Prototype of GIS Based Location Information Enquiry System

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ABSTRACT

The convergence of the internet and wireless communication has led the popularity of using handheld devices. People have now started demanding services that can be delivered any time anywhere, called Location Based Services (LBS). This paper deal with development of location based services on handheld devices that apply to emergency services. Handheld devices suffer from serious constrains in three areas: memory size, processor speed and screen size. This application uses the client server concept within wireless internet environment. The positioning service such as GPS is used to know the position of the user. The objective of this research is to display special query on the required spatial information within handheld devices using different operating systems such as WinCE, Palm OS and Symbian. This implies the strong feature of the proposed system. Hence the system assists people e.g. at the time of emergency to find the shortest path to the nearest hospital. The application will be access through the wireless internet. Only the related location in the entire map will be displayed on the handheld devices to which gives the economical usage of bandwidth and resources for real time response. This technology uses mobile internet as web browser embedded in the handheld devices. In Malaysia, a Location Based Services is still new and can be expand in many ways, especially in emergency cases.

Keywords: location based services, emergency, PDAs, Windows CE, Palm OS

1.0 INTRODUCTION

Advances in wireless communication technologies and mobile Internet enabled devices like smart phones and PDA(s), have enabled global internet connectivity and ubiquitous Web based computing and service distribution. The recent convergence of Internet, wireless communications, mobile positioning and geographic information systems (GIS) has given rise to a new class of location based applications and services [1]. The implementation of GIS into LBS technologies leads to an idea to develop our project entitled "GIS Based Location Information Enquiry System (GISBALIES)". It has been funded by KUTKM short grant. GISBALIES to which this project is addressed deliver geographic information and geo-processing power to mobile and static users via the Internet and wireless network in accordance with current location of mobile users.

Advancement in Internet technologies provided new opportunities for delivering spatial data information to remote users through HTTP protocol [2], but it does not address the interoperability. This implies that spatial data delivered through Internet is limited only in a static and proprietary structures. To enable information flow between GIS applications a standard and portable data modeling approach is necessary steps. An interoperable spatial data service should provide open interface to access distributed geographic information services from diverse user applications without any restrictions both on platform or programming languages.

This research is a considered as a first step in the development of GISBALIES for the mobile users. Its numerous mobile users need online help particularly about the location of the hospital, and how to get there. They can access the website designed specially for the location based services prototype via the wireless network. In such a case, the website can access by the user from a multiple mobile Operating System.

Since existing mobile GIS mapping for location based services were developed independently, yet there is no interoperability to support multiple mobile Operating System such as Windows CE, Palm OS, Symbian and embedded Linux [3]. The on going project has been focused on the efficiency access to multiple operating systems in PDA(s). Normal web application serving location maps cannot be displayed properly on PDA(s) because of the small screen. Apart from this, PDA(s) have limited resources in term of low processor speed, small memory space and limited battery power. Due to these constraints, a lot of desktop systems and applications cannot port to mobile devices directly.

2.0 THE GISBALIES REQUIREMENTS

Location Based Services in Malaysia is still relatively new and this research focuses in emergency services for hospital. The development of LBS(s) for mobile terminals got a strong momentum when US Federal Communications Commission (FCC) set the Wireless E911 Rules, initially in September 1999, requiring that it should be possible to locate all of the mobile phones for emergency purposes with the accuracy of about 100 meters in 67% of the cases. This system is used by the user who was in emergency situation. The on going project proposes the development of LBSs for hospital in Melaka Tengah with intention to assist users (patients) in emergency and has limited knowledge on the shortest path to reach to the nearest hospital. Many attempts and efforts are on the way to use PDA(s) and wireless technology to support fast and timely decision making during emergency situation. Aspects of user requirement analysis and interface development for the PDA(s) user are the major discussion of this paper.

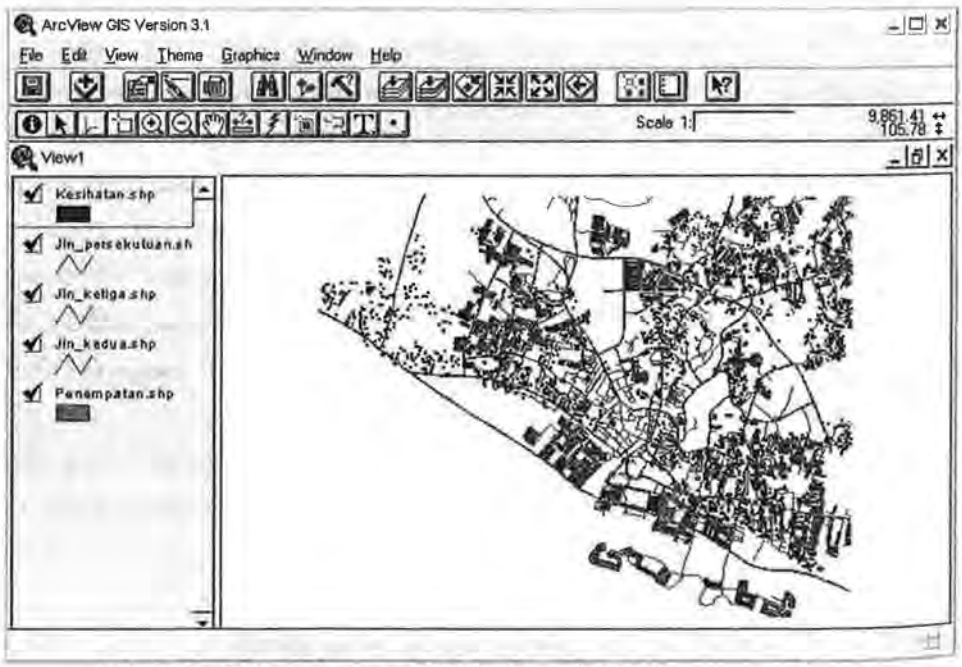

Figure 1 : The study area – Melaka Tengah District

Figure 1 is a digitized map and depicts four different spatial data layers- shape file datasets namely *" kesihatan", "jalan persekutuan", "jalan kedua", "jalan ke tiga"* and finally settlement (*"penempatan"*) shape file layers. Figure 1 shows also four hospital types in study area. One is the government hospital and the others are private hospitals. They are geographically distributed within the study area with their different own road networks (topology) and road types. This implies the complexity of shortest path route analysis particularly if taking other factors such as traveling time and other aspects into consideration.

3.0 OVERVIEW ARCHITECTURE OF THE PROPOSED SYSTEM

Location based services have already proven to be useful as people need information related to their position. Such information is especially important when there is emergency situation, under stress and unfamiliar environment. Questions likes "where is the nearest hospital" and "how do I get there" are already offered and supported by many systems and have their own architecture. In this research, we improve that architecture which is considered some important features. The general architecture of GISBALIES is presented in Figure 2 as below.

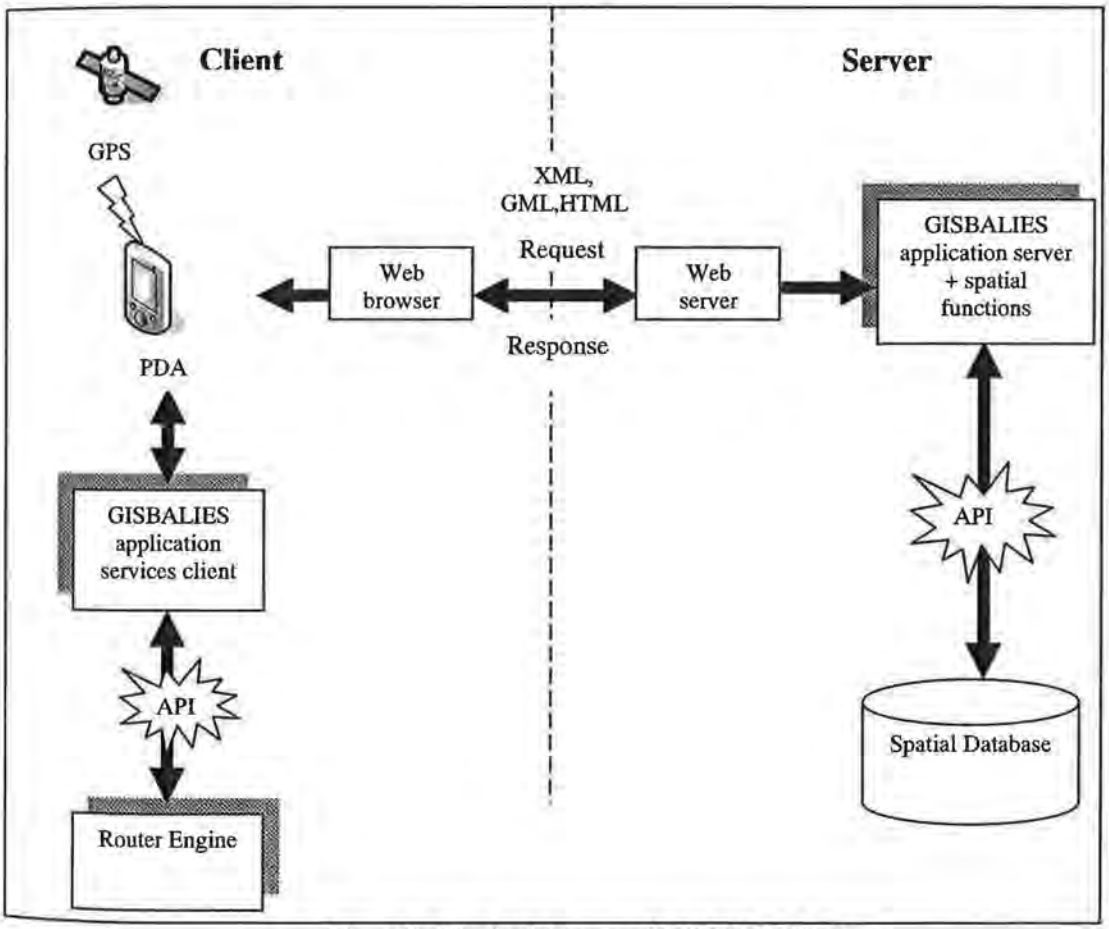

Figure 2: The Architecture of GISBALIES System

The architecture composed of a client with his interface and router engine on one side, and the server, with the database and some middleware on the other side. The web components are distributed in the two sides: web browser for the client and web server for the server sides.

Server side: The web server is one of the main features to give the availability to the LBS demonstrator, because the latter is provided by the Internet medium. Middleware are components that connect to the database to the client. First one is the JDBC API (Java Database Connectivity Application Programming Interface), which permits spatial and non spatial queries from the user to the database through SQL statement. API is a virtual interface that facilitates exchanging massages or data between two or more different software application [6].
Client side: The client application was developed in Java and geographical data is delivered in (compressed) XML-encoded geographical vector form to the client [7]. The client side is responsible for generating alternative views to the data and running a query in router engine which is for routing between two points. This allows reducing network load and working offline. The last element of the GISBALIES application, which is not directly part of the client architecture, is represented by the GPS. A GPS Receiver used to let the user knows their current position.

4.0 THE DEVELOPMENT AND IMPLEMENTATION CHALLENGES

Implementation of GISBALIES is still in progress and will be continued with second phase KUTKM's short grant. For the first prototype is concentrated in the development of the server side and ESRI ArcIMS technology. The prototype developed in this paper, uses a HP iPaq Pocket PC which is run using Windows Pocket PC. LifeDrive Mobile Manager is run using Palm OS. Both are a client devices. Both of the PDA(s) equipped with the Wi-Fi. The Wi-Fi used for the communication between PDA(s) and Web Map Server. For the first prototype, the Web Map Server (ESRI ArcIMS 9.1) was installed in desktop PC. After the digitized the data, we created a web-based GIS content server by installing web server software and ArcIMS 9.1 on a desktop PC. The server component included both web server (IIS 5.1) and web map servers (ArcIMS 9.1). The web server acts as the middleware between the ArcIMS server and the PDA. When testing, the software runs on the PDA device with Windows Pocket PC. Unfortunately when we tested use Palm OS the software is not running well.

During the development of the GISBALIES prototype application and in order to be able to handle the complexity road networks within Melaka Tengah, we have identified several challenges as follows:

- The spatial data transfer rate via PDA(s) GPRS is expensive. In addition to when using wireless 801.11 the signal is weak especially when using PDA. It is cause by the antenna of wireless PDA itself is inside the PDA.
- GPS signals are weak especially in areas of high rise building
- There's no commercial software able to publish map in a multiple PDA(s) Operating System

Most of the challenges are beyond the scope of the project. But for the third challenge, we propose to solve using the open source software.

5.0 ALTERNATIVE SOLUTIONS

In order to enable the proposed GISBALIES to perform a proper function, some constrains associated with mobile computing have been also taken into account. This step is a necessary and aimed at the establishment of a flexible, interoperable of GISBALIES including interoperable of different operating system.

Generally the proposed GISBALIES architecture has employed client server architecture. The proposed GISBALIES system architecture has been designed specifically to meet major requirements of particular mobile computing users.

The proposed GISBALIES system includes the follow important features:

- It is XML based
- It is based on geographic vector data
- Some computation are represent on client
- The client application of GISBALIES system is implemented in Java
- The server side for user-centered data selection

*Extensible Markup Language (XML).*GISBALIES system use XML encoding for geographic data. The XML-based geographic data formats used in GISBALIES are the standard Geographic Markup Language (GML) specified by OpenGIS Consortium (OGC).XML provides a platform independent meta-data [4]. Modeling the data in XML, bring the characteristics of the XML to data. Simplicity, openness, self description, and standardization are the most important advantage of XML over other data formats, especially in the web-based system.

Geographic Vector Format. The GISBALIES system transmits geographic data to the client in the vector form, instead of bitmaps. Scalable vector Graphic (SVG) is a standard of W3C consortium for represent vector data [5]. The advantages of using geographic vector format are; vector data in most cases requires less storage space than data in the raster form. The vector model openly describes geographic feature and this allows linking spatial data and attributes.

Computation represent on the client. The client side is responsible to run some queries, such as search the shortest path to the POI (hospital). Limited memory and computational power of mobile devices is the main constraint in this research and only limited volumes of data are allowed to process in a limited time. On the other hand, execution of queries on the server side cause wide use of the mobile network and cause delay of queries because of the limited bandwidth of the network.

Java implemented in client side application. In order to be the independent of the operating system of the mobile device, Java will be assumed as programming language in development of the client application in GISBALIES. For the prototype, GISBALIES application use Windows CE and Palm OS operating system. Currently these two type of operating system of mobile devices supported by Java.

Server side for data centered. The prototype includes some additional special features. One special feature is user-centered data selection. The system server is capable of selecting spatial data that is relevant for a specific user at a specific time. This again reduce network load and increase the usability of the services.

6.0 CONCLUDING REMARKS

The GISBALIES system is still under early stage of development. What we expect is the system can run on both of Windows CE and Palm OS operating systems. The most critical section in this project is to select the suitable techniques. Currently, the market provides a set of mobile mapping applications and services. Some of them, are born in the GIS field and represent simplified GIS system running on mobile devices, like ESRI ArcPad. But, unfortunately ArcPad not supported by Palm OS operating system. While existing systems rely primarily on bitmaps or some application-spesific formats, XML is positioned currently to be a standard way for encoding geographical data in future, including data transmitted to LBS client. OpenGIS Consortium developed GML language that is going to be standard.

In this paper, we briefly review some of the most important features in designing the GISBALIES architecture. Some actors offer GIS services via Internet. These are not directly applicable to the mobile terminals, because of the small displays and lack of other resources. The services must be adapted to mobile environment. We describe here our GISBALIES proposed system architecture, which demonstrates that vector maps can be presented and manipulated on PDA level devices. When Java support becomes more widely available in mobile terminals, this approach will most probably become more popular. And, of course, many useful location based Web services based on GISBALIES framework are going to be developed, deployed and provided for public access in the near future.

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