

## THE ANALYTICAL AND RETRIEVE SYSTEM OF ELECTRONIC MAPS BASED ON GIS

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**Abstract:** Electronic map system based on GIS is a spatial information system for the officials of the central government and local governments to carry out macro analysis and decision-making. System objectives, overall design, data base establishment, software development, electronic map design, data communication and system application for the electronic map system are described in this paper.

### 1. SYSTEM OBJECTIVES

Based on the information of the National Foundational GIS owned by the National Bureau of Surveying and Mapping (NBSM), to carry out macro decision-making for the leaders of the Secretariate of the General Office of the State Council (SGOSC), the comprehensive state situations GIS of the State Council (9202 Project) is being jointly developed and established. In view of the great difficulties of the technology of "9202 Project", in addition to the rapid development in hardware and software environment, the Project objectives are not available to be reached at one step. And therefore, the overall objectives of the system will be realized in phases and implemented in steps. The development objective of the first phase of the project is to develop electronic map system supported by a set of micro-computers and a large screen display equipment. The concrete research tasks are:

a. To establish the comprehensive data base based on geographic base data, comprehensive state situations file data and national economic statistics data under the support of VAX series computers ARC/INFO and MIGIS software system.

b. To develop DOS version and WINDOWS version which are used to retrieve and display the electronic maps.

c. To develop rapid reliable data communication technology and to realize the data communication between the Government Office Decision-making Serv-

ing Subsystem and the National Foundational GIS.

d. To establish the electronic map system, so that the comprehensive state situation information service can be provided for the leading authorities in a form of electronic map.

## **2. SYSTEM DEVELOPMENT**

### **2.1 Overall Design**

#### **2.1.1 Logical Structure Design**

The electronic map system is composed of Rear Data Supporting Subsystem and Front Operation Subsystem. The Rear Subsystem is established in the Chinese Academy of Surveying and Mapping where the data collection and editing, graphic matching and cutting, format transform and data revision of spatial data, file data and statistics data of national economy are completed. At the same time, the bidirectional data communications between VAX series computers and micro-computers are realized, and the required data for the Front Operation Subsystem will be offered. The Front Subsystem is established in SGOSC which has the function of data retrieval, large screen display and comprehensive application under the support of micro-computer and software systems. The data communication between the Rear Data Supporting Subsystem and the Front Operation Subsystem will be realized by data modem.

#### **2.1.2 Physical Structure Design**

According to the work characteristics of SGOSC, the multi-branch tree structure is used to store data entity for the electronic map system. Each entity is a specific administrative region (e. g. continent, country, province, district or county). Each node and leaf can be added and deleted dynamically on multi-branch tree.

### **2.2 The Establishment of the Comprehensive Data Base**

#### **2.2.1 The Hardware and Software Environment for Supporting Data Base Establishment.**

## HARDWARE ENVIRONMENT

a. VAX 11 series computers and the related peripheral devices, including Calcomp 9100 digitizer, Tektronis 4991 scanning digitizer, Tektronix 41 series graphic terminal and VMS 220 Character terminal which are used for data input, edit and processing of large amount of data.

b. Micro-computer series and large screen display equipments which are used for data communication between VAX computer and micro-computer, input and management of file data and statistics data, edit, revision and maintenance taken administrative division as an unit.

## SOFTWARE ENVIRONMENT

a. ARC/INFO system; used for input, analysis, display, transform, retrieval and management of spatial data on VAX computer;

b. MIGIS system; used for editing, revision and management of spatial data on micro-computer;

c. DBASE III; used for input, edit and management of statistics data;

d. DOS system of SGOSC; supporting system for Chinese word base;

e. Statistical mapping software; used for production of thematic statistic maps;

f. Software of geographic name ; used for editing chinese character notation.

### 2.2.2 *Data Base Design*

a. Data base is established as a data storage unit of different levels according to the world, China, province, region and county. The basic data are divided into boundary, water system, settlement, railroad, highway and notation.

b. The thematic data include various statistics data, thematic graphic data and image data which are reflected the national economy and cultural status taken province as a statistic unit.

c. File data should be to defined document format based on display requirements, to establish indexed file in terms of national standard and to realize the conjunction of data with related graphic document.

### 2.2.3 *Contents of Data Base*

a. Geographic basic data

1:1 million national geographic basic data, 1:250000 geographic basic data of Liaoning Province, 1:4 million national geographic basic data and data of 1:22 million World Map.

b. File data

It mainly includes the general situation of administrative regions of all levels and auxiliary explanation associated with thematic maps. File data are classified into 9 categories and 23 items, including resources, industry and agriculture, transportation and telecommunications, science and technology, culture and commercial trade, financial and monetary, foreign trade and the status of social development etc.

c. Statistics data and thematic data

The statistics data consist of 14 categories, such as population status, agriculture, industry, foreign trade and tourism, education, science and technology, culture, social common wealth, city and commercial situations, transportation and telecommunications, architecture, national administrative division and land use. In addition to the above statistics data, parts of thematic data and scenic spot photos are collected.

## **2.3 The Development of the Software System**

To ensure the operation of the Front Operation Subsystem in order, two software systems supported by computers are developed.

### **2.3.1 The Development of DOS Version Software System**

a. System development and operation environment

Hardware configuration: 486 main Computer, 4M Memory, over 120M Hard disk; Color Display, Resolution over 1024×768; A Mouse.

Software environment: DOS 5.0 Version, DOS and 386MAX.

b. The constitution of system function. The system is developed on the basis of MSC Language and Assembly Language. It is used to manage spatial data, file data and statistics data. The software system of DOS version has the following functions: regional retrieval, inquiry and display of geographic basic feature, file inquiry, screen operation and audiovisual display.

### **2.3.2 Windows Version Software System**

a. System development and operation environment; over 386 computer, over

4M memory, over 200M hard disk, over TVGA graphic card.

b. System function. The software system of WINDOWS version has the following modules: index map, regional retrieval, feature layer inquiry, graphic display, file data inquiry, graphic enlargement and roaming, system help etc.

#### **2.4 The Development of Data Communication Technology**

In accordance with the requirements of SGOSC, the data communication between the rear data supporting subsystem and the front operation subsystem are realized by modems of Motorola Company. Such a data communication method has the characteristics of small in size and strong in real response property. The application practice shows that the communication method can meet the requirements of SGOSC.

### **3. SYSTEM APPLICATION**

The first phase of the project has been put into trial operation in SGOSC. The personnel of SGOSC considered that the electronic map system can provide the accurate spatial positioning information and file document of related provinces and regions. The function of the software system is perfect. They hope that thematic data should be further enriched. The result of the first phase of the Project has been introduced into the electronic halls of related provincial governments. It has got good reputation.

### **4. CONCLUSIONS**

In December of 1993, the result of the first phase of "9202 Project" passed the technical appraisal held by SGOSC with the NBSM. The participated experts pointed out that the completion and application of the first phase Project has laid a good foundation for the second phase of the Project. Meanwhile, the experts marked that the first phase of the Project is advanced in technology, strong in science and good in application.

After the technical appraisal of the first Project approved, SGOSC and NBSM has determined to start the second phase of the Project. The main research tasks of the second phase of Project are:

a. To improve and extend the project result of the first phase, to establish the data supporting and updating systems of comprehensive situation GIS for

provinces.

b. To develop distributed GIS software system, so as to set up a unified new distributed GIS combined office with GIS based on client/server and multi-medium technology.

c. To develop various thematic electronic map system with the function of management and analysis, so that to make it to be an efficient tool for the government officials to carry out strategical analysis and decision-making.