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AUTOMATED APPROACH TO MONITOR DISASTER ON REAL-TIME DISASTER RESPONSE SYSTEM

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Abstract: - Disaster admonishing and surveillance systems have been widely refer to help the public be aware of an emergency. However, existing warning systems are unable to cooperate with household appliances or embedded controllers; that is, they cannot-provide enough time for preparation and evacuation, especially for disaster like earthquakes. In addition, the existing warning and inspection systems are not answerable for collecting sufficient information entrails an edifice for mitigation worker to conduct a decent rescue action after a misfortune occur. In this paper, we describe the design and implementation of a proof of concept prototype, named the real-time disaster response system (RDRS), which automatically performs emergency tasks when an earthquake happens. RDRS can interpreted Common-Alert-Protocol (CAP) messages, announce by a public agencies, and impel embedded supervisor to perform emergency-tasks to respond to the quick. An examples of crisis-business contain breach passage, windows and sarcastic the might off lines and fart valves. In addition, RDRS can maintain a temporary network by utilizing the embedded controllers hence, victims trapped inside a building are still able to post emergency messages if the original network is disconnected. We management a field trial to evaluate the efficaciousness of RDRS after an earthquake happened.
Keywords – Disaster, technology, prototype, emergency, Protocol, RDRS

1. INTRODUCTION

DISASTER is a broad term which can include a range of crisis situations arising as a result of natural and/or man-made phenomenon. Disasters have various magnitudes, temporal and spatial dimensions and varying social and economic consequences. The impacts of disasters change the socio-economic environments of human life locally, and in many cases, regionally [1]. We understand disasters as "a serious rent of the functioning of a community or a partnership causing widespread hominine, corporeal, economic or environmental losings which exceed the aptitude of the affected frequency or fellowship to buy using its own resources"[1]. In the event of a disaster, the affected population needs large scale material and humanitarian assistance to cope with the loss, and thereafter, recover from it. The total systematic coordination of activities undertaken before and after a disaster, are termed as disaster management activities. Disaster management, as a process, comprises of four distinct phases: Mitigation, Preparedness, Response, and Recovery.

In this paper, we examine disaster management systems from a software architecture perspective. We identify the types of systems and the phases within which they are expected to operate. We outline the vital quality attributes required in the different types of software systems developed for disaster management. We examine some of the existing systems developed for responding to emergency and disaster situations. We describe the software architectural concerns addressed by the existing systems. We thus develop a framework (prototype) within which emergency and disaster can be analyzed.

2. DISASTER MANAGEMENT AND THE USE OF ICTS FOR DISASTER MANAGEMENT

The Federal Emergency Management Agency (FEMA) has categorized four stages in a Comprehensive Emergency management system. They are structured by time and function for all types of disasters. The phases are:

2.1 Mitigation/Prevention

This phase focuses on long-term measures for reducing or eliminating risk. It is necessary to prevent hazards from developing into disasters.

2.2 Preparedness

In this phase governments, organizations, and individuals, develop plans to save lives and minimize disaster damage. Preparedness is a continuous cycle of planning, organizing, training, equipping, and exercising, evaluation, and improvement activities.

2.3 Response

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The response phase starts when removal efforts miss and events trigger a crisis. At this point, organizations shift their resources and efforts towards response activities designed to provide emergency assistance for victims. They also aim to stabilize the situation and reduce the probability of secondary damage and speed-up recovery actions.

2.4 Recovery

Recovery activities aim to return the living conditions to normal or better and they usually include two sets of activities.
1) Short-term recovery activities return vital life-support systems to a minimum operating standard.
2) Long-term recovery activities may continue for a number of years after a disaster.
Recovery efforts are primarily solicitous with actions that overwhelm rebuilding destroyed belongings, re-employment, and the repair of other pure infrastructure. This phase also represents the first step to a new planning/mitigation phase, because this is the point when the analysis of the cause of the disaster or emergency takes place.

3. CATEGORIZATION OF DISASTER MANAGEMENT SYSTEMS

Disaster management systems can be categorized on the basis of their characteristics and the phase in which these are used. Our classification of disaster management systems is as follows:

3.1 Monitoring System

A monitoring system records data as real world events occur. These data are helpful in spreading timely warning to agencies and populations at risk. It allows them to take precautionary measures to prevent and reduce loss of life and property caused by events like earthquakes, floods, tsunami, forest-fires etc. The monitoring data may be used to run simulation systems which are described below.

3.2 Live System

A live system, as the name suggests, will be up and running during the response, relief, and recovery phases of a disaster. Such systems will assist the responders in issues such as situational awareness, information gathering, exchange and dissemination, and management of relief effort information.

3.3 Simulation Systems

Simulation systems are used to present computer-generated scenarios using real world situations.
These are used in the preparedness phase to train the rescue, relief and decision-making personnel. Simulation systems are crucial as they can be used to present varied scenarios and check the efficacy of procedures to deal with them. More sophisticated simulation systems can be used to predict the disaster progression and damage estimation.

4. SOFTWARE ARCHITECTURE ANALYSIS OF DISASTER MANAGEMENT SYSTEMS

In the previous article, we categorized injure management systems. Certain architectural anxiety are living for the development of these systems. We now explain from, the meaning of each of the quality reputation and their implication in the context of disaster management.

4.1 Availability

Traditionally, accessibility is concerned with the extensive-extremity proportion of time the system is practical and delivering its avail. In the accident of systems operating in the readiness and answer state of disaster intrigue, it is important that they composition round the ornament accumulate authentic time data.

4.2 Reliability

Reliability is troubled with the likelihood a system will not fail over some specified interval of tempo. This degraded that the system should not lose when it is needful the most. Often, systems are accountable to failure when inquire is proud i.e. during crisis situations.

4.3 Modifiability

Modifiability is the address of the system to be changed after it is implemented. It is by and large concerned with the charge of change. For warning, a feint system should be customizable. It should be fitted to resemble distinct sign of emergency and misadventure situations, for absolute preparedness.

4.4 Maintainability

In the context of mishap management software systems, maintainability send to the ease or difficulty of vindicate a system in such a possession that it will be expeditious for custom in the hasty, critical situations spring on the event of a misfortune.

4.5 Interoperability

Interoperability means that a number of organizations coming together to equal with a mayor disaster should be vigorous to change data for effective visitation response.

4.6 Scalability

Scalability is the ability of a data processor resort or product to go on to service well when it (or its close) is exchange in size or scroll in arrangement to suffer a use's penury.

4.7 Performance

Performance is the address of a system to allocate its computational contrivance for benefit in a manner that will compensate set requirements. Another term commonly used is 'latency'.

4.8 Portability

Software portability is the propriety of a software system to be executed on a variety of software and ironmongery platforms. In some instances, the software system should be portable enough to discuss on handheld devices carried by rescue and remedy workers to the site of the disaster.

4.9 Usability

Usability is affected with how easy it is for a use to equip a wish task and the kind of support the system provides. In the misfortune contrivance context, the fast upset of personnel attending to the efforts direct that the system be perceptive and not have a steep learning curve.

5. DISASTER MANAGEMENT SYSTEMS: AN ANALYTICAL STUDY

In this portion, we review some existent ill luck government software systems. We describe their bare-bones province and provide a transitory software architectural analysis of the same.

1. Envimon is a project which was undertaken by the VTT Technical Research Centre of Finland in company with National Research Institute for Earth Science, Japan. The principal unbiased of the contrive was to make systems to equal multiform environmental track necessarily. Envimon was one of six Earth Observation (EO) applications fabricated onto a threadbare software framework EOFrame , which was also propose and implemented in the project.[6]
2. Spatial Data Infrastructure and Intergraph GeoMedia® Most of the information need for mischance intrigue has a spatial constituent. This gives arise to several problems in the congregation, advance and habit of mischance control data. These problems source tarry that unfortunately affect the temper of decision-construction and consequently, the injure answer is also affected badly. An aviator project conducted in Iran bestow that web-based GIS using an SDI framework facilitates and improves the settlement-manufacture advance and inter-action coordination. It reduces the response time by 60%. This devise also improved an SDI concipient model which sketch the components of SDI.
3. Sahana Disaster Management System development was untried by considerable comfort coordination necessarily in Sri Lanka successive the Indian Ocean tsunami in 2004. It is designed to address the imperative necessity for the establishment of an institutional framework and a hale complaint communication system. It is texture-supported free and open source software specifically designed for injure management. It helps in resolve the problems in coordination of relief provide, direction of camps, inventories supplies, provision missing people and managing voluntary.
4. First TrakTM by Disaster Management Solutions (DMS) First TrakTM Patient Tracking Solution (PTS) uses supply kingly-time, electronic patient trail solutions that course the numerousness, status, and location. It is maturely scalable and configurable. First TrakTM PTS has been extend in over 60 entities across the United States, to direct mass casualty incidents and forward inversion of patients. Key features of First TrakTM PTS are:
   1) Reliability
   2) Scalability
   3) Customizable and Configurable
5. Decision Support Systems for Disaster Management Decision Support Systems (DSS) are intentional to complement the cognitive processes of humans in their decision making. They can be used during disaster management for preparedness, through making maintain and actual response activities in the post-visitation phase. A scalar of exemplar and systems relate in, have been developed for different scenarios likely venomous shed management, shock abatement policy analysis, nuclear divinity plant accidents, approach defense search, and rescue response.

6. REAL-TIME DISASTER RESPONSE SYSTEM

The high level overview of the data that are useful for analysis and prediction of the natural disaster. Much of the data will qualify to be called "Big Data"', because of all or some of the dimensions of volume, variety and velocity as listed below:
1. Volume (GIS data, meteorological data, social media data).
2. Variety (text, time series, spatial data, GIS images).

3. Velocity (because of the rate in which data are generated as well as because of the speed in which a decision needs to be taken).

What are the different types of data that are useful for each type of disaster?
What are the sources and format of such data, at national and international level?
How the data can be accessed? Whether it is freely available or not?

Table 1-A: Earthquake data, model and task summary.

Task	Detailed objective	Model techniques used	Data source, type	Country
Prediction	Predict magnitude of earthquake	Particle swarm optimization	Seismological data	China
	Focus on abnormal animal behavior, rather than the geophysical indicators. The study has been done mainly in Japan, China and USA. Animals are much more sensitive to the change in electric field precursor to the earthquake.	NA	NA	Japan, China, USA
	Predict magnitude of earthquake	Neural network	Seismological data	USA
	Building a data warehouse for earthquakes, for uniformity of data and structure of data for a uniform interchange and better decision making	Ontology, star schema, data warehouse	Seismological data	All over the world
	Predict earthquake based on time series data	Nonlinear time series and fuzzy rules	Seismological data	All over the world
	Predict earthquake from historical data and also propose a grid system for distributed processing and better information interchange[9]	Feature generation and clustering	Seismological & GIS data	USA
Detection	Discover major earthquakes faster than seismological observatories	Text mining	Twitter	USA
	The affected area citizens visit web pages of the Swiss Seismological Service, by doing an IP tracing and volume analysis, the affected regions can be tracked easily	Regular log mining techniques	Web server logs	Switzerland
	To detect earthquake from social sensors i.e. twitter, do a spatial, temporal analysis and send notification much faster than that of the Japan Meteorological Agency (JMA)	Temporal Analysis, Kalman filter	Twitter	Japan
Disaster management	A temporal analysis of peoples need after the earthquake from blogs and social media. This can make the relief operation more effective	Text Mining, latent semantic analysis (LSA), time series	Blogs & social media data	Japan
Behavioral and social analysis	To study general peoples reaction after a natural disaster like an earthquake and how long they take to subside to normal level	Time series, text processing	Twitter	Japan

Table 1-B: Cloudburst data, model and task summary.

Task	Detailed objective	Model techniques used	Data source, type	Country
Prediction	Observe different parameters of climate from the earth science data, to find out whether there was enough indication of the Uttarakhand disaster	Anomaly detection, time series	Earth science data	India
	To leverage OLAP structure to store metrological data and analyze them to identify cloudbursts	OLAP cubes, K means clustering	Meteorological data	India

	Real-time newscast and prediction of rainfall in case of extreme weather like cloud burst from Doppler weather radar data	Mesoscale model	Doppler Weather Radar data (DWR)	India

There is a Wireless sensor device associated with a RTDRS which is emerged into a certain level of water. If the water level reached to a certain level of threshold value, then the WS device sends a danger signal to receiver station through broadcasting.

Table 1-C: Flood data, model and task summary.

Task	Detailed objective	Model techniques used	Data source, type	Country
Prediction	Build a model and select appropriate parameters to assess the damage from flood	Decision tree	Hydrological data, remote sensing data, GIS	Germany
	To build a model to find susceptible flood regions based on spatial data	Logistic regression and frequency ratio model	Meteorological data (digital elevation model), river, rainfall data, etc.	Malaysia
	To build a model to predict monsoon flood (1 day ahead). The built system gave better results than existing auto regressive models	Wavelet transform, genetic algorithm, artificial neural net	Hydrological time series data	India
	Build a system for flood forecast for medium- to large-scale African river basins (before 2 weeks)	Probabilistic model & ensemble	Hydrological data	Africa
	Build a flood routing model based on past data	Muskingum flood routing model, Cuckoo Search (for parameter values and calibration)	Hydrological and hydraulic data	All world
Disaster management	A study of tweets during various floods was done to identify key players. The study shows the effect of local authority involvement in successfully tackling a disaster	Text mining methods	Twitter	Australia

Table 1-D: Landslide data, model and task summary.

Task	Detailed objective	Model techniques used	Data source, type	Country
Prediction	Build a classifier to identify landscapes to landslide susceptible areas based on soil properties, geomorphological, and groundwater conditions, etc.	Discrete rough set and C4.5 decision tree	Remote sensing data and GIS	Taiwan
	To build a classification model to predict land slide. The various factors considered are rainfall, land use, soil type, slope, etc.	SVM, Naı¨ve Bayes	GIS (rainfall, land use, soil type, slope and its)	India
	A generic note on usefulness of data mining/machine learning models in predicting place and time of a land slide	NA	NA	All over the world
	Build a prediction model based on an inexpensive wireless sensors placed on susceptible regions	Distributes statistical prediction method	Wireless sensor data	India
	To build a model to identify areas of shallow landslide	Spatial distribution	Geomorphologic information and hydrological records	Taiwan
	Predicting landslide based on past data	Back propagation neural network, genetic algorithm, simulated annealing		China

Table 1-E: Volcanic eruption data, model and task summary.

Task	Detailed objective	Model techniques used	Data source, type	Country
Prediction	Analysis of multivariate time series data to understand the state of the volcano and potential hazard assessment.	Multivariate time series clustering	Geophysical data through monitoring network	Italy
	To monitor and predict trajectories of volcanic ash cloud, to minimize air crash.	Not mentioned	Plume height, mass eruption rate, eruption duration, ash distribution with altitude, and grain-size distribution	USA

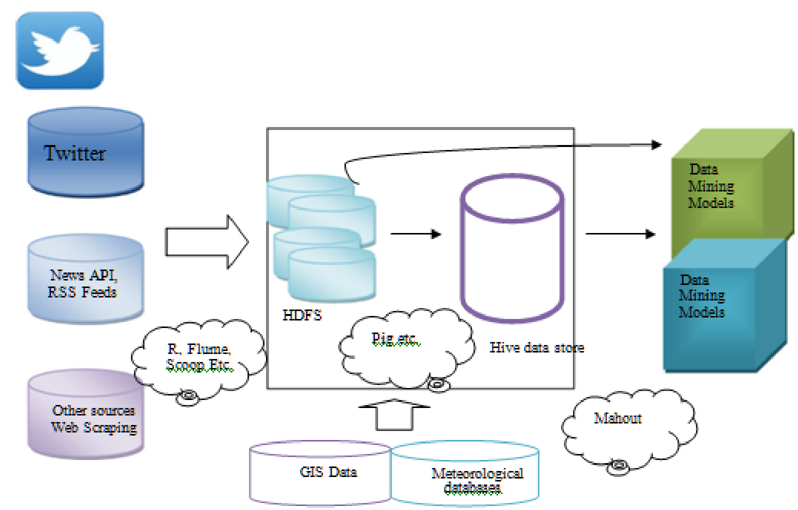

Figure 1: High level architecture of the Real-Time Disaster Response system.

7. CONCLUSION

It may be observed that advancement in Information Technology in the form of Internet, RDRS, Remote Sensing, Satellite communication, etc. can help a great deal in planning and implementation of hazards reduction. For maximum benefit, new technologies for public communication should be made use and natural disaster mitigation messages should be conveyed through these measures. GIS can improve the quality and power of analysis of natural hazards assessments, guide development activities and assist planners in the selection of mitigation measures and in the implementation of emergency preparedness and response action. Remote Sensing, on the other hand, as a tool can very effectively contribute towards identification of hazardous areas, monitor the planet for its changes on a real time basis and give early warning to many impending disasters.

8. REFERENCES

[1] Book M. Mecella, M. Angelaccio, A. Krek, T. Catarci, B. Buttarazzi, S. Dustdar, “WORKPAD: an Adaptive Peer-to-Peer Software Infrastructure for Support Collaborative Work of Human Operator in Emergency/Disaster Scenarios”, International Symposium on Collaborative Technologies and Systems, May 2006.

[2] L. Northrop, “The Important of Software Architecture in system”, http://sunset.usc.edu/gsaw/gsaw2003/s13/northrop.pdf.

[3] W. A. Wallace, and F. De Balogh, “Decision Support Systems for Disaster Management”, Blackwell Publishing. Available: http://www.jstor.org/stable/3135008

[4] Applied Research Projects. Texas State University. Paper 312. http://ecommons.txstate.edu/arp/312

[5] R. R. Rao, J. Eisenberg, and T. Schmitt, “Improving Disaster Management: The Role of IT in Mitigation, Preparedness, Response, and Recovery”, National Academies Press, 2007. Available: http://www.nap.edu/catalog/11824.html

[6] M. Louhisuo, SAR-based natural disaster monitoring Case: Flooding, Envmon Research Project Document. Available: http://virtual.vtt.fi/virtual/proj2/envimon/material/disastermonitoring1.pdf

[7] Disaster Management Solutions website: http://dmssolutions.com/

[8] Bhargava Neeti, Katiyar VK, Sharma ML, Pradhan P. Earthquake prediction through animal behavior. Ind J Biomech 2009:159–65.

[9] Nimmagadda Shastri L, Dreher Heinz. Ontology based data warehouse modeling and mining of earthquake data: prediction analysis along Eurasian–Australian continental plates. In: 5th IEEE international conference on industrial informatics, vol. 1; 2007. p. 597–602.