Applying ArcGIS Server to Educational Administration

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ABSTRACT:

Traditional educational administration relies on non-spatial information, and lacks visual representation of regional difference. Web GIS technology is adopted to assist visualizing the real world and to integrate data from various sources. ArcGIS Server is chosen to perform advanced GIS functionalities and to distribute information to the public.

A web service application is developed to help the educational administrators distribute subsidies to the schools based on certain criteria. The functionalities include query, statistical analysis, and map display. The geodatabase contains locational data, school basic data, and subsidy data. The issues of integrating various data are discussed in this paper as well. In addition to the existing functionalities, online data updating service will be introduced into the application in the future.

1. INTRODUCTION

In general, the level of educational achievement correlates to individual earnings (Makino and Watanabe, 2002). In order to be educated, the disadvantaged students require government support. Government subsidies, therefore, are critical for these students and schools to develop equal education opportunity. The schools consist of students, teachers, staff and numerous facilities, which are considered as an important part for educational strategies. Previously, the educational administrators made decisions depending on non-spatial information, including all kinds of statistical graphs and tables of various school information mentioned above. The meanings of geographical relationships, patterns and trends were hidden until the widespread use of Geographic Information System (GIS), which is able to display, store, retrieve and analyze geographical data with various formats from diverse sources (Brown, Baird, and Rosolen, 1999).

The Web-based GIS (WebGIS) has become prevalent due to the rapid development of computer technology, the extensive use of the Internet, the increasing need for spatial representation of the real world, and the powerful capability of geographical information analysis. ArcGIS Server is adopted to develop the WebGIS application, because it “provides enhanced functionality to support more advanced user workflows and services” (Peters, 2005). This application will not only help the public to be aware of educational policies, but also assist the educational administrators in decision-making via visualization, data retrieval and information analysis. In the future, data updating service will be created to complement the decision-making procedure.

2. METHODOLOGY

Web services are a cost-effective way to integrate a variety of data from different

sources and to provide multiple users the remote access to getting these data through the communication with server. The server will process users' requests and then send the responses back to the users (Vassilopoulos and Evelpidou, 2003).

2.1. Software Selection

There are two solutions for the WebGIS application, ArcIMS and ArcGIS Server. The advantage of ArcIMS is to efficiently "publish maps, data, and metadata through open Internet protocols" (Bader, E. et al, 2004). While ArcGIS Server "is both robust and extensible, and its rich functionality allows developers to concentrate on solving organizational problems, not building GIS functionality from scratch" (Bader, E. et al, 2004). In this paper, ArcGIS Server software is chosen since it is more powerful and flexible with the provision of "full complement of ArcGIS ArcObjects for deployment on the Web and as network services" (Peters, 2005).

2.2. Data Sharing and Data Integration

The data used in this paper include Excel files, Shape files and a SPOT satellite image (Table 1).

Data	Format	Scale/Resolution	Sources	Time
Basic Data	Excel	NA	Ministry of Education	2003-2006
Subsidy Data	Excel	NA	Ministry of Education	2003-2006
Schools	Shape File (SHP)	1:25,000	Computer Centre, Academia Sinica	2006
Roads	Shape File (SHP)	1:25,000	Computer Centre, Academia Sinica	2005
Boundaries	Shape File (SHP)	1:25,000	Computer Centre, Academia Sinica	2006
Image	SPOT satellite image	2.5m	CSRSR	2004

Table 1. Data Sources and Data Format

School basic data contain the school codes, addresses, phone numbers, websites, and the amount of students, staff and all kinds of facilities. Subsidy data contain not only the criteria, which are school location and the amount of dropouts, immigrants,

single-parent students, imbeciles and the percentage of student loss, but also the amount of subsides determined according to the criteria. These data are collected from Ministry of Education in Excel format from year 2003 to year 2006. The SPOT satellite image is collected from Center of Space and Remote Sensing Research, National Central University (CSRSR). While the locational data, including schools, boundaries and roads data that are in SHP (shape file) format, are collected from Computer Centre, Academia Sinica. The scale for these shape files is 1:25,000.

In order to facilitate the process of data sharing and data integration, the Excel files are converted to DBF format, which can be directly used in both Access and ArcGIS software. School codes are unique, and therefore are taken as the primary key to join the tables (DBF) and the shape files.

2.3. Functionality

This application consists of the map area, table of content (TOC), developed query interface, and the standard tool, including zoom in, zoom out, pan, full extent, back, forward, identify, selection, and clear selection functions (Figure 1).

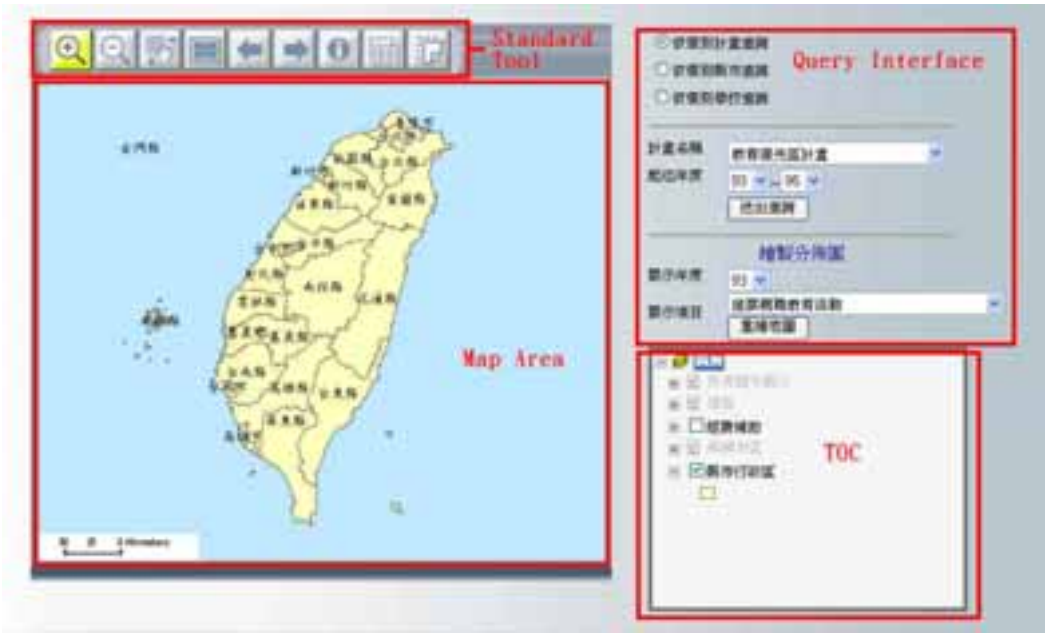

Figure 1. The Overview of the WebGIS Application

The developed query interface contains the functions of creating tables and statistical charts and drawing choropleth maps, which gives the web users a comprehensive understanding of schools' and counties' general information about the amount of students, staff, facilities, and subsidies.

2.3.1. Map Display

To avoid the complexity of the map and to speed up the performance of the transactions, the visible scale of the satellite image is set to 1:50,000 (Figure 2). The satellite image will not be seen if the scale is smaller than 1:50,000. The satellite image, and schools and boundaries maps (Figure 2) display school locations and reveal the density of schools in each county.

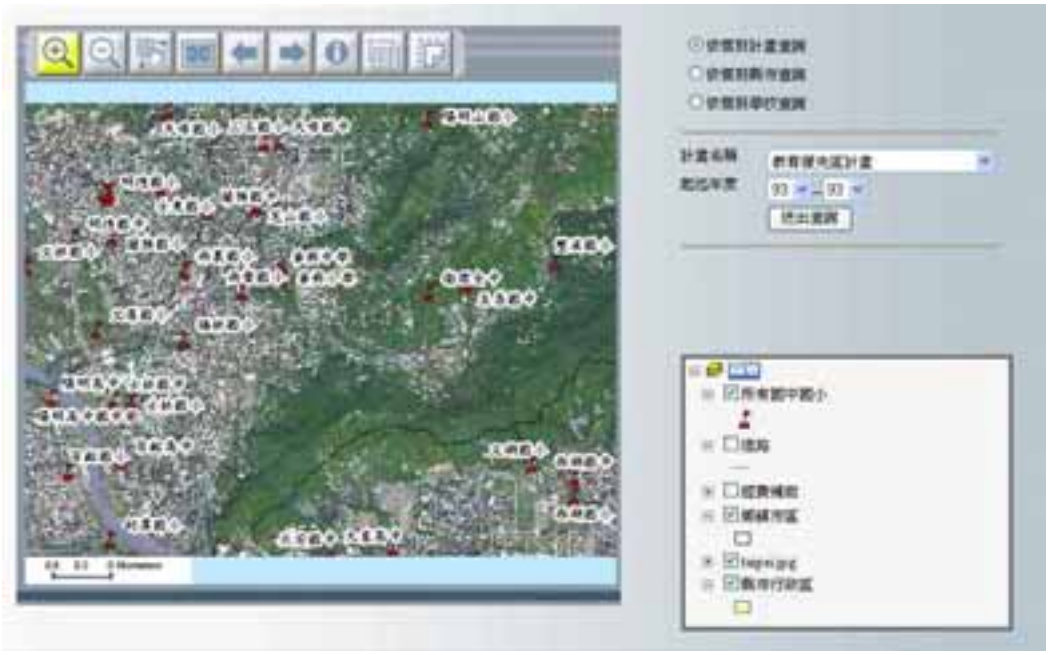

Figure 2. A Satellite Image, and the School and Boundary Maps in Taipei

2.3.2. Data Retrieval and Chart Production

The query interface allows the users to retrieve data by selecting a county or a school. The data, general and subsidy information of the selected county or school

from 2003 to 2006, will be retrieved and shown in both tables and a chart (Figure 3). The information change during this period can be easily detected.

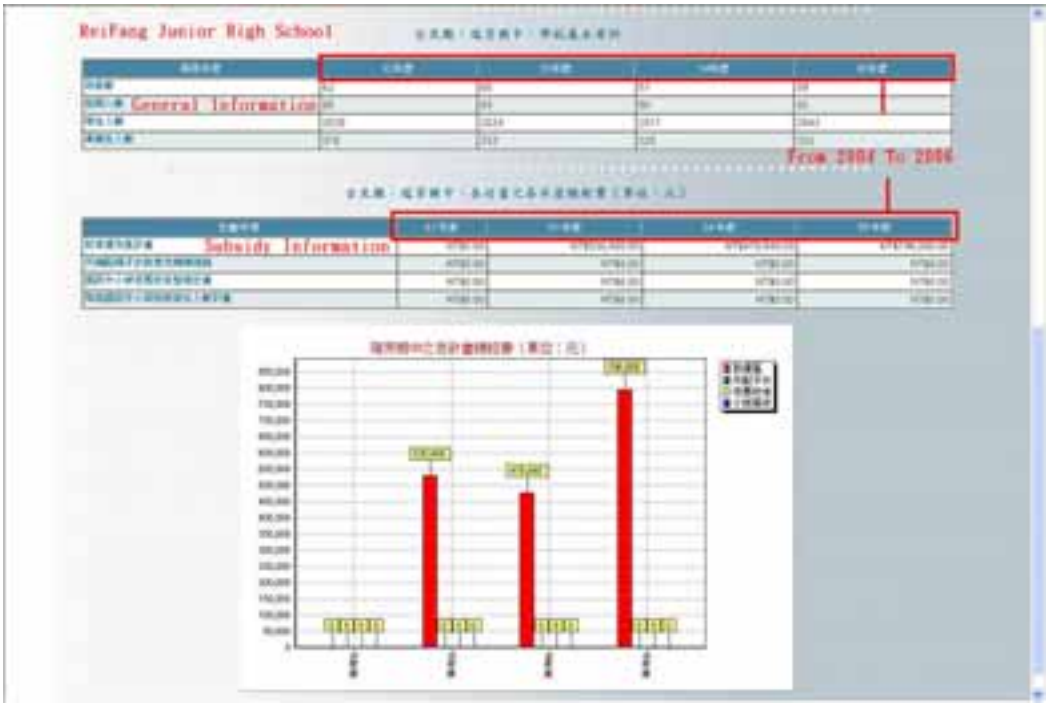

Figure 3. Result Chart and Tables

2.3.3. Choropleth Map Production

In addition, the function of creating choropleth map is developed to reveal the importance of visualization. The choropleth map assists people to rapidly identify and compare the attribute data of the counties or the schools. In Figure 4, dark red color represents the maximum value, while yellow color represents the minimum value. PingTung county and HuaLien county, filled with dark red color, get more money in the item of imbecile students than the other counties.

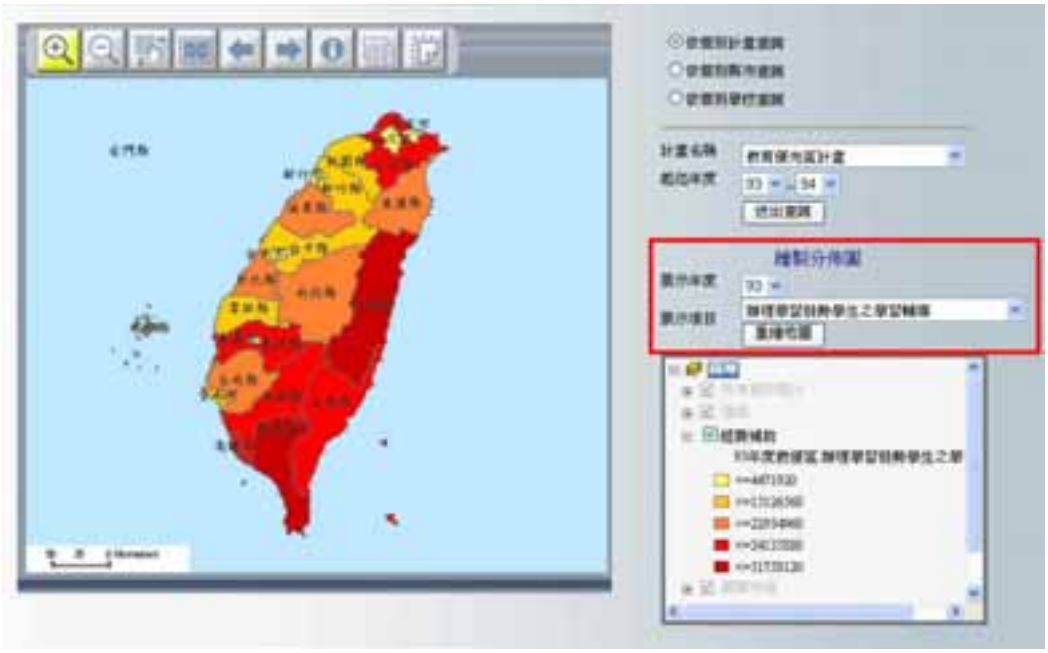

Figure 4. Choropleth Map of Imbecile Subsidy

3. RESULTS

The layers, which contain a satellite image, and schools , roads, and boundaries maps, display the locations of the schools. People, therefore, get the overview of topography and school distribution. The map display, moreover, helps the administrators to visually discern the suitability of establishing the schools in certain areas, to easily deal with the issue of school mapping, and to equally distribute the subsidies by the complement of school attributes. Figure 3 and figure 4 present the results that are generated by this WebGIS application. The tables and charts display the requested data in a traditional way, yet they are simplified, reorganized and retrieved automatically from various databases. The choropleth map demonstrates one of the powerful GIS functions, which enables the users to visually obtain the overall information within specific regions. In order to fulfill the functionality of this application, it is necessary to provide real-time information updating service and advanced school mapping analysis function in the future.

4. CONCLUSIONS

Locational data, basic data, and subsidy data are the main part of this application. They are collected from different sources in different formats, and therefore have to be converted into the common format for data sharing and data integration. School basic data and subsidy data are Excel files that are inconvenient to be integrated into ArcGIS software. Hence, they are converted into DBF format and join the shape files by the unique school codes. This WebGIS application can help the administrators visually comprehend the information about the schools and the counties. It also enables the public to display and retrieve the data through the Internet.

Further steps are to design a web form that allows data input and data update, and to publish the printable reports that include querying tables, maps and charts. School mapping is an important issue as well. Detail school mapping requires the information of demography, terrain, services and transportation. Although the administrators are able to detect school distribution and school district via map display, advanced analysis functions, including buffer and categorization, are demanded to support the decision making based on several established rules. This application will work on school mapping analysis.

5. REFERENCES

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