

OPEN SOURCE SOFTWARES IN BUILDING WEBGIS OF BUS INFORMATION SYSTEM.

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ABSTRACT

Easily and visually accessing to buses information is the important factors to growing up voluntary using-public-transportation guests, especially in over-10-millions-residents city as Ho Chi Minh City. More and more, with a WebGIS, the information will be more accessible. That is due to its representation, including images, routes, related spatial sites... This paper focuses on using low cost open source software solution (the software included: pgRouting, GeoServer, OpenLayer,...), to demonstrate some activity in bus system.

1. INTRODUCTION

Currently the buses are one of the means of public transportation, which was heavily invested to reduce the amount of personal vehicles, thereby reducing traffic congestion in major cities.

In addition to the investment in facilities such as vehicles, terminal... the system management and providing information to users are critical to the bus system to reach more customers.

If they are supplied with sufficient information, they will easily select and decide on the bus line appropriate with the route.

Ho Chi Minh city currently has more than 3000 buses on 129 routes operated differently, with more than 15000 vehicle trips per day, approximately about 7% demand of travel, oriented development in 2020 of the city bus to meet the demand for travel 15-20% of the people, so that the route of vehicles and cars will grow in the future.

The system management and providing information for the bus with such a big amount of data require a scientific solution. Information that users want to know exactly the right onto railroad, down at the station, how long it takes and how much it costs... and so on. Therefore the construction of a WebGIS used data about buses, bus routes, terminals and bus location data in real time using open source software to provide information to users is urgently needed.

Around the world, there are many countries that have built WebGIS information & query system for passengers such as Singapore with IRIS (Intelligent Route Information System), or in the city of Kaohsiung (Taiwan) has built ITS systems (Intelligent Information System) which provide information bus. These systems were brought utilities for passengers to ride.

2. METHODOLOGY:

2.1 Theoretical :

In the information that the user is interested in, the information about the pathfinder in the system bus is the most complex.

Finding the path itself was very complex with many algorithm, which was developed as A*, Dijkstra, Shooting* and each algorithm has its advantages as well as disadvantages. Finding

the way to the bus has its own characteristics: Routes that the bus moves are the roads but it does not completely coincide with the road traffic (because the buses do not go on all the roads and streets). Given that, if the buses are separate from roads and streets, then the search will not be performed.

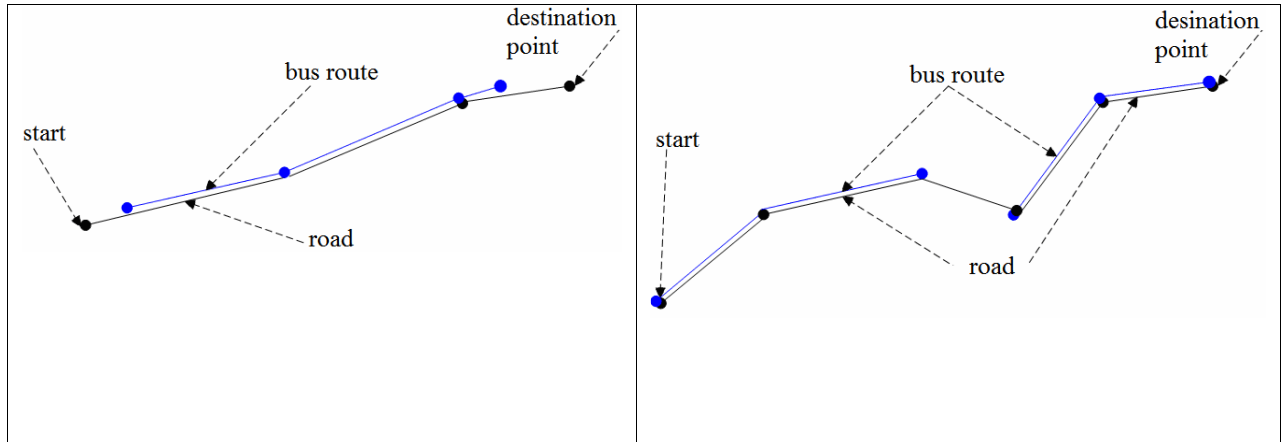


Figure 1: The system cannot find the path if the start and destination point not in peak of bus route, or two route is not connected.

Combination between road and bus, with this way user can locate any 2 coordinates on a map and the system will answer queries correctly and in details.

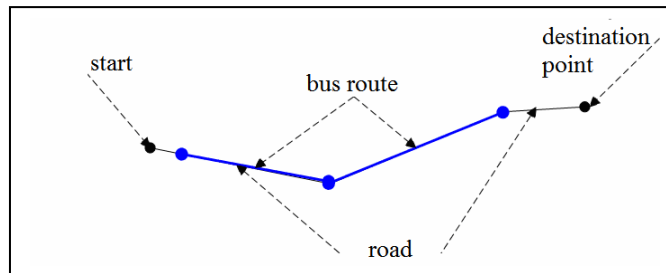


Figure 2: System will find the way: walking then go to buses and walk back down

Finding the way to the bus not merely find the shortest path by bus take the road map, in the process of moving by bus, transit is inevitable, so the weight for the cost of moving will based on three elements: the shortest path, transit least and walking least.

Cost from the state T_k to the status of T_i is calculated according to the formula recommended as follows:

$$cost(T_k, T_i) = KCT(T_k, T_i) * A + B \quad (1)$$

Where:

KCT (T_k, T_i): The distance actually travelled from to T_k to T_i

A: Coefficient of Road/Bus route

B: Coefficient of transit

System of the bus moves follow the bar itinerary, so the anticipated location of a vehicle based on the road map and timetable is completely able to perform. However with the status

regularly jammed roads in the city, this would be the lack of accurate predictions, so the acquisition of bus information in real time is needed.

Providing information to passengers travelling by bus in data such as cruise lines, time schedule or information about the station, the line through the station is fairly easy, maybe even using common web technologies and database without spacial such as MySQL, Access...

However, if you need advanced information such as position or queries to find the optimal way for the bus, the database must be able to store spacial data, and web can display and interact with the map. So WebGIS solution is suitable for problems, to build many WebGIS technology to choose from, you can use the commercial software such as ArcGIS, ArcIMS, Oracle Spatial Sever... or chooses open source software like GeoServer, MapServer, OpenLayer, PostgreSQL...

In this study, open source software is used with the advantages such as free of cost, custom computer systems and computer technology activeness.

2.2 Practical steps:

Step 1: Data collection.

The data here include background data including system administration, data about road traffic. Data about systems, terminals, and routes was provided from the Central Operator of Public Passenger Transport, in addition data about terminals, routes also collect by GPS, location of vehicles in real time was collected by black boxes that integrates GPS and send data through GPRS or 3G connection of telecommunication networks.



Figure 3: Transmission of GPS data displayed on the dedicated LiveGPSvn software with map background is Google Maps

The GPS receiver has a 10-15 m degree of accuracy, however this totally meets the relative positions of the car in real time.

When GPS signal is lost or GPRS signal is lost, we can determine the location of the bus through the schedule and position, speed previously received from bus.

Step 2: Data processing

For service queries the data traffic in the city need to cut at the intersection.

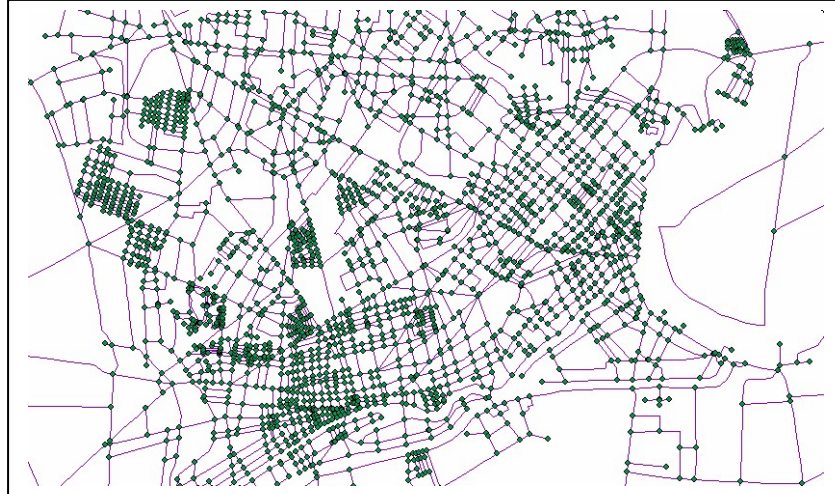


Figure 4: The roads are cut at the intersection

The data are aggregated in database PostgreSQL/PostGIS, in addition to serving for the queries with PgRouting library, you will need to build the columns properties such as source, target, length and create network topology for the network traffic through the SQL function in PostgreSQL, including attention to calculating weighted length for edges to look towards the cost of the walk and the bus ride.

Step 3: Build WebGIS Applications

After collection and processing of data is carried out construction of WebGIS system buses Ho Chi Minh City by connecting a database just created with GeoServer and Openlayer library to display interactive maps.

Simple queries such as station information, bus route information can be done directly through the Geoserver, however with the queries as complex as finding the optimum paths, search for near the station, seeking to use the function of language PHP queries directly on the database and via PostgreSQL, PgRouting, PostGIS to recheck query results and through Openlayer to display.

3. RESULTS:

Structure of WebGIS system:

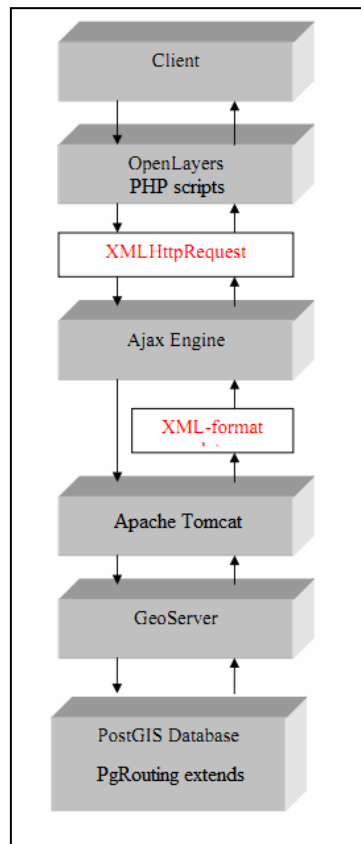


Figure 5: Structure of WebGIS system for search query service bus.

WebGIS research products and installed on the system of open-source software:
 Database management systems: PostgreSQL 8.4 + PostGIS 1.5 in conjunction with PgRouting 1.05 library for handling queries route data format.

Technological process and view the map: Apache Tomcat 6.0 + GeoServer 2.0 for server, javascript library for displaying maps: Openlayer 2.11 and language PHP for database queries.

WebGIS with experimental data sample:

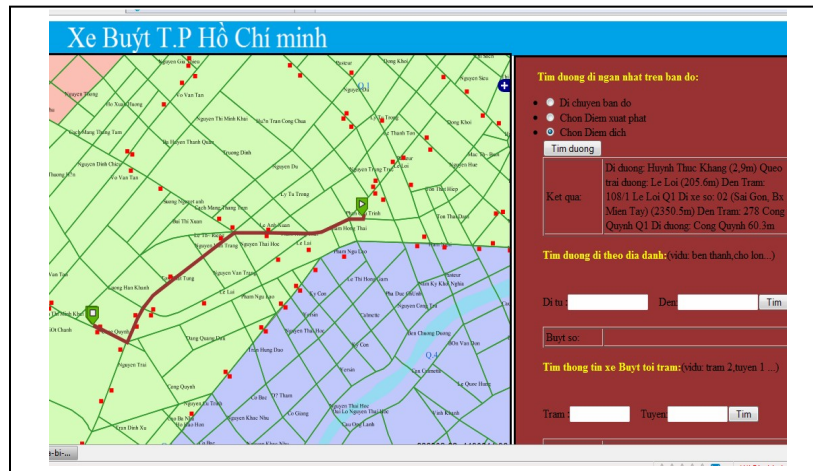


Figure 6: WebGIS interfaces.

4. CONCLUSION AND DISCUSSION:

From the results of research on the construction of WebGIS, some conclusions are drawn as follows:

The construction of full and accurate data for the management system of bus is a key decision for the provision of information to users.

The open source software to build WebGIS in the system allows us to customize the advanced and master technology in the process of operation, in addition to the cost savings from using open source software.

How to access to information of users is very important, so there needs to be additional external WebGIS solutions to provide online information, schedule ... through common protocols such as access from mobile through WAP (Wireless Application Protocol), SMS, or Mobile GIS.

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