

An Internet GIS Application for a Prototype of Water Resource Infrastructure

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Abstract. This paper describes the capability of computer system for integrating, analyzing, and displaying geographically referenced information. The Internet GIS application has been developed for water resource management as it gives users better understanding of the overall country watershed. In addition, an integration of the GIS information technologies is also presented in this paper.

Keywords: Internet GIS, GIS, MIS

1. Introduction

A Geographic Information System or GIS is a collection of computer hardware, software and geographic data. This technology is used for managing, analyzing, integrating and displaying various forms of geographically referenced information. Today, more GIS applications are created for modeling real world to the map forms. The Internet system is applied to easily access these applications and to distribute the geographic or non-geographic information. An important concept of this Web-based GIS or Internet GIS application development is to represent spatial information analysis. The released application is one of the assistance tools to support natural resource planning and management.

The paper gives a description of the Internet GIS application architecture and general features of the application to provide the framework of water resource management. This application has been developed by using PHP, HTML, and Javascript computer programming languages. Furthermore, this paper also briefly discuss about the Internet GIS technologies integration that is the implementation of a combined the MapServer base map and the Scalable Vector Graphic or SVG base map in this Internet GIS application.

The remaining of this paper is organized as follows: Section 2 presents the Internet GIS application architecture and introduces the Internet GIS spatial operation. Section 3 proposes the general features of Internet GIS application. In section 4, the examples of Internet GIS application for a prototype of water resource infrastructure are shown, while the integration of two GIS technologies is described briefly. Finally, section 5 is the conclusion.

2. Internet GIS Application

2.1. Internet GIS Application Architecture

The architecture of Internet GIS application is given in Fig. 1. From Fig. 1, the Internet GIS architecture can be classified into three main modules as follows: Database, Pre-process, and Operation&Display. Database module includes database and spatial database management system, data collections, and import and query data processing. The application has been specifically developed not only to handles both geographic and non-geographic information, but also to handles both vector and raster data formats. In Pre-process module, the vector and raster data inputs are prepared and processed before they are demonstrated in Display module.

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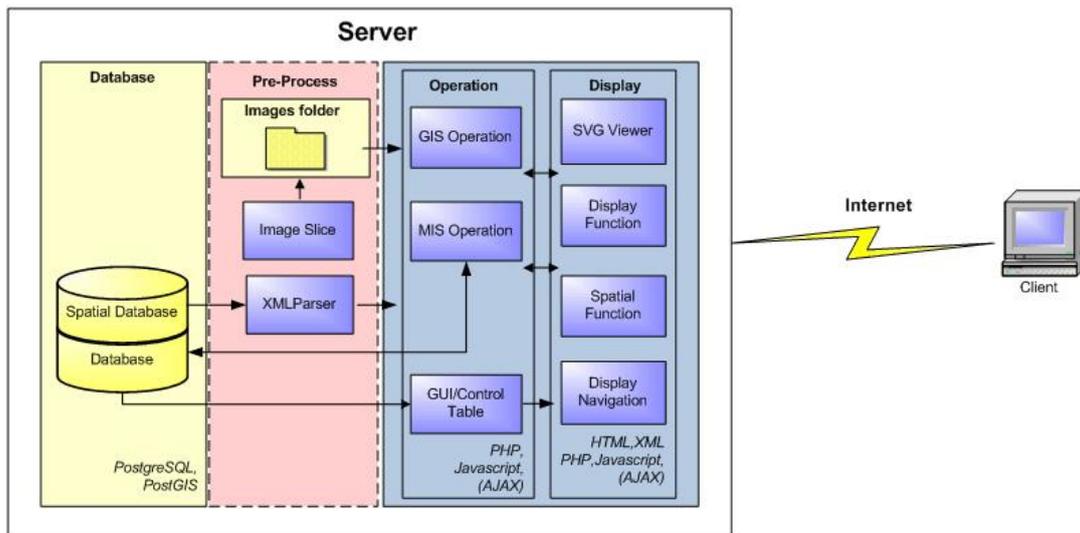


Fig. 1: Internet GIS application architecture.

The vector data is the geographic data representation in co-ordinates form which includes points, lines and polygons. In this Internet GIS application, the original vector input files (shape files) are imported to the open source spatial database. These data must be converted to SVG format by XMLParser processing before they can be disseminated in the map form on the client.

The raster data is the georeferenced image, for example, aerial or satellite photograph. The image is cut into the small same-size pieces of map by image slice processing programmed in Java programming language before a collection of sliced map is laid on the server.

GIS can arrange the location data such as rivers, reservoirs, and villages that are line, polygon, and point type, respectively, into GIS layers or thematic layers. Each layer should be designed to contain only one type and one category of spatial data. In this application, the conduction of layers is controlled with the Control Table operation. This operation is the database operation that is applied to determine and to handle the menu list of spatial data, for example, the enabling and disabling list, the adding list, and so on.

This Internet GIS application is one component of our Internet GIS system developed and run on a Linux operating system server by using PHP, HTML, Javascript, and XML programming languages. In addition, we use the open source database and spatial database such as PostgreSQL and PostGIS, respectively, to collect the spatial and non-spatial data. These data in the map form can be accessed from anywhere clients.

2.2. Internet GIS Spatial Operation

The structure that is concerned with the Internet GIS spatial operators is briefly mentioned in this section. As shown in Fig. 2, the spatial operations are the GIS processing functions to perform spatial analysis. There are two modules of spatial operations addressed in this application. First, the inputs files are processed by this operation before these data are imported in the spatial database. They are operated in suitable data by using the spatial operators such as *Geom_union* (geometry union), *Geom_intersection* (geometry intersection), *Geom_identity* (geometry identity), and so on for meeting the objective of applications before they are converted to SVG formats. For example, some classified spatial data have the large size, so these data are generalized by simplify function (in PostGIS) to reduce time-consuming data loading. Another, the spatial operation is a part of GIS operation. The spatial data can be manipulated on-the-fly by the spatial operation that includes the spatial operators. The spatial operators used depend on the specific function that is needed by the end users such as area measurement, zoom-in/zoom-out, panning the map, and so on.

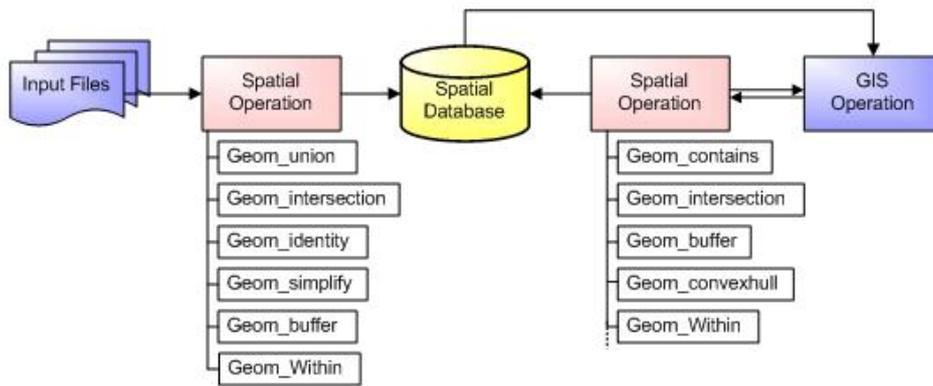


Fig. 2: Internet GIS application user interface.

3. General Features

The user interface of this Internet GIS application contains two main focused features: GIS and MIS modules. An example of Internet GIS interface is illustrated in Fig. 3. From Fig. 3, the layers of GIS data can be overlaid on the map which is the middle of screen by mouse-clicking on the left side menu list. The GIS operations are controlled by computer programming tools that are a collection of buttons above the map. These tools are developed in order to operate the GIS functions on the map such as zoom in, zoom out, area measurement, displaying elevation profile, eraser, panning the map, and so on.

A Management Information System or MIS operations are the representation of non-geographical information processing which all MIS operations appear on the right side of screen. These data are obtained from databases and then are processed to represent the statistical data as reports, charts, and tables. Moreover, the quantitative data can be indicated by filling colours on the map as shown in Fig. 4. This Internet GIS application has an advantage that is the simultaneously representation and cooperation of geographical or GIS data and non-geographical or MIS data for better decision making.

Anyway, the program interface between modules and GIS operation tools are programmed in Javascript or some AJAX. The user interface is developed by using PHP, HTML, and XML programming languages.

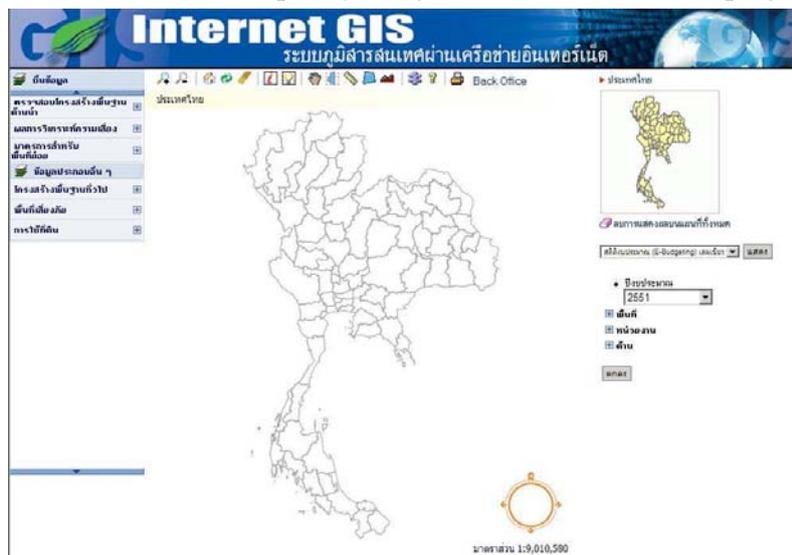


Fig. 3: Internet GIS application user interface.

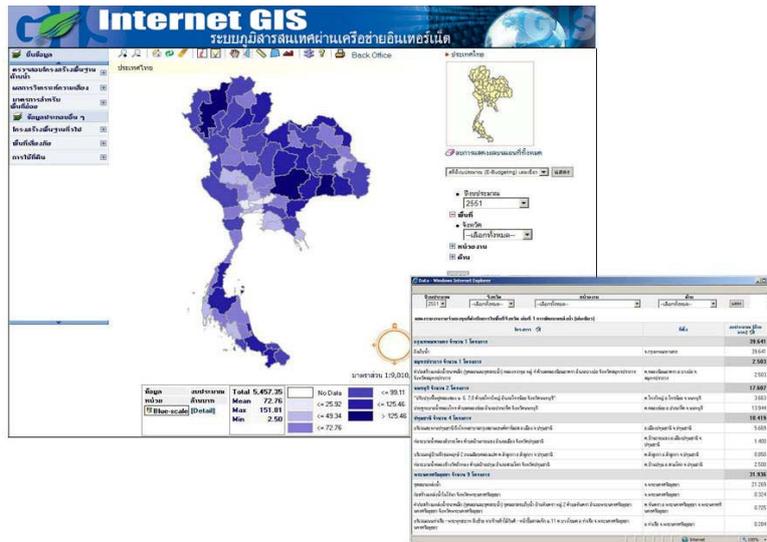


Fig. 4: MIS operation.

4. The examples of Internet GIS Application

An example project applying the Internet GIS application has been developed to be a prototype of Thailand water resource infrastructure for supporting management and decision. Fig. 5 shows the user interface of Internet GIS application which demonstrates the flood area of Utradtit province level in Thailand. The set of geographical information are the reservoirs, forest landuse, risk flood areas and stream overlaid on the map.

Furthermore, in this project, we have tried to implement the cooperation between the digital base map provided by MapServer and the vector base map generated in SVG format. Fig. 6 illustrates the vector base map lied on the digital base map. The vector base map must pass some parameters about coordinates through the API of the digital base map for getting the same map. This program interface is written with Javascript programming language. Fig. 7 presents the drill-downed and zoom-in map of Utradtit province.

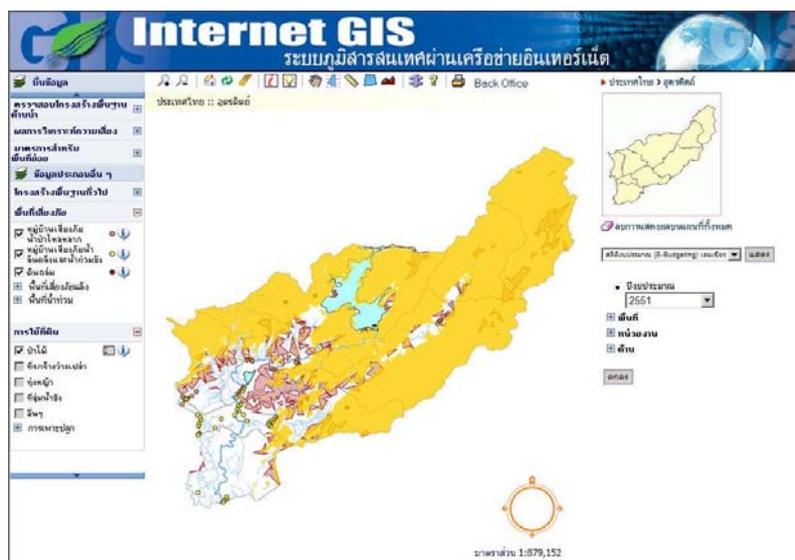


Fig. 5: Utradtit province of Thailand shown in the Internet GIS application.

5. Conclusion

The Internet GIS application, in this paper, can be applied for other natural resources management. The application programs are developed on Linux server and served the geographical and non-graphical information via Internet system. In addition, the Internet GIS application is based on the open source

software. Anyway, the cooperation between MIS and GIS is an advantage of this Internet GIS application because it helps government to support decision making better.

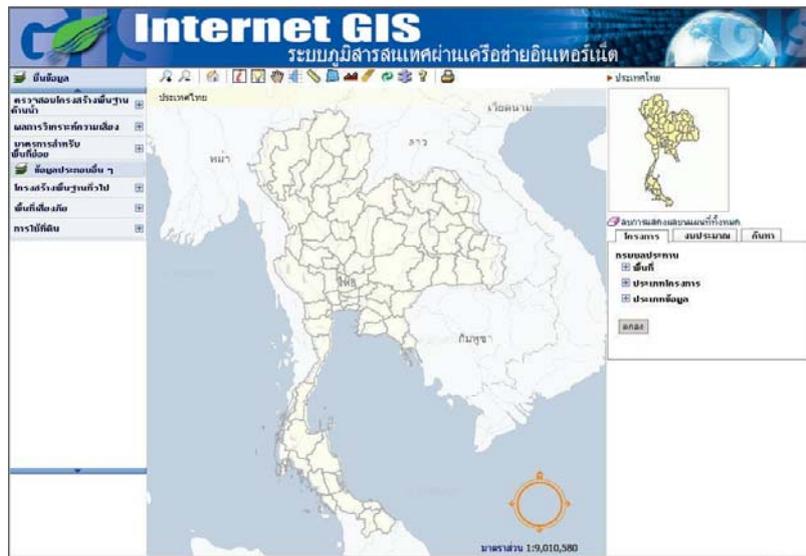


Fig. 6: The integration of the digital map and the vector map.

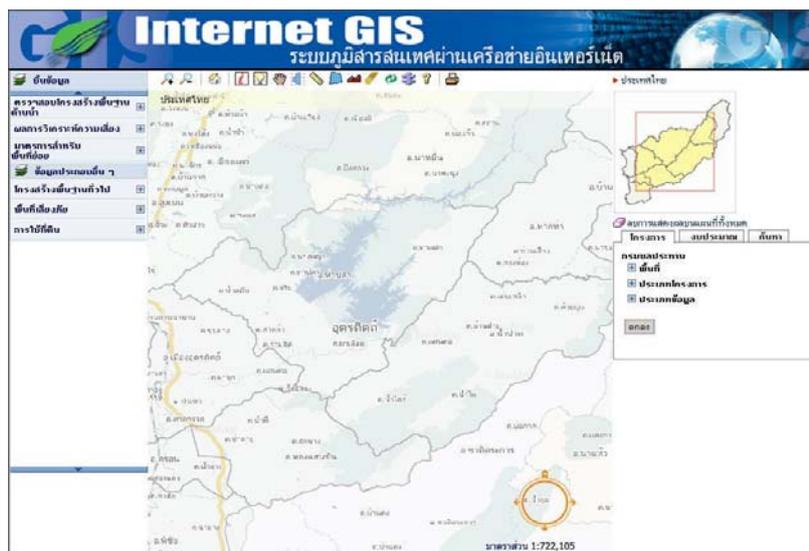


Fig. 7: The zoom-in Utrดิต province map.

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