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GIS Based Interoperable Platform for Disaster Data Exchange Using OGC Standards and Spatial Query

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ABSTRACT

Accurate, speedy and interoperable information exchange among the stakeholders achieve effective rescue and relief operations in an emergency. The current research work aims at location-based real time or near real time disaster data gathering and accumulation. The dynamic disaster data is integrated with the static geospatial data to facilitate spatial analytics and disseminate the integrated data through OGC web services to various stakeholders for further processing by different expert domain applications. The research work also facilitates spatio-temporal querying system through Geo-query, and OLAP operations on integrated disaster data with geospatial visualization. The design and implementation of the work is achieved through a mobile application integrated with a GIS based web portal by a centralized remote server. The entire architecture has been tested by implementing in an emergency situation and facilitated by an effective interoperable information exchange and spatio-temporal queries.

KEYWORDS

Disaster Management, Information Infrastructure, Location Based Services, OGC Web Services, Web Portal

INTRODUCTION

India has unique geo-climatic conditions, which is vulnerable to several types of disasters such as floods, earthquakes, cyclones, landslides, tsunamis, etc. The super cyclone of 1999, Bhuj earthquake of 2001, Tsunami in 2004, Kosi (Bihar) flood in 2008, Sikkim earthquake in 2011 and Uttarakhand disaster in 2013, Chennai floods in 2015 have shown the urgent need in capacity building for handling disasters in a very efficient and effective manner. This is an urgent need for all our present endeavours to meet and exceed the societal requirements of coordinated scientific and technological output.

First, there is a lack of stakeholder's awareness and information exchange before, during and after disasters (Perry & Lindel, 1978; Pearce, 2003; Bosher, Dainty, Carrillo, & Glass, 2007). A qualitative research design has been used to the focus group interviews in Tamilnadu, India. Questionnaires were distributed to collect the demographic data and the responses to open-end questions and collected after the discussions. The role of ICT in disaster management is very well conceived in providing access to vital information on disaster management to stakeholders (Abbas, Srivastava, Tiwari & Bala, 2009; Nigel & John, 2012; Taohidul, & Zamri, 2011). Emergency communication for timely relief and response measures is evaluated by actual field data from the affected sites. The various challenges for effective disaster management are:

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- Gathering timely and location based real time situation data
- Information availability and accessibility
- Information infrastructure to bridge the information needs between victims and service providers
- A platform to integrate dynamic disaster data with static geographic feature data
- Interoperable information dissemination services among disaster management stakeholders
- A strong spatio-temporal query system through Geo query and OLAP operations

To address the above challenges in an integrated system of multiple artifacts like mobile application, web portal and integration of these artifacts has been designed, implemented and tested. The integrated system is designed aiming at location based real time situation gathering, non-geospatial data and integrated with geospatial data and disseminate this data through OGC web services and also facilitate a strong spatio temporal query system through multiple query engines.

The final system results in effective and efficient disaster-GIS information infrastructure as per OGC standards implemented through the mobile application and web portal.

CURRENT STATE OF THE ART

This phase discusses various methods and mobile applications that addresses information needs of disaster risk management. The state of the art is organised into two sections: 1) Mobile applications in disaster management, and 2) Integration of disaster data with other spatial data sets and disseminated using web services.

State of Art: Mobile Applications in Disaster Management

Mahfuzulhoq, Debashis and Parijat (2014) proposed a GPS based framework for android application environment. The framework allows victims to select their location on Google maps, request for aid and report missing person. The information stores into a database and service provider organizations can view the requests and finds exact location of victims. Sasan, Hien, Seon, Patrick and Cyrus (2016) introduced a crowd source based framework for post disaster data acquisition. It improves data analysis by prioritizing information contained in collected data. Justyna and Sulfikar (2016) proposed a conceptual model to build information capital from social capital and information technology (IT). The model aims at reducing disaster risks for the people in Yogyakarta and surrounding areas. Social capital includes social media platforms like twitter, Facebook etc. The model collects data from social media once per day. IT is used to disseminate information to various parties involved in Disaster Management. Norliza, Ku, Norita and Safaai (2009) presented a four-phase methodology to improve process, data management and provide response to victims of flood disaster in Malaysia. The phases include knowledge acquisition, extraction, analysis and visualization. These phases assist agencies in manage and maintain data related to floods and to monitor the current situation. The methodology is implemented as web based support system for flood response operations.

Anubhav et al., (2015) presented a framework to develop Android applications that supports data acquisition and communication during a crisis scenario. The mobile applications developed using the framework gathers user, context data with current location and visualize the results. Asif, Nitin, Ullah and Sarfraz (2012) proposed an Android mobile application based framework that gathers information about disaster and made available in online for general public and decision makers. The information is used for rescue process of affected people, delivering facilities and infrastructure etc. Mira and Teddy (2013) proposed a coordination framework for disaster management logistics distribution, communication among rescue, volunteers and humanitarian teams. The framework is implemented in the form of prototype for mobile application.

Tanya (2014) discuss the development a GIS- based mobile app on the Android platform to provide support for disaster rescue operations, coordination and information exchange. The author interviewed and discussed Natural Resources Development Foundation (NRDF) officials to find requirements for the application. The major modules of the application are reporting, emergency alerts

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