WEB AND MOBILE MAPPING APPLICATION FOR FLOOD INFORMATION SERVICE: A CASE STUDY IN THAILAND

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ABSTRACT

In year 2011, Thailand faced a serious flood crisis for the whole country. This caused severe damage to socio-economic of the country. Nevertheless, this situation also led people to be more aware of disaster information and knowledge. They all began to learn more to use geographic information technologies and services to watch over their lands and properties during the crisis. People in the flood risk zone could inspect vast amount of flood information from many websites and social network services. The objective of this study was to use web and mobile mapping technology to construct a location-based tool to provide locationally flood information during year 2008-2013. Flood data of the whole country in spatial format from year 2008-2013 were collected from GISTDA's Thailand Flood Monitoring System. All data were managed and systematically stored on PostgreSQL/PostGIS database server. The application was constructed in two platforms including: 1) web map service and 2) android application, which used the same database to retrieve. Users could use both applications to find out whether each location in Thailand that users picked was in flood zone or not in past 6 years. This application is very useful and convenient for users or organisations who need to make decision on site selection and planning which is concerning to the flood risk area. For instance, home buyers might need to inspect the flood history of new property they want to buy; home insurance agents could use this application in order to compute charges of insurance.

1. INTRODUCTION

Thailand faced a serious flood crisis in many parts of the Kingdom in year 2011 especially in the lower north and central parts of Thailand. From official report, 65 provinces (from 77 provinces) were announced flood disaster zones. Over 20,000 square kilometres of agriculture land was damaged. A lot of main cities were completely inundated including some part of Bangkok—the capital of the Kingdom (Emergency Operation Centre for Flood, Storm and Landslide, 2012). This event was one of the worst flooding disasters in Thailand history. The World Bank estimated more than 1,400 billion bath in economic damages and losses during this disaster (World Bank, 2011). This circumstance was one of world's costliest disasters.

However, this situation led people of Thailand to be more aware of disaster knowledge and information. Social network became the tool to caution, and share knowledge and information (Rizza and Pereira, 2014; Goldstein, 2011). Thai people began to learn to use geographic information technologies and services to watch over their lands and properties during the crisis. People in flooding areas could collect and inspect massive of flood information e.g. most updated flood prone areas, closest locations of emergency centre and potential flood risk zone in next few days etc. These could be accessed from many websites and social network services (for example, http://www.thaiflood.com, http://www.youtube.com/channel/UCEpI9nmlU-0rS7eAbu_GhVw). Another important source of flood information could be collected from GISTDA (Geo-Informatics and Space Technology Development Agency). GISTDA is a public organisation, which acquire, collect, analyse and produce information from an amount of earth observation satellites, played major role of producing flood information in form of geo-information data layers during this crisis. GISTDA then launched a web service, Thailand Flood Monitoring System (http://flood.gistda.or.th), to provide online flood data in forms of both web map service and downloadable spatial data. Users could easily access and gain necessary data from this website.

Although the flood data layers from GISTDA could be directly used by viewing flood area on the web services or adding them instantly on desktop GIS to make maps and to perform spatial analysis. Unfortunately, size of flood data layers downloaded from GISTDA were gigantic. It took long time to load even only one year flood map data on any web map services; and it would need longer time when applying 8 years flood data. General or novice users might ask a simple question such as 'Is this place (or specific location) flooded in 2008 and 2009?' or 'how often is this location flooded for the last 8 years?'. These questions are simple to ask but are quite difficult to answer if still viewing map layers directly on the web. To handle this, integrating geo-database management, spatial query language, web map service and location-based service on mobile applications cab be a perfect solution. This study constructed an application in three platforms: website, Android phone, and iOS phone so called 'Flood Point Service', which can provide flood information based on specific location choosing by users. This application is very useful and convenient for users or organisations who need to make decision on site selection and planning which is concerning to the flood risk area.

2. OBJECTIVE

This study aimed to use web and mobile mapping technologies to develop web map service and mobile's location-based tool to provide locationally flood information during year 2006-2013.

3. FRAMEWORK

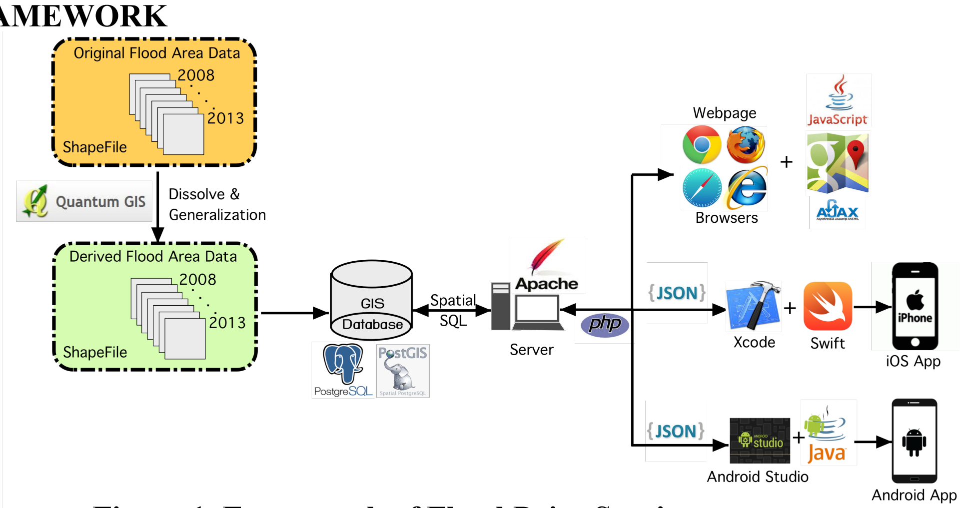

Figure 1. Framework of Flood Point Service.

Figure 1 above represents the framework of this study. Flood data in year 2006 to 2013 collected from GISTDA's flood information service were derived using QGIS in order to reduce file size of each layer. Dissolve operation was used to combine a million polygons in original flood data to one objects. To decrease complex shape of polygons, simplification operation was applied. Every derived layers were imported and managed to a spatial database system—PostgreSQL/PostGIS. This study used APACHE web service to connect to the database and manage the website. In this study, three flood point services were developed including: 1) web map application using JAVASCRIPT and AJAX technology, 2) iOS application using new iOS language—SWIFT and 3) Android application using JAVA for Android. All applications would send required locations to the database to retrieve a response that shows whether those locations are in flood area or not.

4. THAILAND FLOOD DATA

In this study, flood area from year 2006-2013 were collected from GISTDA's Thailand Flood Monitoring System. To generate flood data, several satellite images that GISTDA can receive were collected, e.g. RADARSAT, THAICHOTE and LANDSAT etc. GISTDA allows users to view flood area online and also allows advanced users to download the data in SHP and KML formats. Figure 2 visualised derived flood area in year 2011. As can be seen on the images, the most damaged flood event occurred in year 2011. The data layers were imported as spatial data table into PostgreSQL/PostGIS in order to construct the services.

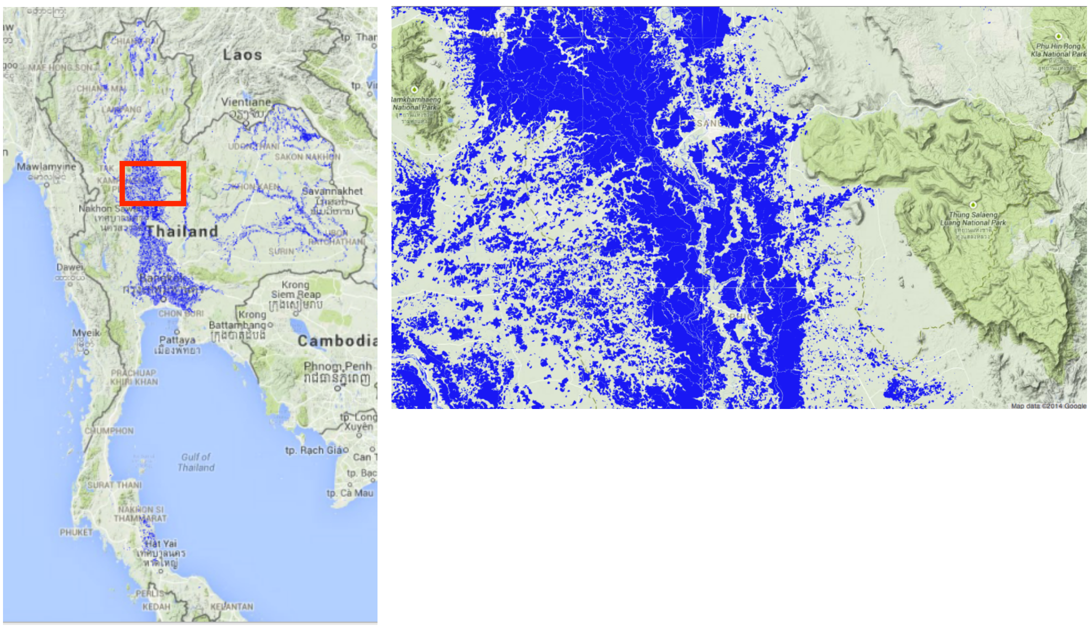

Figure 2. Flood Area in year 2011.

5. IMPLEMENTATION OF WEB AND MOBILE FLOOD INFORMATION SERVICES

5.1 Constructing spatial database

The flood data layers were imported to create data tables with geometric column to refer to spatial information in each layer. Each data table has therefore full property of spatial information which users could access directly as spatial layer using GIS softwares that can connect to PostgreSQL such as QGIS and ArcMap. Moreover, programmers could also connect to the data tables to create more complex applications.

5.2 Programming web application

This study utilized Google map API version 3 to build web map application. The application was therefore constructed based on Javascript language. To access to PostgreSQL, the server-sided script, PHP script, was used to interpret spatial SQL requests to and retrieve results from the database via AJAX code that can synchronously the client-sided Javascript and the server-sided PHP.

Procedure of the application:

- Collecting a location (latitude and longitude) using Google map API.
- Using AJAX to submit latitude and longitude information to the server.
- Using PHP script, server receives latitude and longitude and put them to spatial SQL request, for example to check whether this location is within flood area in year 2011 or not: *ST_Within(ST_GeomFromText('POINT(" .longitude . " " . latitude . ")', 4326), flood2011.the_geom)) from flood2011*.
- The result is returned to the webpage via AJAX and is represented on the webpage. For example the result from above, if the result returns 'true', this location is in a flood area in year 2011.

5.3 Programming mobile applications

In case of mobile applications, we can use the same flood data tables as using in web application. For Android, the major language is Java for Android. On the other hand, new programming language called SWIFT was used to develop. Both Android and iOS platforms need PHP script to access to the database and both can retrieve data returned from the server in JSON format. The procedures were described below:

- Collecting a location (latitude and longitude) using builtin GPS in smartphone or users can choose a desired location by tap on the map.
- Using JAVA in case of Android or SWIFT in case of iOS to send the location to PHP script on the server.
- Server retrieves latitude and longitude of the location and put them to spatial SQL request to get the result. (See example in 5.2)
- Converting the result to JSON format.
- Mobile applications retrieve the result in JSON format.
- Changing JSON result to valued information in the mobile interface.

6. TESTING THE SERVICES

Flood point web map service has been implemented in the URL: http://www.wearehappy.sci.nu.ac.th/pj_map/floodmain3.php. Users can launch this website and choose any location in Thailand to acquire 8 years flood data. Figure xxx represents the example of three different locations. Figure 3a) was a location closed to Naresuan University, Phitsanulok which was flooded only in year 2006, 2007 and 2011. Figure 3b) depicts a point that never been inundated for all 8 years. A point in Bangrakam district shown in Figure 3c) is an example of a worst location which was flooded every year.

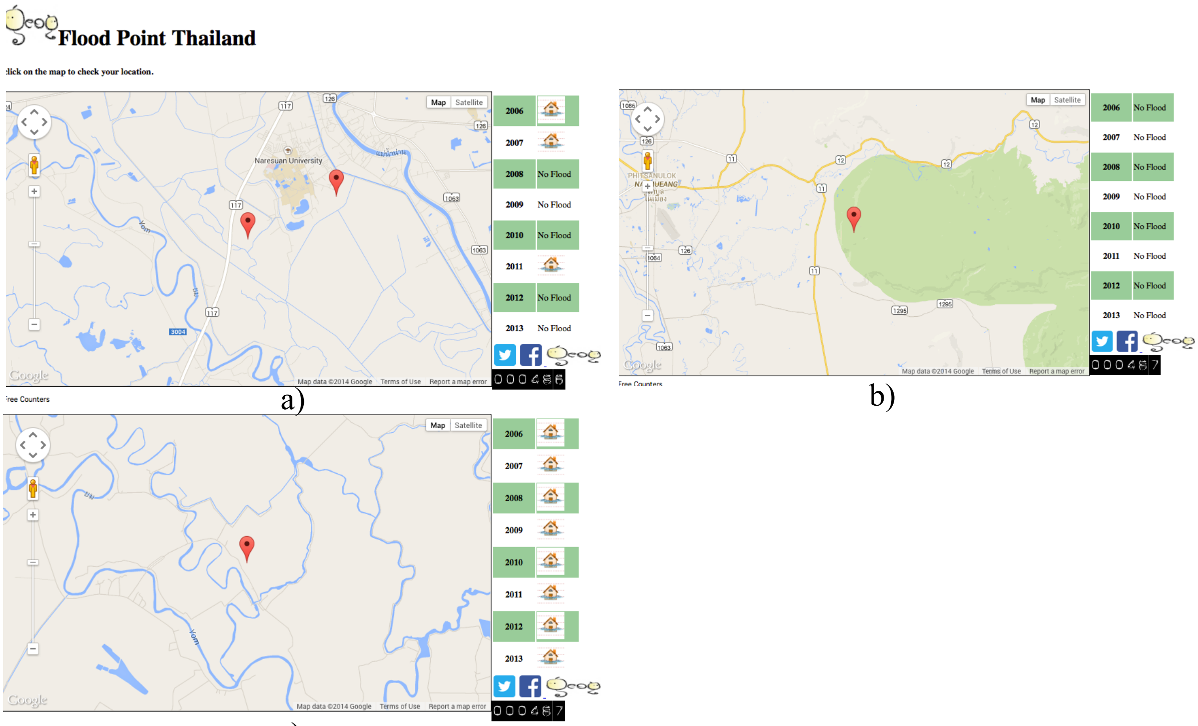

Figure 3. Web interface and some results.

On the other hand, Figure 4 represents examples of flood point service on iOS mobile application. The figure depicts another possibility to use this application by determining the background as satellite image. Users can locate a demanded parcel which clearly exists on the image and obtains 8 years flood information. Moreover, smart phone basically includes builtin GPS that can locate user's position automatically. Suppose users want to buy land and need to know whether the desired land has ever been flooded before. Users can go to the the site with this application and use current location to easily find out flood history of that site.

Figure 4. iOS mobile device interface and some results.

Figure 4a) represents the first page of the application. Figure 4b) shows a point obtained from current location which was located by GPS in the smartphone. This position (latitude: 16.656 degree and longitude: 100.136 degree) was flooded for 4 years (2006, 2008, 2010 and 2011). The application allows user to tap on the screen to obtain flood information for other locations. For instance, after the users explore the desired land, they might want to know whether surrounding lands have ever been flooded or not. Users can tap to other locations in order to acquire the flood data as shown in Figure 4c).

7. SUMMARY AND RECOMMENDATION

The multi-year flood data in spatial format are normally huge, which consume seemingly endless time to open via web services, and users sometimes need only to inspect flood history of their desired locations. This paper patently represents a potential way to use those huge data in powerful spatial database system to return rich information in a second. This application is very useful and convenient for users or organisations who need to make decision on site selection and planning which is concerning to the flood risk area. For instance, home buyers might need to inspect the flood history of new property they want to buy; home insurance agents could use this application in order to compute charges of insurance for flood risk properties (Department for Environment, Food and Rural Affairs, 2012); Local government officer might need to know flood risk status of lands and properties in order to pay for compensation etc.

Nevertheless, the flood data used in the study needed to be prepared by downloading from GISTDA website. It is still impossible to directly connect to the flood database from the original source. It will be better if GISTDA can prepare the data and allows developers to access directly to the database for reducing data redundancy. For future study, it is potential to integrate this service to other applications concerning to flood risk information. For example, flood frequency can be included as a major criterion from many criteria in decision support system for home buyer which can use their smartphone to make decision to buy a house (see Rinner and Heppleston, 2006).

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