A WebGIS-based system research and design for the traffic information management

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Abstract: Along with the rapid development of urban traffic system and the continuous progress of intelligent transportation system, traditional management mode of transportation system can not adapt to the increasing requirements. To solve the emerging problems of data sharing of GIS and to improve the whole work and service efficiency in the traffic management departments, this paper analyzed the requirements of traffic information management and proposed system architecture; then the paper discussed several key problems in design and implementation of the system. Finally, the paper indicates the system implementations. The system now plays a good effect in improving the efficiency of the urban traffic management and expanding scope of information sharing.

Keywords: WebGIS; traffic information systems; data integration

1 Introduction

Along with the rapid development of urban traffic system and the continuous progress of intelligent transportation system, urban traffic management system requires traffic information support for its complexity. For transportation departments, traditional management mode of transportation system can not adapt to the new economy development, the main task is to adopt the advanced information processing methods to construct and gradually improve basic traffic network. Therefore, we must raise all kinds of information resources management level and comprehensive utilization level of the urban traffic system, improve the whole work and service efficiency in the traffic management departments, and thus realize the urban traffic management levels rising [1].

Currently, because of the diversity and complexity GIS data, we must use the modern information technologies to develop the basic traffic information management platform based on WEB. To enhance urban transportation, the development of a Web GIS-based comprehensive traffic information management system has become the first choice architecture for the system.

This paper is structured as follows: the second part introduces the technical requirements, and then we propose the structure and function of system. The fourth section describes the key technologies of the system and our solutions. Finally we conclude the system.

2 System technical requirements

2.1 System requirements

The ultimate goal for the system includes:

(1) To provide timely, accurate and comprehensive transportation routes (including roads, passenger lines and waterways etc.), mileage, line condition for the related departments of transportation departments;

(2) To integrate various transportation infrastructures and provide information sharing, which can provide all kinds of information services according to the administrative jurisdiction scope, technical level and administrative level;

(3) Visualization of electronic map;

(4) To provide management, decision analysis for relevant departments;

(5) To provide data collection and conversion for attribute data and GPS data so as to ensure the quality of the data;

(6) To facilitate query and edit maintenance.

In addition, through the implementation of the system, it will make greatly improved the environments of traffic information and also accelerate the information construction for road and waterway departments.

2.2 System structure

Because the system is provided to the business departments and also provides necessary services for the social public, the system architecture is organized as figure 1.

In figure 1, Web server layer acts as information exchanging bridge among modules. Application server is SuperMap IS.NET, which used to access spatial data and provides map services. All data are stored in database systems. The system can also directly access the non-spatial

data by ADO.NET. This three-tier architecture of the system can facilitate data organization and management. It can improve the system stability and scalability [2].

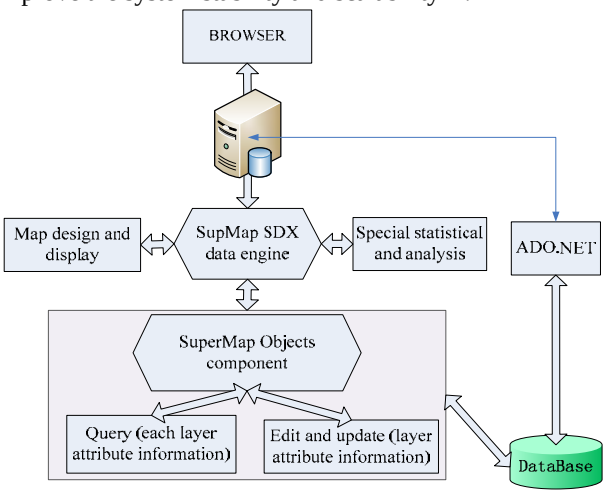

Figure1. Schematic diagram of system architecture

3 System function architecture

From section 2.1, we design the system functional modules which are shown as figure 2.

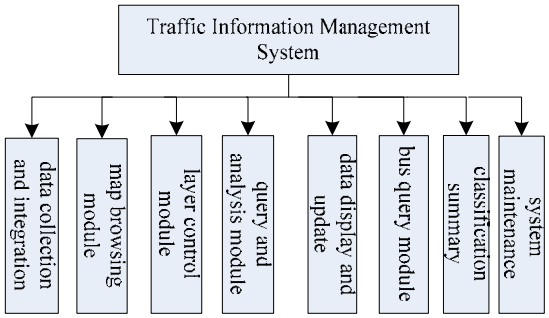

Figure2. Schematic diagram of system functions

Data collection and integration module involves acquisition and processing of GPS data and CAD data. The GPS data is used to update the spatial data in database systems. In aspects of GIS and CAD multi-source data fusion processing, the system store the CAD data directly in databases and uses special plug-ins at client browser to display CAD design data. The main functions include data import and export processing, address matches, projection coordinate transform, the registration data processing, etc. Collecting renewal structure is as shown in Fig 3.

Map browsing function adopts a number of controls provided by SuperMap IS Web Controls to implement map zoom in and zoom out, map pan, distance and area measurement etc.

The functions of the layer control module to control whether the layer display or not and whether user can edit map. All Layers are designed by means of trees. The organizations relation of tree's node is customized by XML. The control logic is configured by Web configure file. Further more, map editor can provide spatial operation such as add, delete and move object, another function is to update non-spatial attribute information.

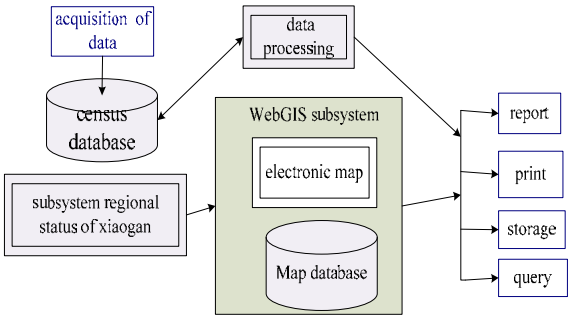

Figure3. Data acquisition and processing

Query analysis provides both attribute query and spatial query such as road, waterway, bridge and CAD design information. The main function contains: simple query, comprehensive query and spatial query. Simple query is a kind of fuzzy attribute query. Spatial query provides multi-way spatial query mode，such as point, line, regional query. Integrated query is a relatively complex query. Search results support paging display function. Each data can be highlighted in the map. At the same time, the query results can be imported into Excel file to make report.

Data display and update module judge what kinds of operation it executes according to user role. Data are dynamic presented in accordance with the administrator setting. Users can edit and add the attribute fields for database tables. The publics only have the ability to query and can not modify any data. Specific functions include: display data and design materials, upload and download data, drawings etc.

Bus query function: First of all, the users input information of the start and end point. Then all requests are transmitted to the WEB server and application server. Finally the system gets results by the optimal path search algorithms [3].

The Statistic report module gathers query results according to certain levels according to given conditions. All report forms are designed using template techniques.

System maintain module contains adding system users, modifying layer attributes, setting display properties, modifying system users and so on.

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4 The key issues

4.1 Multi-source data integration

To make full use of existing data, reduce costs and achieve the sharing of information resources, the system should integrate the multi-source data such as GPS data, GIS data and other database data collected before. There are three ways of multi-source data integration: data format conversion, interoperability mode and directly accessing data mode [4]. The system adopts direct data access mode to realize multi-source data integration.

Direct data access mode means to directly access data format of other software by SuperMap SDX. Users can use the software to access a variety of spatial data. This access mode not only avoid the complexity of data conversion, but also don't require the user owns the data format of the host software and also don't need to run other tools when accessing spatial data. SuperMap SDX supports directly access the data format, such as SQL Server, Access MDB, ESRI SDE, Super Map SDB, AutoCAD, DWG, ArcGIS, GDB, MAPINFO and etc.

In the specific research, this system has designed a data integration scheme for the Multi-sources of special data acquisition ways and storage format. The data used in the system mainly include basic geographic data and traffic thematic data.

Basic geographic data contain all kinds of layers such as administrative zoning, residents land, water, pipeline and railway. In the basic geographic data, we should convert different projection coordinate into the same projection coordinate in order to superimpose with a variety of different sources of data. The main source of foundation geographical data includes: (1) the 1:1 million map of national map libraries; (2) the collected data from the highway department, this data format is ArcGIS shape format; (3) real-time data collected by GPS which should convert into common data format, the GPS data collected by GARMIN tools; (4) data from traffic professional departments, the data is GDB format.

Traffic thematic data contains the specialized data from highway, harbor, station yard and other layer; it also articulated a lot of existed data. Data from highway are the main data the system manages, which include management of county roads, and the main street roads of cities, bridge management, tunnel management, foundation information management of toll stations, and traffic observation stations. These data, such as bridges and roads, require connecting to the data that already exists in Visual Foxpro and SQL Server 2000. Some Roads data and GPS data have been stored as AutoCAD files. So the system should design a mediator to access these data sources transparently.

4.2 Bus transfer model

Bus network is composed by three data sets that are bus point sets, bus line network and bus line sets. Bus point sets indicate all bus stops; the main information includes bus stop identification (ID) and bus stop name. Bus line sets indicate all bus line among cities, the basic attributes must include bus line identification and line name; in some application area, it also includes bus line direction and running priority. Bus network is a topological description between bus stop and bus line, it must contains bus stop ID and bus line ID and other auxiliary information. The relationship among bus stop, bus line and bus network is shown in figure 4.

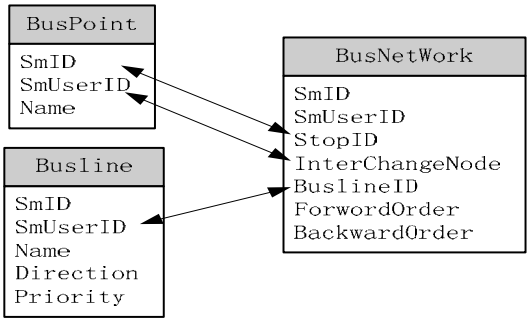

Figure4.Transit network model

4.3 system security technology

Data security plays an important role in GIS applications. In this system, the security mainly includes two aspects: one is the user control and the other is data control.

User control means different user role can only use the provided functions and data. To solve the problem, the system firstly uses encryption technology to encrypt user information such as password by MD5. And then, role based access control (RBAC) also considered in background peer. For example, system administrator has the authority to perform a variety of input and modification, while the public can only query and browse general information.

Data control means different user or role may get different data from databases. For example, data level used to

the public may not detail as the professional users. This kind of data control is implemented by .NET web configure controller and data extract technologies.

5 System implementations

Our system is implemented in Visual Studio.NET 2005 platform, the GIS application server is SuperMap IS .NET and IIS acts as WEB server. And we use Xiao-gan city, Hu -bei province to show our implementations.

Figure 5 indicates the main client interface,

The main client interface provides the following functions, such as map control, simple query, check search results, spatial query, integrated query, edit layer, route query, and classified summary and so on. SuperMap IS .NET provides the function, it contains maps of the browser query, editing, dynamic thematic map making, transfer path analysis, which can meet the basic functions needed by Web site map construction. In environment, in C#.NET for the development language, the system adds Super Map IS.NET Web Control controls, Tree View control, Data Grid control into project, modify the various properties and write the relevant function module code to achieve map operation and the function of query [5].users can access the corresponding modules in accordance with authority allocated by the system administrator.

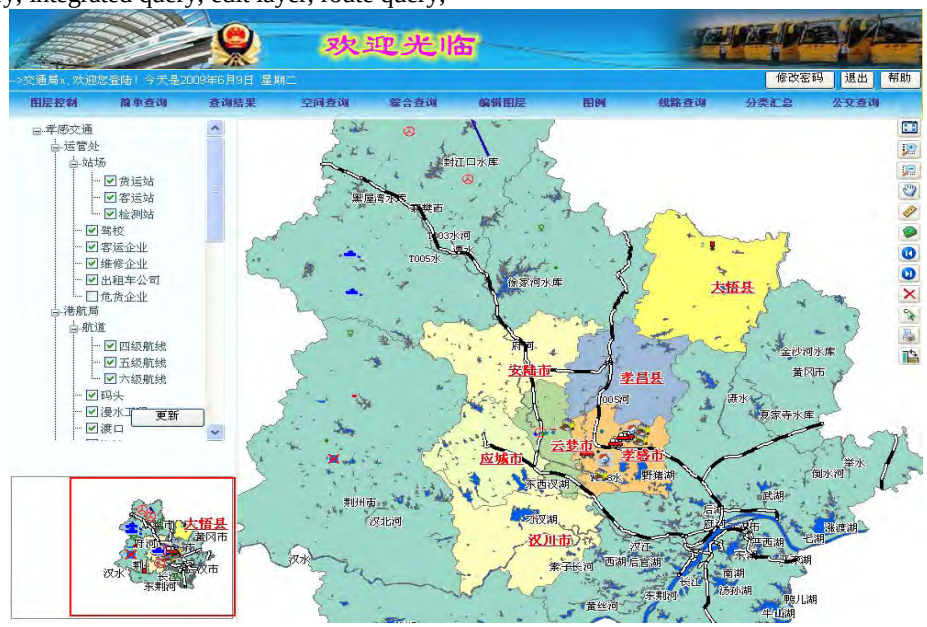

Figure5. Home page of system

6 Conclusions

Through setting user rights, this paper has successful solved the problems, that are the scope and extent of traffic information sharing and data confidentiality, which are caused by data sharing in traditional WebGIS information systems. At the same time, this system constructs the new traffic WebGIS System adopting .NET platform and Web Service technology and using the features of their loosely coupled, interoperability and supporting multi-language. This paper solves the problem of the data sharing between office business and GIS and achieves the maximum seamless cohesion between GIS and business. The difficulty of development and costs are reduced to a great extend. But due to the propagation delay caused by the transmission the transmission of large object (e.g. documents, photos, spatial objects), it makes to increase response time of the system. In the future, we face the problem that is how to improve system performance efficiency.

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