# Disaster Information Sharing System Using Open Source Web GIS

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## ABSTRACT

Civil infrastructures should be safe and kept in good condition, because they are important roles in economy and emergency services. If large-scale damage occurs to infrastructures in urban areas and they cannot be used, many aspects of life will be affected. Thus, it is important to protect infrastructures from large-scale damage in order to maintain services for the public. For local governments, it is necessary to act disasters quickly. Disaster information should be collected and shared quickly for acting rescue and rehabilitation smoothly and effectively. However, in Japan, there are several problems for sharing the information in stakeholders. In this paper, a disaster information sharing system was proposed. The paper discusses the problems for submitting and sharing in disasters of earthquake, cataracts, flood, landslide, and so on. The prototype system was designed and developed using Web GIS. The system was used GeoServer and OpenLayers as open source Web GIS, and PostGIS and PostgreSQL as DBMS. The collection function was worked out by posting e-mail of disaster abstracts and photographs in site from local government staff and private engineers. The system put the point on digital map automatically analyzing e-mail. Local governments share the disaster information using Web GIS. The prototype was used for windstorm and flood disaster response exercise in local government for testing the usability and application in June 2013. The results showed the ability of the system for sharing disaster information. However, they showed the problems of usability and everyday use.

**INTRODUCTION**

Civil infrastructures should be safe and kept in good condition, because they are important roles in economy and emergency services. Moreover, they are necessary in all kinds of circumstances, from moving around in daily life to implementing disaster recovery efforts. If large-scale damage occurs to infrastructures in urban areas and they cannot be used, many aspects of life will be affected. Thus, it is important to protect them from large-scale damage and to carry out maintenance in order to maintain services to the public (Hassanain et al., 2003). For local governments, it is necessary to act disasters quickly. Disaster information should be collected and shared quickly for acting rescue and rehabilitation smoothly and effectively. However, in Japan, there are several problems for sharing the information in stakeholders. For collecting disaster information, phone and fax are now used. And whiteboards are used for attaching FAX paper and write the situation by permanent marker. Thus, it is difficult to understand for disaster response engineers in

In the present research, a disaster information sharing system is proposed for sharing disaster information quickly. The paper discusses the problems for submitting and sharing in disasters of earthquake, cataracts, flood, landslide, and so on. The prototype system is designed and developed using open source Web GIS. The prototype is used for windstorm and flood disaster response exercise in local government for testing the usability and application in June 2013.

**PROBLEMS FOR COLLECTION AND SHARING OF DISASTER INFORMATION**

**Problems.** We analyzed problems for collection and sharing of disaster information by interview for local government engineers. Several problems were identified. (1) Authenticity and position of the reported disaster information are affirmed on the site by local officer. (2) Paper is used for distributing the information. Thus, the latest information do not share among disaster countermeasures office. There were several cases which disaster information were reported over again in previous exercise. (3) It is difficult to share and manage disaster information in an integrated fashion among local governments, fire brigade offices, police offices and road occupied companies.

**System Requirements.** In this paper, a disaster information sharing system is presented to solve the problems mentioned above. (1) Information management, collection, and update of disaster information on first reaction. (2) An accurate traffic regulation plan and road open plan are released for citizens. (3) Disaster information are shared accurately and quickly among stakeholders. And, they update the information.

## DESIGN AND DEVELOPMENT OF THE SYSTEM

A road data model is defined as the product data model of a road structure to which attribute information is added in order to link the model to the spatial data infrastructure. Information on the geometric shape and attitude of items such as roads, buildings, and rivers has been generated from a wide variety of construction projects. This information should be shared and utilized by project participants. The road data model is a concept for sharing and utilizing information collected over the life-cycle of a construction project. The road data model is a method for analyzing the situation and solving the problem. Construction stakeholders and computer software can share and utilize the standardized information by using the road data model. The road data model has information from documents, CAD data, drawings, design calculations, and other sources which can be used by those involved in a construction project. In the present study, the constructed road data model has structural and work information. Structural information includes road structures such as bridges, carriageways, sidewalks, and road furniture. Inspections, repair judgments, repair of pavement, and construction of pavement are defined as work information. Traffic accident data is also defined in the model. The road data model is shown in Figure 1; the location- based expressions 'GM_Point', 'GM_Surface', and 'GM_Polygon' are defined to connect the road data model to map information. The information portal system was developed based on the proposed idea. A disaster information sharing system was designed and developed using open source Web GIS components. This section proposes the concepts of the system. Road data models are constructed so that information within the information management system can be shared among those involved in the management of roads.
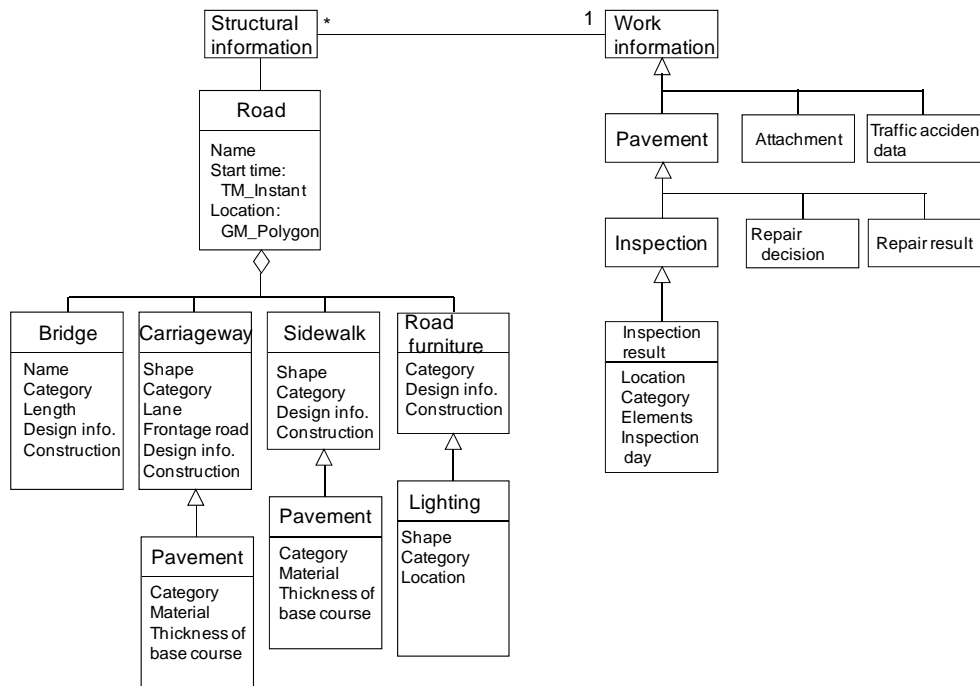


**Figure 1. Road Data Model.**

**OUTLINE OF THE SYSTEM**

A disaster information system is prosed for solving the above problems and system requirements. The system can manage the disaster information and points by submitting e-mail of site situations and photographs using GPS (Global Positioning System) and smartphone. A civil engineering officer can browse and understand the points and situations on their personal computer display.

**SYSTEM ARCHITECTURE**

The proposed system is access through the internet. The system architecture is shown in Figure 2. The system was used GeoServer 2.2.3 and OpenLayers 2.12 as open source Web GIS, and PostGIS 1.5.3 and PostgreSQL 8.4 as DBMS. The collection function was worked out by posting e-mail of disaster abstracts and photographs in site from local government staff and private engineers. The system put the point on digital map automatically analyzing e-mail. Local governments share the disaster information using Web GIS.
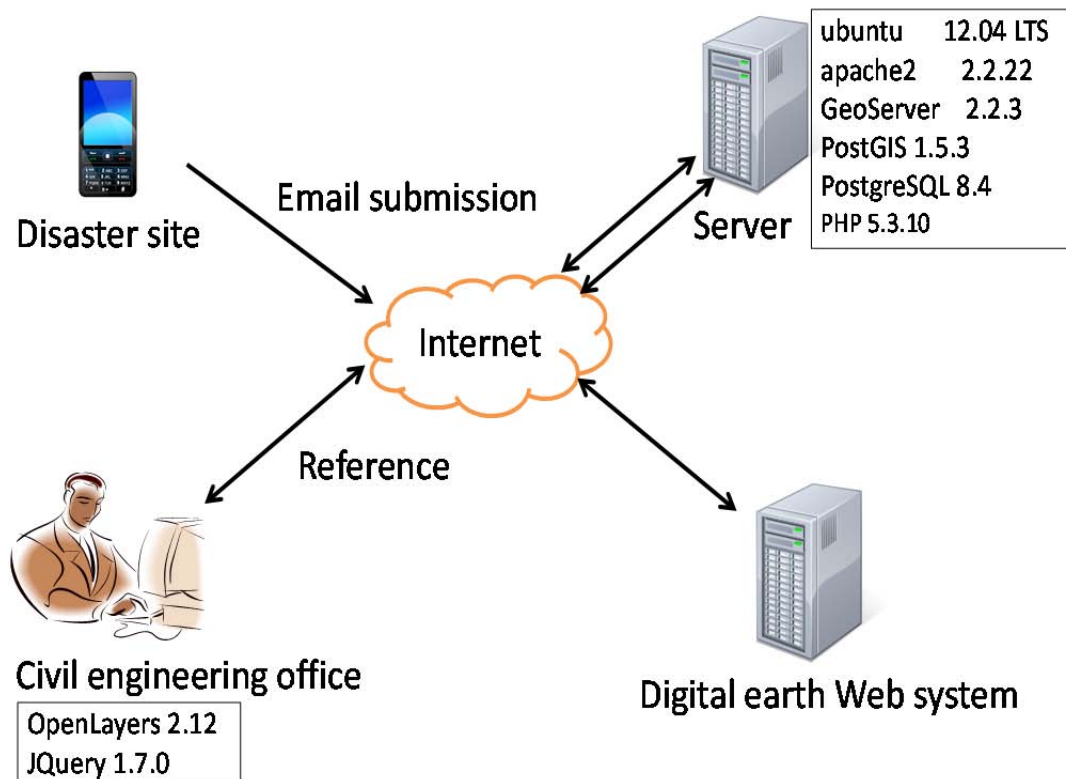


**Figure 2. System Architecture.**

**SYSTEM USE FLOW**

The proposed disaster information sharing system is used as follows. (1) A local government officer takes a photo by using GPS attached smartphone on a disaster site. And he/she submits e-mail of situations and photos to system's mail address. (2) The system extracts longitude and latitude from Exif data of photos and posts marker of the position, situation, and photos. (3) Disaster countermeasures officer browse the map and disaster situations.

**EXPERIMETNS IN DISASTER RESPONSE EXERCISE**

The prototype was used for windstorm and flood disaster response exercise in local government for testing the usability and application in June 2013. The system use in disaster response exercise is shown in Figure 3. In the system test, 8 virtual disasters were made. There were river, landslide, road and park disasters. The



**Figure 3. System Use in Disaster Response Exercise.**

## RESULTS

Figure 4 shows the posted disaster situation using the proposed system. Figure 5 shows the photo. In disaster countermeasures office, the system was used by digital light projector. The officers browse the disaster information and photos on the map and discuss measures. The user said that it is easy to understand the point of the site and situations by using the proposed system. The system has the capability of use in the disaster site. However, there were several challenges of user interface and the posting method of e-mail.
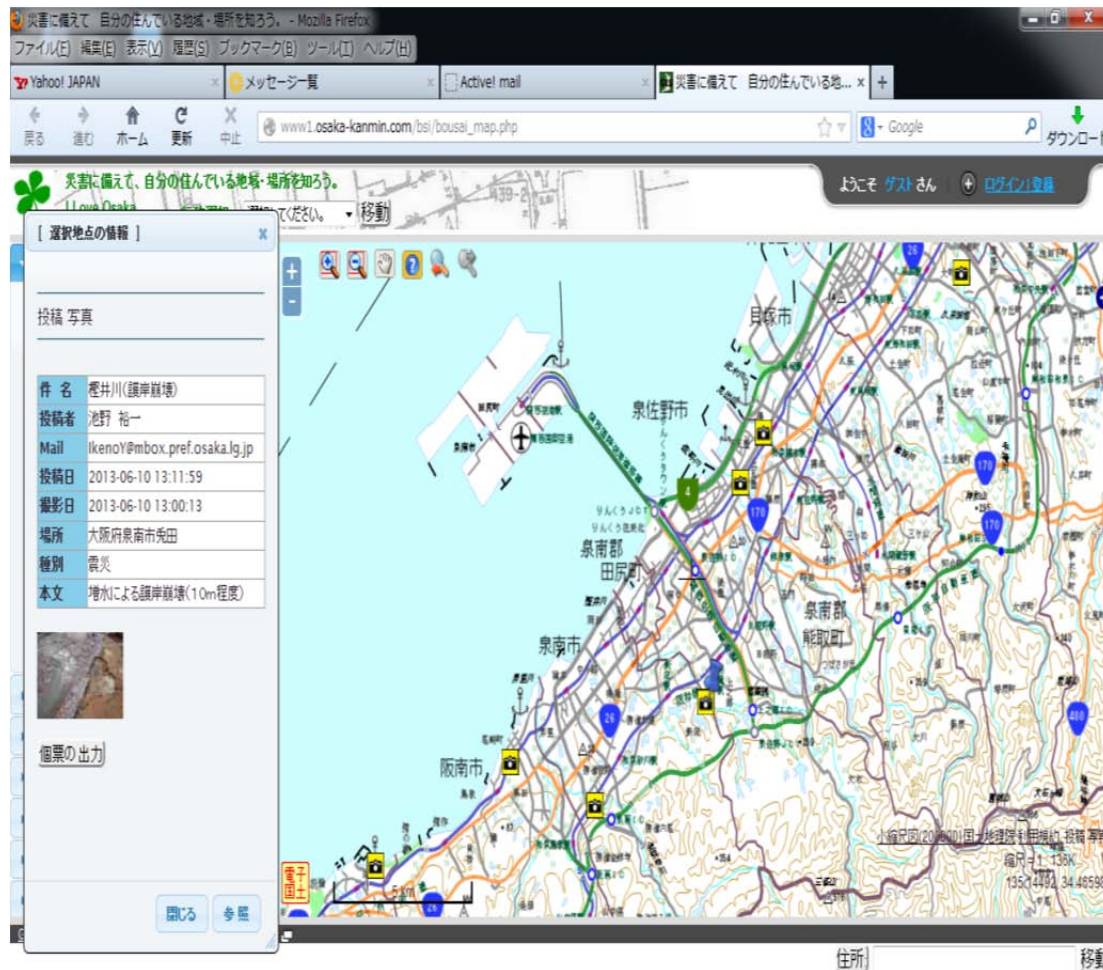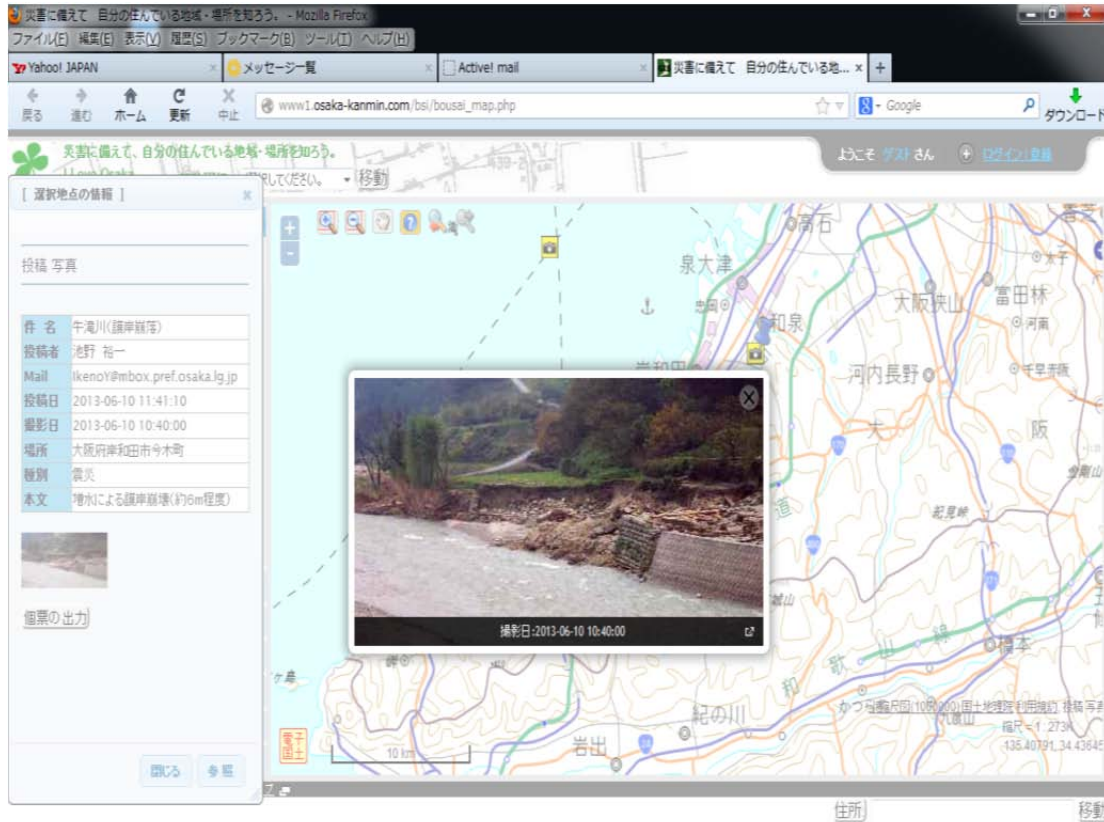


**Figure 4. User Interface of the System.**

**Figure 5. User Interface of the System.**

**CONCLUSION**

This paper proposed a disaster information sharing system which aims for sharing disaster information quickly. The paper discusses the problems for submitting and sharing in disasters of earthquake, cataracts, flood, landslide, and so on. The prototype system is designed and developed using open source Web GIS. The prototype is used for windstorm and flood disaster response exercise in local government for testing the usability and application in June 2013.

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