility in querying and visualizing data. Disadvantage is that the system doesn't mention about dimensional model at RTDW.

g) Research of GIS-based Urban Disaster Emergency Management Information System.

The paper proposes system architecture and the content and method of spatial data organization in an urban area. This scheme is capable of assisting urban disaster emergency management, disaster documentation provision and Aid in Decision Making (ADM)[7], and improving the ability of disaster relief and resistant of government.

Spatial data play a significant role in urban disaster emergency management system, the diversity, validity and timeliness of Data directly related to the System Effect. For urban emergency management systems, they recommend exercise remote sensing orthophoto maps in large-scale, after pretreatment of radiometric rectification, feature extraction and selection, data compression and noise cancellation, extract road and river network, get vector map of transportation network with digital means what we need. Base map data structure should be able to support the basic spatial analysis function.

Analysis and result: urban disaster emergency management information system improved the response speed and accuracy of the Government's Emergency Management. Management of urban basal information and disaster information, major management of hazard, analysis and simulation of disaster, public safety planning and management of emergency grow achievable. The demerit is that it is a complex engineering for setting up and researching on a urban disaster emergency management system.

h) Intelligent disaster management system using cloud enabled vehicular networks.

The proposed system is concerned with developing emergency response systems for disasters of various scales with a focus on transportation systems which exploit ICT developments.This paper focuses on Intelligent Transportation Systems (ITS)[8]

including VANETs (Vehicular Ad hoc Networks), mobile and Cloud computing technologies to propose an intelligent disaster management system.

The change, progress, mobility, entertainment, safety and security of humanity are leading the way to the development of intelligent transportation systems (ITS). Vehicular ad hoc network (VANET) are the most prominent enabling technology for ITS. Here VANETs are formed on the fly by vehicles equipped with wireless communication capability.

Analysis and result: The system is intelligent because it is able to gather information from multiple sources and locations, including from the point of incident, and is able to make effective strategies and decisions, and propagate the information to vehicles and other nodes in real-time.

III. COMPARISON OF VARIOUS TECHNIQUES

The importance of understanding emergency management from a comparative perspective is owing to several reasons. Natural and man-made disasters, such as earthquakes, floods, high-rise building collapses, or major nuclear facility malfunctions, presents a challenge to public emergency services. Police, fire departments, public health, civil defense and other organizations have to react not only efficiently and individually, but also in a coordinated manner. Disasters impact all nations directly or indirectly hence various techniques used in different methods are to be compared. In seeking to reach this objective, goals, different architectures, and parameters of various methods are used.

The various parameters in different methods are compared such as various techniques, accuracy, event phase and types of disasters etc

Table 1

METHOD	TECHNIQUE	ACCURACY	EVENT PHASE	TYPES OF DISASTERS
Intelligent systems for human behavior Analysis and personal Following Large scale Disasters	Disaster Behavior Analysis and Probabilistic Reasoning System (DBAPRS)	Medium	future disaster relief and management	Earthquakes ,Tsunami
A Context-aware Disaster Response System Using Mobile Software Technologies and Collaborative Filtering Approach	Context aware system using collaborative filtering approach	High	Disaster response phase	All types of disasters
A Model-Based Systems Engineering Approach to Capturing Disaster Management Systems	Model based system engineering (MBSE)	Not mentioned	Preparedness , Time of Hit (Emergency) Recovery	Hurricane , Earthquake, Wildfire , Pandemic
Design challenges for an integrated Disaster Management Communication and information system	Disaster response mechanism	Medium	Response and recovery phase.	Earthquakes, floods, plane crashes, high-rise building collapses etc
Policy Based Migration of Mobile Agents in Disaster Management Systems	Scalable fault tolerant Agent Grooming Environment SAGE	High	Disaster response,	Earthquakes
Disaster Management in Malaysia: An Application Framework of Integrated Routing Application for Emergency Response Management System	GIS Technology	Not described	Emergency Response	All types of disasters
Research of GIS-based Urban Disaster Emergency Management Information	GIS Technology	Average	Disaster response	Flood,cyclone,wildfire etc

System				
Intelligent disaster management system using cloud enabled vehicular networks	Vehicular ad hoc network (VANET)	Average	Emergency Response	Earthquakes, Tsunami.

IV. CONCLUSION

In this study, we've analyzed that the accurate simulation or prediction of all severe disasters is possible. The main challenge in constructing the proposed system categorizing and analyzing the context information of mobile application users and using that to customize the context-ware and targeted instructions to user's mobiles.

The client application captures the disaster environment information and users feedback that will be sent to the response server. The server has three main modules, which are response customization, response presentation and user context databases. Based on this infrastructure, the paper discussed the approach to analyze and use them in customizing and presenting targeted response in a most appropriate

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