Development of A Web-GIS Application Based on Mobile Interface for Multi-Purpose Application Fields Using FOSS4G

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ABSTRACT

Information technologies have gained importance in the worldwide organizations due to their efficiency with low costs. Spatial data management is necessary for sustainable development. New technology is using to collect and update spatial data. New services are offered by computer systems and the Internet for spreading of the data. The extension of a GIS instead of using computer from office to the field is Mobile GIS. It allows to accesses, store, update, analyze and display geographic information directly in the field.

Nowadays mobile devices are widely available and they are used in gathering field data in near real time. With many offered open source solution. The jQuery Mobile (jQM) provides a rich set of jQuery plug-ins, widgets and a cross-platform API for creating mobile web applications. In terms of code implementation, it is very similar to the jQuery User Interface (jUI). However, while jUI is focused on desktop applications, jQM is built with mobile devices in mind. jQM is a freely available as an Open Source code base and provides a rich user experience on Web browsers running on mobile devices. In this research, Web application will implement using jQM to interact with the spatial database on a mobile device. The user-friendly application for mobile device wills develope using HTML, PHP and JavaScript. The system allows the Client GIS up to date the GIS spatial data via mobile devices. Since the Web application is executed on the server side users need not have jQM installed on client devices and the application can on all Web browsers for mobile devices.

This research aims to develop the Web-Based GIS mobile application for multi-purpose fields using Free and Open Source Software for Geospatial (FOSS4G) like MapServer, PHP, QGIS, PostgreSQL, PostGIS, GRASS GIS, the OGC's Web Map Service (WMS) Web Feature Service (WFS) to make an easy Web interface based on real-time update data. To respond to the need for spatial data management remotely, web-based analytical tools to process geospatial data manipulation used by many services, organizations etc.

1. INTRODUCTION

Nowadays mobile devices are widely available and they are used in gathering field data in near real time. Mobile GIS are systems supposed to be run on all the available smart phone mobile platforms. The usage of such a kind of systems can be very wide: they can be used simply for navigation purposed (routing and tracking) or for maintaining inventories characterized by a geographic component, for events and incidents reporting or for directly mapping on the field.

The early work on Mobile GIS applications was mainly used as a guide or location-aware system. The Mobile GIS technology nowadays can represent a potential alternative to fill the gaps of the traditional static mobile GIS systems. These systems are capable of providing the GIS systems by the near real-time data about various spatial features such as street networks, hospitals, cinemas, schools, and business markets. With the mobile GIS technology, the emergency workers, inspectors, maintenance teams, utility crews, fire fighters, and many other field workers have the potential to access the enterprise geospatial data as the server-side to accomplish their tasks with high level of accuracy. More

importantly, updating these geospatial enterprises is feasible. Since the introduction of these technologies to the community, new revolution has been accomplished through the last few years on the Mobile GIS-based technology by means of hardware and software.
The mobile GIS have two main categories of application; the field-based GIS and the location-based services (LBS). The field-based GIS are mainly concerned about collecting, validating, and updating the GIS data in the field. For instance, adding new point feature or street polyline feature and changing or updating its existing attribute data is field-based GIS tasks. Unlike the field-based GIS, the LBS is concerned mainly about retrieving information regarding specific spatial feature such as finding specific location or defining paths between sources and destinations. The main difference between the field-based GIS and the LBS is that the field-based GIS is capable of editing the geospatial data and/or add new spatial features in the field (Tsou, 2004).

This research aims to develop the Web-Based GIS mobile application for multi-purpose fields using Free and Open Source Software for Geospatial (FOSS4G) like MapServer, PHP, QGIS, PostgreSQL, PostGIS, GRASS GIS, the OGC's Web Map Service (WMS) Web Feature Service (WFS), jQM to make an easy Web interface based on real-time update data. To respond to the need for spatial data management remotely, web-based analytical tools to process geospatial data manipulation used by many services, organizations etc.

2. CONCEPTUAL FRAMEWORK AND METHODOLOGY

The conceptual design of the mobile-field based GIS architecture uses the same architecture of the GIS web application via the Internet because it relies on the same client/server architecture. The server-side provides a comprehends geospatial data and performs online spatial requests such as spatial query, find etc. based on the online requests made by the end users at the client-side. On the other hand, the end user at the client-side can display data hosted by the server-side. The major components of the mobile-filed based GIS system are presented in Figure 1.

In this study, a jQuery Mobile (jQM) Web application was implemented to interact with the road network database on a mobile device. The user-friendly application for mobile device is developed using HTML, PHP and JavaScript.

The jQM provides a rich set of jQuery plug-ins, widgets and a cross-platform API for creating mobile web applications. In terms of code implementation, it is very similar to the jQuery User Interface (jUI). However, while jUI is focused on desktop applications, jQM is built with mobile devices in mind. jQM is a freely available as an Open Source code base and provides a rich user experience on Web browsers running on mobile devices (Ableson, 2011). jQM uses HTML5, JavaScript, AJAX and CSS3 features to enhance basic HTML markup in order to create a consistent mobile experience across supported platforms. jQM based applications work on mobile devices without JavaScript, even though a lot of redundant HTML is transferred over the network. For users who have a browser that supports JavaScript, the server only generates HTML on the first request and then subsequent requests use JSON and client-side templates to dynamically render the page. JSON is syntax for storing and exchanging text information. JSON documents are typically smaller than XML, and faster and easier to parse.

The system allows the Client GIS up to date the geospatial data via mobile devices. Moreover, users can map data in the real-time tracking GPS. The GPS tracking on this system directly send and store the data into the database in the server side. In figure 2 is showing example of the GPS tracking and real-time mapping in the same time based mobile

user interface. Figure 2(a) showing the GPS tracking data interface. The interface is showing the GPS tracking status, date-time, Lon and Lat data for each point. Figure 2 (b) showing the acceptable data tracking in the city area (Bangkok high way) and figure 2 (c) showing the data tracking in the density of building area in the big city like Bangkok, Thailand. Figure 2 (d) showing the tracking data from Phitsanulok province to Khonken province where the route is less of building and construction. Therefore, some area where is lacking of 3G or WIFI signal is could not get the point as can see in figure 2 (d) in the mountain area (green area on the map). The data accuracy is acceptable in map scale 1:10000 and some area can see the accuracy in map scale 1:5000 viewed from QGIS software as can see the points data located in the corrected way on the road in figure 2 (e).

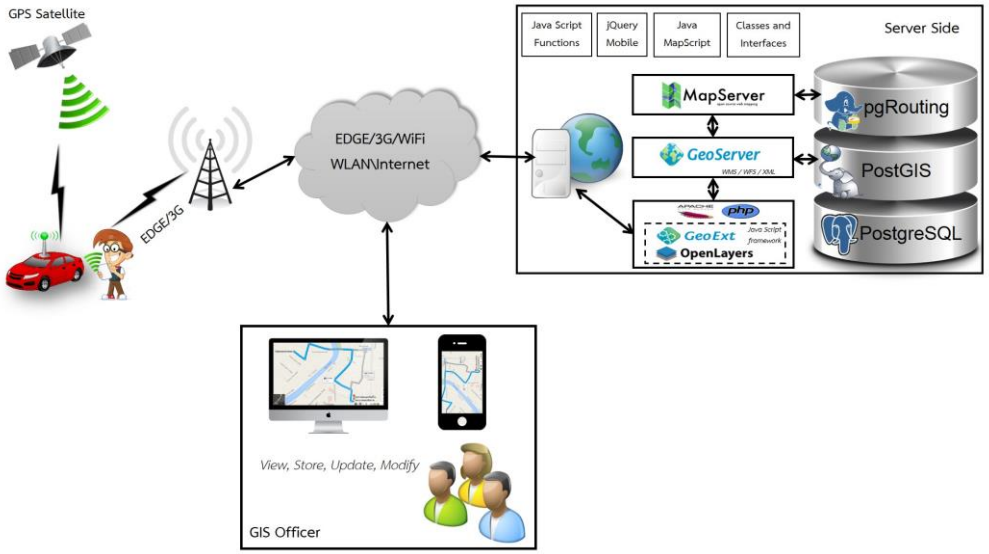
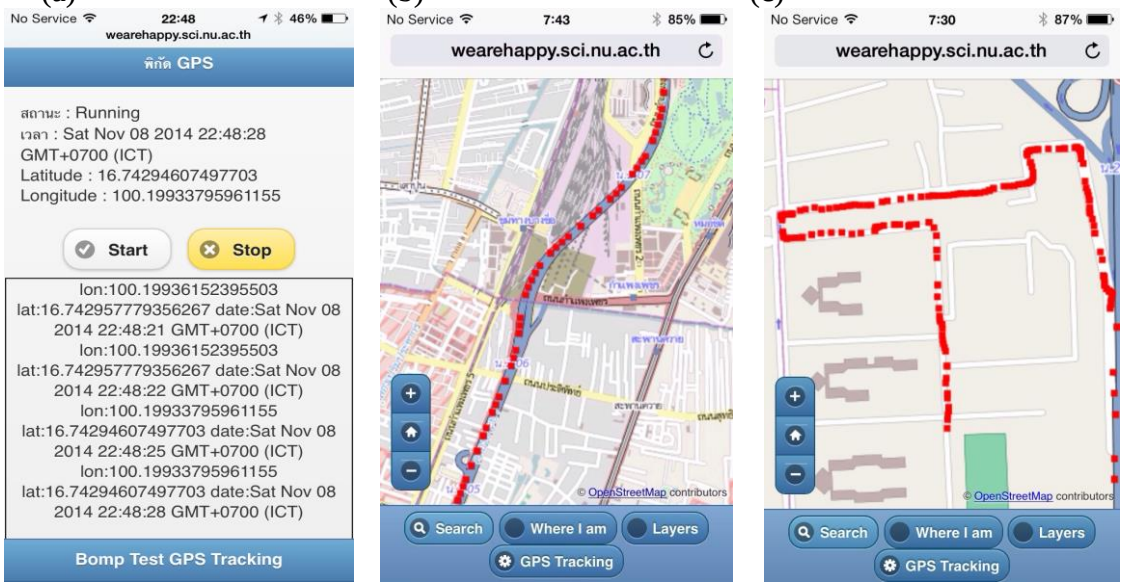


Figure 1. Mobile based GIS framework

(a) (b) (c)



(d) (e)

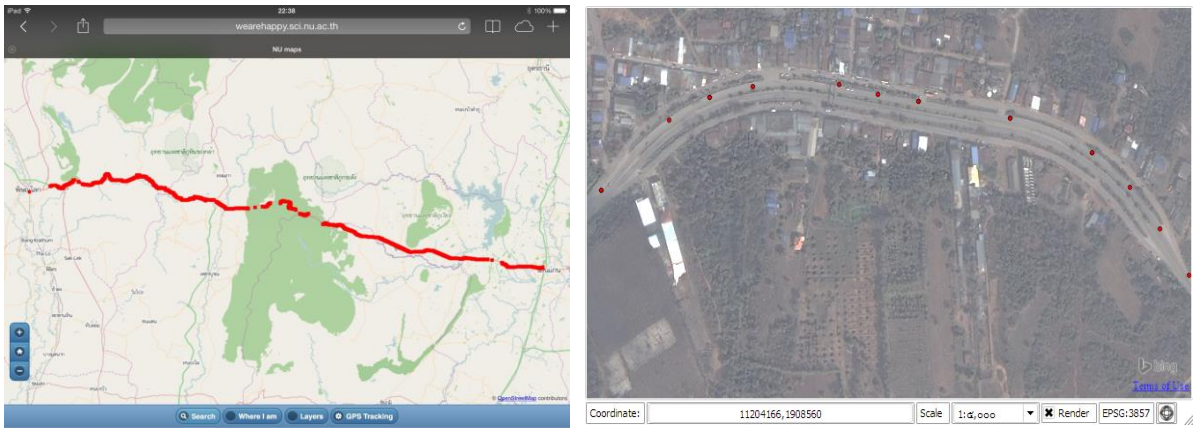


Figure 2. Experiment of data tracking based Mobile Web GIS

3. THE IMPLEMENTATION MOBILE GIS FOR MULTI-PURPOSE

3.1 GPS Tracking for road trip

Recently, many applications on smart phone such as Apple or Android can use GPS tracking and see your routing recoded. However, such kind of the application one could not apply to use with other application or cannot keep as the own data in the server. Thus, the aim of this system is to implement the warning system for the risk accident area. The system architecture is show in the figure 3(a). Figure 3(b) showing the point has change when intersected with the risk area.

(a) (b)

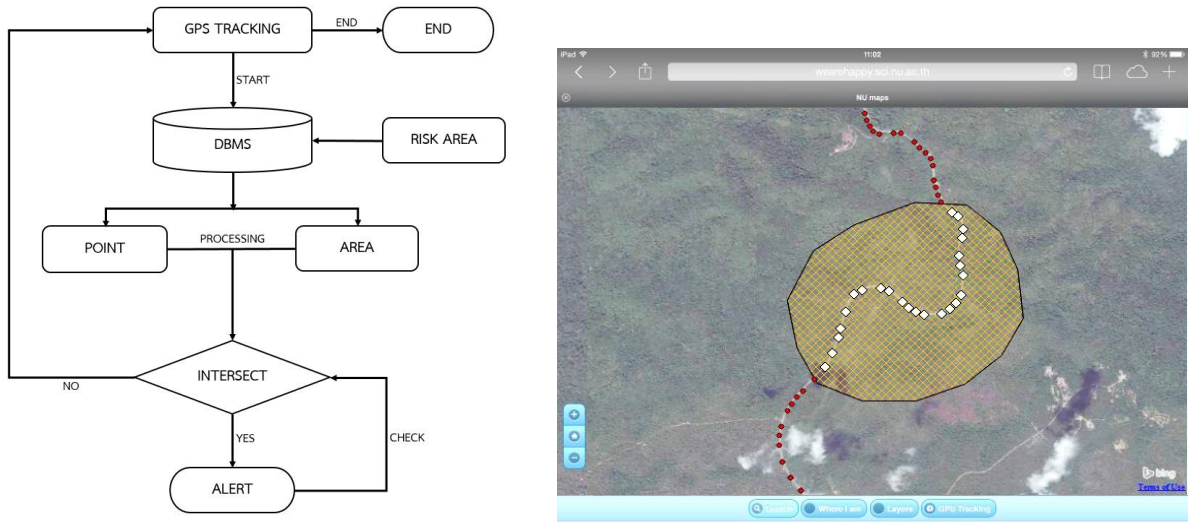


Figure 3. Warning system for the risk accident area framework

3.2 EMS member club

The Emergency Medical Service (EMS) plays an important role to relief the accident people or patients. EMS system is belonging to the National Institute For Emergency

Medicine (NIEM[1]) that serves the Emergency Car (EC), Ambulance Car (AC) etc. in Thailand. The EMS in Thailand has been started by Hua Khew Poh Teck Tung Foundation (Poh Teck Tung Foundation in present) which has initiated transportation of bodies without relatives in B.E. 2480 (1937) and began to transfer patients and emergency casualties in the following years. The Ruam Katanyu Foundation has served as the same activities in B.E. 2513 (1970). Both Foundations are initiated the emergency medical system that people can access services without discrimination nor specific services. The emergency medical system in Thailand has been developed since then together with the development of tools and life saving appliances in the emergency rooms of each hospital, both public and private sectors. Therefore, the EMS staff needs more system to support and make more easy works such as the real-time location of the accident point, which EC or AC that located nearest to the accident point. Moreover, to guide them which route is the optimal route to go.

The idea is 1.) how to know *Where* is the location of the patient from their calling? 2.) *Who* is calling? And 3.) *How* about the state for the calling? (W2H). This study examine and investigation the system with Buddhachinaraj hospital, Phitsanulok, Thailand. The emergency officers have the basic information for the entire patient who used to admission such as name, sex, age, chronic disease etc. However, the emergency staff could not fast understanding the W2H when the patient got some emergency case and calling from home. Thus, the EMS member club system needs to implement to store the location of the patient including others important information. The aim of this system is to implement the Mobile-based GIS easy user interface to support the EMS member club system in order to get the data and store into the database. Moreover, this system had integrated with Emergency Routing Decision Planning (ERDP) (Choosumrong *et. al*, 2014) that can find the optimal routing from the nearest ambulance care to the patient's house and from the patient's house to the hospital. Evaluate patient

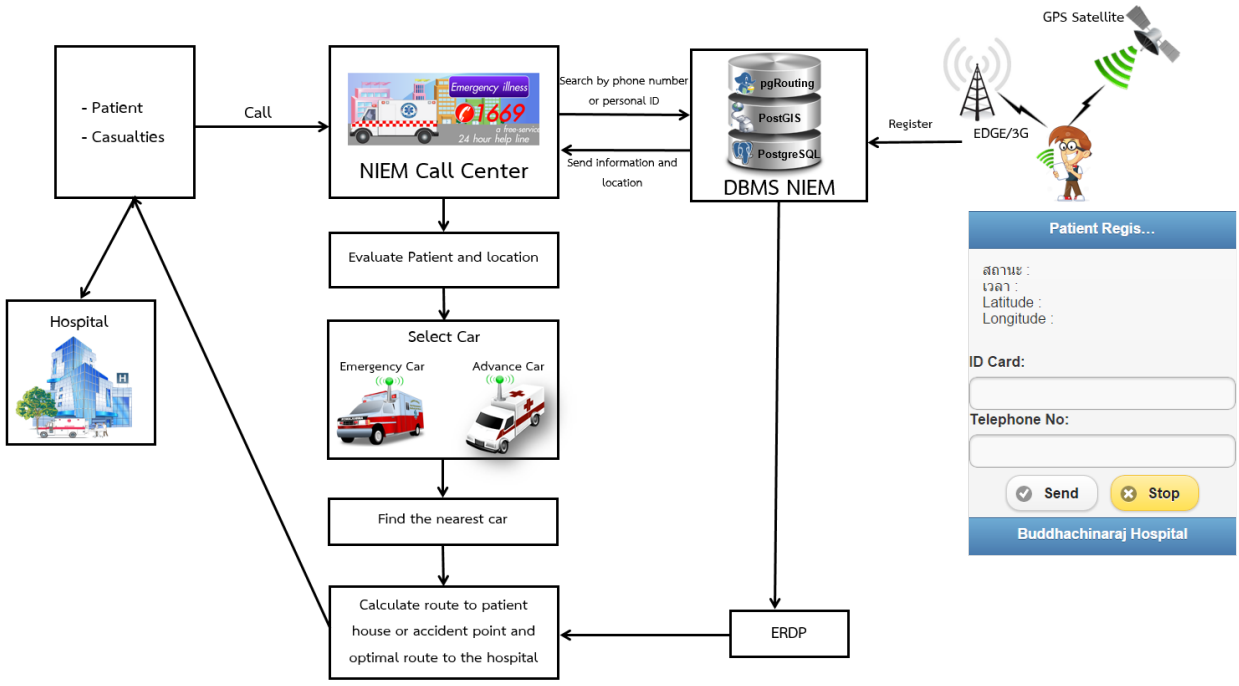


Figure 4. EMS member club system framework

[1] http://www.niems.go.th/

4. DISCUSSION AND CONCLUSIONS

At the current step of its developments, the implemented mobile GIS presents the basic GIS functionalities, user's positioning and locating. ERDP system can in integrated with EMS member club system in order to calculate the optimal route from the nearest ambulance car to the patient's house and bring the patient to the hospital. The main conclusions that can be drawn from outcome of these studies are as below;

- A new LBS application has been implemented by using FOSS4G.The integration of EMS member club with ERDP prototype incorporates functionality to update and query patient information, road network from mobile devices and, thereby, provide ubiquitous participatory framework wherein route reflect current road conditions.
- The geospatial standards compliant EMS member club and ERDP system provides access to geospatial services via standard HTTP communication from a Web browser, thereby eliminating need for any special software on client side.
- The efficacy of the ERDP system has been successfully demonstrated considering scenarios of medical emergency.
- Successful implementation of integrated EMS member club with ERDP system using available FOSS4G stack, Open Data and Open Geospatial Standard affords the immense benefits of building interoperable, scalable and robust platform to offer routing services in normal and emergency situations.

Some of the enhancements and improvements that need to be considered in future works are;

- The risk area such as accident point can be deploying as WPS to automatic process and update the risk area using GRASS GIS and ZOO platform.
- Integration of the EMS member club, ERDP and GPS tracking system to support for emergency scenario.
- Support for OGC Sensor Web Enablement (SWE) standards, wherein data such as CCTV cameras, weather stations etc. could be automatically received from field sites and provide routing results that reflect such data inputs.

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6. REFERENCES

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