A Review Study on Information Technology for Enhancing Disaster Management

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ABSTRACT: ***A catastrophe is a tragic event that has a detrimental impact on society or the environment. It may be a natural occurrence (tornadoes, hurricanes, tsunamis, floods, earthquakes, etc.). Responding quickly and effectively to natural or man-made catastrophes may help to minimize fatalities, injuries, and economic losses. Research initiatives bringing advanced information technology solutions to the crisis management area have developed, based on the premise that better information leads to more efficient decision-making and more successful crisis response performance. Disasters result in the loss of life and property, as well as halting economic activity and wreaking havoc on the impacted people. The catastrophe is thought to have destroyed all existing infrastructure, including communication equipment. Interventions in disaster zones are clearly made more difficult as a result. This article gives an overview of some of the most current efforts in this field from across the globe. Furthermore, the research shows how scalable and reliable IT solutions may dramatically improve access to the appropriate information by the right people and organizations at the right time.***

KEYWORDS: Disaster Management Systems, Information Technology, Information Management, Wireless Communications.

1. INTRODUCTION

The tsunami that hit Thailand in December 2004 and the September 11 World Trade Center assaults are two of the most memorable recent catastrophes. During the past several decades, the number of catastrophes has increased significantly. The total number of catastrophes that have happened across the globe in the past two decades. These figures are from the WHO Collaborating Centre for Disaster Epidemiology Research (CRED). Algeria was ranked ninth among the most impacted nations in 2007, according to data compiled by the CRED. Approximately ten major catastrophes have hit our nation in the past fifty years. Earthquakes have caused extensive damage to buildings and infrastructure, as well as a significant number of casualties (varying from 60 to 3000)[1]–[4].

Disaster management is the science of devising methods for mitigating the effects of catastrophes and providing aid to those who are impacted. Mitigation, preparation, response, and recovery activities are all part of disaster management to lessen the effect of catastrophes. Mitigation refers to measures taken to lessen the physical and social consequences of future catastrophes. It include constructing buildings that withstand the physical pressures of disasters, as well as attempts to reduce human populations' exposure to hazardous circumstances. The creation, implementation, and testing of disaster management systems are all part of preparedness. Direct involvement in the disaster region for the immediate preservation of life and property while reducing the catastrophe's consequences is referred to as response. Finally, recovery refers to the procedures and actions involved in ensuring the continued functioning of critical systems.

Several research and development initiatives have recently focused on the use of IT in disaster management (use of databases, GIS, wireless and mobile technologies, etc.). The survey reported in this article was inspired by our research team's decision to start a disaster management project, and it is part of the first phase of that project's aim of observing real occurrences, learning lessons from responders and domain experts, and reviewing existing literature[5]–[8].

1.1.Project Overview in Disaster Management:

1.1.1. DUMBO project:

DUMBO (Digital Ubiquitous Mobile Broad-band OLSR) is an emergency network platform created by three major research groups: AIT's intERLab lab, INRIA institution, and the WIDE Project team. They were inspired

by the 2004 tsunami, which wreaked havoc on many nations along the Indian Ocean's coastlines and destroyed telecommunications infrastructure. DUMBO was created to facilitate multimedia communication between field team members and a remote command headquarters. It is intended for use in a variety of disaster-affected regions for collaborative simultaneous emergency response activities[9]–[11].

DUMBONET combines mobile ad hoc networks (MANET) with a satellite IP network in its design. Each isolated disaster site has its own MANET, with satellite connectivity allowing multimedia communication between locations and with the distant command headquarters.

Intra-site, site to headquarter, and site to site communications are the three types of bidirectional communications we identify. A terrestrial satellite gateway is required for site-to-site traffic.

DUMBONET is home to three major applications:

- Multimedia applications, such as video, audio, and brief messages;
- Sensor applications for detecting and monitoring environmental and possibly hazardous variables that may influence the rescue effort, such as temperature, humidity, rainfall, wind speed, and so on.
- A facial recognition program that enables a rescuer to compare recorded face pictures to a database of recognized faces.

DUMBONET is still in its early stages of implementation. Only two isolated catastrophe sites and a replicated headquarters have been used in the experiments.

1.1.2. WISECOM project:

WISECOM (Wireless Infrastructure over Satellite for Emergency Communications) is a European Commission-funded project led by the German Aerospace Center. The WISECOM project seeks to provide a comprehensive telecommunications system that can be quickly implemented in the event of a catastrophe. The WISECOM system aims to reestablish local GSM infrastructures so that regular cellphones may be used, as well as to offer wireless data access through Wi-Fi and WiMAX via satellite communication. The system also includes location-based services for finding victims and rescue personnel.

One of the two European portable satellite systems, Inmarsat, BGAN, and DVB-RCS, is included in the WISECOM architecture. Wireless local access points are also utilized to allow emergency personnel and/or victims to connect to the network through Wi-Fi enabled devices (laptops, PDAs, WiFi phones, etc.). Local Wi-Fi hotspots are placed around the vehicles to give rescuers with wide-area coverage of up to one kilometer inside a Wi-Fi cell. The satellite access point is linked to the Wi-Fi hotspots through 802.16d WiMAX connections that cover a radius of up to 10 kilometers. All of the necessary equipment may be carried to the catastrophe scene quickly in a regular vehicle or as ordinary baggage on a plane. In March 2008, the WISECOM system had its first trial test. This test confirmed network functionality and enabled the proper functioning of applications including file transfer, online browsing, VoIP, videoconferencing, and video streaming to be verified.

1.1.3. Project Rescue:

The RESCUE project (Responding to Crises and Unexpected Events) aims to drastically improve responding organizations' capacity to collect, manage, utilize, and distribute information within emergency response networks as well as to the general public. Response may be targeted and focused on actions that have the greatest potential to save lives and property with more powerful information systems.

Such a dramatic change requires a multidisciplinary approach that acknowledges that, although information technology is important, it is not the only factor to consider. The answer requires a comprehensive knowledge of how emergency groups develop and collaborate in crisis circumstances. The team offers a study agenda based on this knowledge, which includes five key interdisciplinary research projects:

During or after a disaster, the goal of situation awareness (SAMI) is to design and develop technologies that can create actionable situational awareness from heterogeneous multi-modal data streams (audio, speech, text,

video, etc.) including human-generated input (e.g., first responders' communications, field reports, etc.). When it comes to situational awareness, SAMI adopts an event-oriented approach.

Understanding data sharing and privacy policies of companies and people, as well as designing, developing, and evaluating a flexible, adaptable, resilient, scalable, policy-driven architecture for information sharing (PISA).

The goal of robust communications (ENS) is to create systems that offer computation, communication, and higher-layer services at a disaster site. The aim is to create a system that can function under severe circumstances by combining and improving existing systems and seamlessly extending new capabilities to all end users and devices when communication services are gradually restored.

Information distribution focuses on information that is communicated to the general population in order to promote self-protective activities such as evacuation from hazardous locations, sheltering-in-place, and other measures to minimize exposure to natural and human-caused hazards. Building highly scalable, reliable, and timely dissemination services from unstable and unreliable resources utilizing a peer-based architecture for both wired and wireless dissemination are among the major problems addressed.

The study of privacy is concerned with determining "best practices" (minimal data collection, limiting information disclosure/inference, establishing clear policies for information collection/use/sharing, and so on), exploring how such practices can be realized technologically (policy languages, enforcement mechanisms, information hiding techniques such as data perturbation, anonymization, and so on), and studying how such practices can be implemented.

Several products have already been developed to evaluate RESCUE research, including the Crisis Alert System, which disseminates information to schools and other organizations in the event of disasters, and the Disaster Web Portal, which provides a wide range of real-time information in disaster situations, such as situation summaries, announcements, shelter information, and aggregation information. The City of Ontario launched the initial edition of this site in September 2007. The present system acts as a foundation for developing and refining findings from a variety of research fields, which are then integrated into the system to offer new or improved capabilities.

1.1.4. FOSS Disaster Management System Sahana:

The Sahana initiative arose in Sri Lanka shortly after the December 2004 tsunami, which wreaked havoc on more than 12 Asian nations (Table 1). It quickly drew the attention of developers and humanitarian experts all around the globe. Sahana's goal is to provide an integrated collection of pluggable, web-based disaster management tools that address large-scale humanitarian issues during disaster assistance. The system is based on the AMP (Apache, MySQL, PHP/Perl) technology stack, which is a robust FOSS (Free and Open Source Software) technological stack.).

Table 1: The main applications built into Sahana and the problems they address so far are as summarized in Below Table.

Module	**Goal**
Missing Person Registry	Helping to reduce trauma by effectively finding missing persons
Organization Registry	Coordinating and balancing the distribution of relief organizations in the affected areas and connecting relief groups allowing them to operate as one

Request Management System	Registering and tracking all incoming requests for support and relief up to fulfilment and helping donors connect to relief requirements
Camp Registry	Tracking the location and numbers of victims in the various camps and temporary shelters setup all around the affected area
Volunteer Management	Coordinate the contact info, skills, assignments and availability of volunteers and responders
Inventory Management	Tracking the location, quantities, expiry of supplies stored for utilization in a disaster
Situation Awareness	Providing a GIS overview of the situation at hand for the benefit of the decision makers

1.1.5. The DDT Project:

The DDT Project on Rescue Robots and Related Technologies was established by the Japanese MEXT in 2002 as a unique project for earthquake catastrophe mitigation in metropolitan areas. It was run by the International Rescue System Institute (IRS), a non-profit organization, and more than a hundred researchers and students contributed over the course of five years. The project's goal is to create viable robotics technologies for seismic catastrophes, such as robot systems, intelligent sensors, information devices, and human interfaces, to aid emergency response operations (urban search and rescue, information gathering, and communications).

Teleoperated robots for victim search in dangerous catastrophe areas, as well as robotic systems with distributed sensors for collecting disaster information to aid human decision-making, are examples of such technology. The DDT Project was made up of the four Mission Units (MU) listed below, which were divided into research groups. Residents' information, collected by distributed sensors, Rescue Communicators of IIS, is instantly transmitted to disaster response groups after obtaining Earthquake Early Warning (EEW) before the shaking. The sophisticated ARS devices fly autonomously to get a broad overview of the impacted region. First responders use ORS robots to gather victim information and assess structural damage and dangerous items at disaster sites.

As illustrated in Fig. 8, all of the collected data is incorporated into a distributed database DaRuMa through an XML-type standardized protocol called MISP (Mitigation Information Sharing Protocol), and can be referred to and searched using SQL queries and viewers like Google Earth. The database's data may be credited, added to, and analyzed later over the Internet. Such data might be beneficial in improving decision-making efficiency [2]. Several tests, demonstrations, and exercises were carried out in order to test the created systems and technologies. Active-duty firefighters formed a volunteer team and conducted extensive testing and demonstrations to assess the study findings.

2. DISCUSSION

Networks, mobile and distributed systems, databases, data analysis and mining, image processing, security, decision-support tools, and other information technologies are used in the research with the goal of revolutionizing the ability to gather, manage, analyze, and disseminate information in crisis response. The main features of the projects described in this article are summarized in Table II. Other disaster management systems, however, have been created or are in the process of being developed. Based on the data provided in this article, we can see that the academic community, governments, and commercial organizations are

increasingly recognizing that a disaster management system, particularly one that utilizes mobile and wireless IT, is helpful in reducing the impact of catastrophes. As a consequence of this awareness, more effort is being put into creating IT-based disaster management systems and apps.

3. CONCLUSIONS

The survey provided in this article is part of the project's first phase, which seeks to create a state-of-the-art on IT-based disaster management advances. There are two goals in mind. First, it enables us to get a deeper understanding of the project's different aspects and focus our efforts into goals aimed at (a) fast creation of applications for which the technology has matured and (b) more or less long-term study on still-open problems. Second, it demonstrates that our idea is solid and capable of persuading different crisis management players, including the government, to join the effort. Indeed, the ultimate aim is to create a government-controlled technology platform that provides critical emergency management services.

REFERENCES:

[1] T. C. Chan, J. Killeen, W. Griswold, and L. Lenert, "Information technology and emergency medical care during disasters," *Acad. Emerg. Med.*, 2004, doi: 10.1197/j.aem.2004.08.018.

[2] B. Pitrėnaitė-Žilenienė, A. Carosi, and P. Vallesi, "Enhancing Societal Resilience Against Disasters: Engaging the Public Via Social Technologies," *Soc. Technol.*, 2014, doi: 10.13165/st-14-4-2-06.

[3] F. Shafiq, K. Ahsan, and A. Nadeem, "Solving Real-Life Problems: Future Mobile Technology Sophistication," *Mehran Univ. Res. J. Eng. Technol.*, 2016, doi: 10.22581/muet1982.1603.04.

[4] V. Marchezini, F. E. A. Horita, P. M. Matsuo, R. Trajber, M. A. Trejo-Rangel, and D. Olivato, "A review of studies on participatory early warning systems (P-EWS): Pathways to support citizen science initiatives," *Frontiers in Earth Science*. 2018, doi: 10.3389/feart.2018.00184.

[5] M. F. M. Firdhous and P. M. Karuratane, "A Model for Enhancing the Role of Information and Communication Technologies for Improving the Resilience of Rural Communities to Disasters," 2018, doi: 10.1016/j.proeng.2018.01.091.

[6] J. R. Santillan, J. T. Marqueso, M. Makinano-Santillan, and J. L. Serviano, "Beyond flood hazard maps: Detailed flood characterization with remote sensing, gis and 2D modelling," 2016, doi: 10.5194/isprs-archives-XLII-4-W1-315-2016.

[7] F. Shafiq and K. Ahsan, "An ICT based Early Warning System for Flood Disasters in Pakistan," *Res.J.Recent Sci.*, 2014.

[8] M. Vos and H. Sullivan, "Community Resilience in Crises: Technology and Social Media Enablers," *Hum. Technol. An Interdiscip. J. Humans ICT Environ.*, 2014, doi: 10.17011/ht/urn.201411203310.

[9] Z. Abu Bakar, N. A. Yaacob, and Z. Mohamed Udin, "THE INFLUENCE OF BUSINESS CONTINUITY MANAGEMENT FACTORS ON ORGANIZATIONAL PERFORMANCE: IT CAPABILITY AS MODERATING FACTOR," *Labu. e-Journal Muamalat Soc.*, 2016.

[10] J. Weichselgartner *et al.*, "Urban resilience and crisis management: perspectives from france and Germany," in *Urban Book Series*, 2018.

[11] B. Zhou *et al.*, "Development of web-based tabletop emergency earthquake exercise system," *J. Disaster Res.*, 2015, doi: 10.20965/jdr.2015.p0217.