

The Design and Implementation of National Economic and Social Statistical Electronic Atlas

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Abstract

National Economic and Social Statistical Electronic Atlas (NESSEA) is a CD-ROM software system for public. It is an integration of data and software. The data of NESSEA includes economic and social statistical data of China in three Administrative Division levels--provinces, cities and counties, and 1:1million fundamental GIS data of China. The software is used to query, analyze and visualize statistical data both in traditional mode, including tables and charts, and GIS mode, such as maps and thematic maps. GIS plays an important role in this system to integrate statistical data in spatial information framework and visualize spatial characteristic of national economic and social phenomena by spatialization of the statistical data.

The methods for designing and implementing NESSEA and its function are introduced in this paper.

Keywords: Statistical Electronic Atlas, IST Model, GIS, Statistical Analysis

1 INTRODUCTION

National Economic and Social Statistical Electronic Atlas (NESSEA) is a CD-ROM software system, which is an integration of statistical data, spatial data and software. NESSEA is intended to provide a comprehensive, map-like view for public into the enormous wealth of data collected by National Bureau of Statistics of China. The atlas:

- delivers authoritative data of societal and economic information by a CD-ROM,
- makes this information more convenient, efficient, intuitive to individual, and
- provides easy-to-use tools to query, display, visualize, and analyze statistical data so that customers can produce their own relevant information.

2 DATA COLLECTION

The data of NESSEA include statistical data and spatial data. Statistical data, including China annual statistical data, basic statistics of cities and counties economic and social conditions, and other thematic statistics, such as China second national census of basic units, are provided by National Bureau of Statistics of China. Spatial data, provided by National Geomatics Center of China, are derived from 1:1M-scale Topographic Database of the National Fundamental Geographic Information System of China. These spatial data include several map layer, such as boundaries (county boundary and above), major roads, railways, cities (county and above), major rivers and lakes and so on.

3 SYSTEM CONCEPT DESIGN

3.1 DESIGN OF SOFTWARE ARCHITECTURE

The three tier architectures facilitate software development because each tier can be built and executed on a separate platform, thus making it easier to organize the implementation. Also, three tier architectures readily allow different tiers to be developed in different languages, such as a graphical user interface language or light internet clients (HTML, applets) for the top tier; C, C++, SmallTalk, Basic, Ada 83, or Ada 95 for the middle tier; and SQL for much of the database tier [Edelstein].

In view of above advantages, NESSEA is designed by three tier software architectures and Model-View-Controller (MVC) design pattern. The "User Views" (or logic layer) consists of Navigate Windows, Data Windows, and other window forms. The Central Controller component and Data Access and Analysis application components make up of the "Controller" (or business logic layer). The "Model Layer" includes data and analysis models.

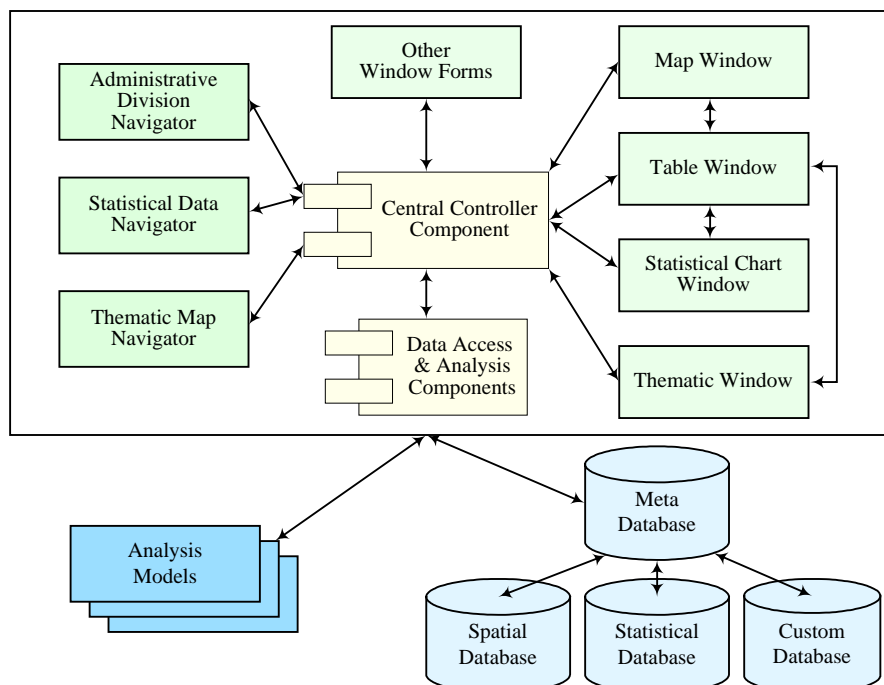


Fig.1 The architecture of NESSEA

3.2 GIS SOFTWARE PLATFORM SELECTION

NESSEA is developed by Supermap Objects, which is a powerful COM-based GIS software platform. As ActiveX controls, SuperMap Objects control can be embedded into various visualized program language environments to implement system integration and development frameworks.

3.3 DATABASE

NESSEA includes four databases: meta-database, statistical database, custom database, and another is spatial database. Because NESSEA is a CD-ROM software system for public, Microsoft Access Database is chosen for meta-database, statistical database and custom database, and Supermap SDB Spatial Database is chosen for spatial database.

4 MAIN FUNCTIONS

In order to provide easy-to-use tools to query, display, visualize, and analyze statistical data for public, the system is designed to 5 modules. All the modules of NESSEA are described below.

4.1 Map Tools

The module of “Map Tools” includes following functions: map selection, map browse, identify, measure, layer control, position, and export map. “Map selection” provides several modes, such as select by point, rectangle, circle, region or line, to select interested regions on the map. “Map Browse” provides common operation of electronic map, such as zoom in/out, pan, entire view, refresh, previous view, forward view, and also provides some peculiar functions. For example, “show higher level” or “show lower level” can show the map layer of higher or lower administrative division level by shifting map layers’ visible scale automatically and dynamically. “Identify” allows the user to identify an area, retrieve its attributes, such as name, administrative division code, and other indicators configed on “Basic Indicators Configuration Window”. “Position” allows the user to search units by coordinate, division code or name, and then position or select on the map. “Export Map” allows the user export the map to common image format file, such as BMP, JPEG file.

4.2 Indicators Query

The module of “Indicators Query” includes two functions: Basic Indicators Configuration, and statistical indicators query. “Basic Indicators Configuration” can config the default indicators for query. “Statistical indicators query” allows the user to select indicators by tree or search indicators, set query condition, save query, and display the query results on “Table Window”.

Indicators Query and the presentation of query results are based on Indicators-Space-Time (IST) Model. In IST Model, “T” is a collection or set of indicators; “S” is a collection of spatial units; and “Time” is a collection of time series of indicators. As shown in Fig. 2, IST Model is parsed and converted to 2-dimension tables by Central Controller Component.

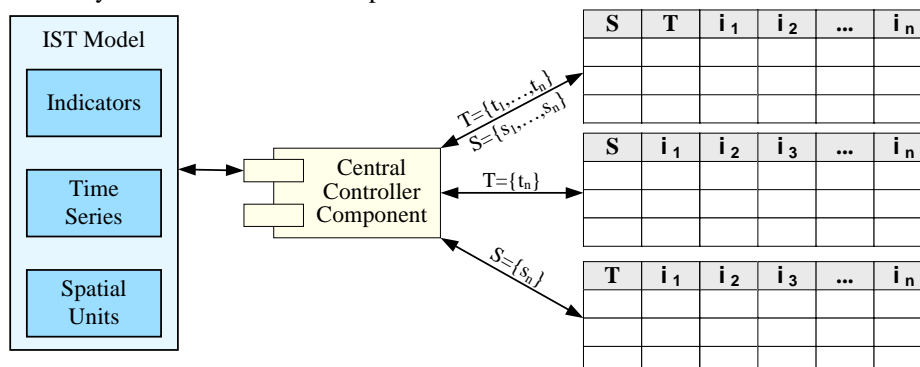


Fig.2 Indicators-Space-Time (IST) Model

4.3 Table Analysis

The module of “Table Analysis” includes following functions: link to map, custom indicator computer, statistical analysis, and export table. “Link to map” makes the selection of the table relate to map, so the selected indicators can be shown by “identify” on “Map Window”. “Custom indicator computer” allows the user to construct expression (or model) to generate custom indicator using existing indicators, arithmetic operators, and some basic math functions. “Statistical analysis” includes some basic statistical analysis, such as description analysis (includes mean, sum, Std. deviation, variance, minimum, maximum, median), correlation analysis, and cluster analysis.

4.4 Statistical Charts

Unlike a table, the most important function of a statistical chart is to convey information visually. A statistical chart is better than a table for displaying the structural aspects of data, summarizing large amounts of data, demonstrating how things are connected, communicating ideas and conclusions and setting up a situation or feeling. This module can draw most popular chart types, such as line charts, column and bar charts, pie charts. Many of these types have several subtypes. In addition, some less used, but highly informative, chart types are provided, such as area charts, doughnut charts, and radar charts.

4.5 Thematic Maps

A thematic map shows the spatial distribution of one or more specific data themes for spatial units or areas. Statistical thematic maps include a variety of different map types such as unique value maps, range maps, dot density maps, proportional symbol maps, and statistical graph maps. “Thematic map” allow the user to make these four types of thematic maps, and save, rename, modify, delete, export maps.

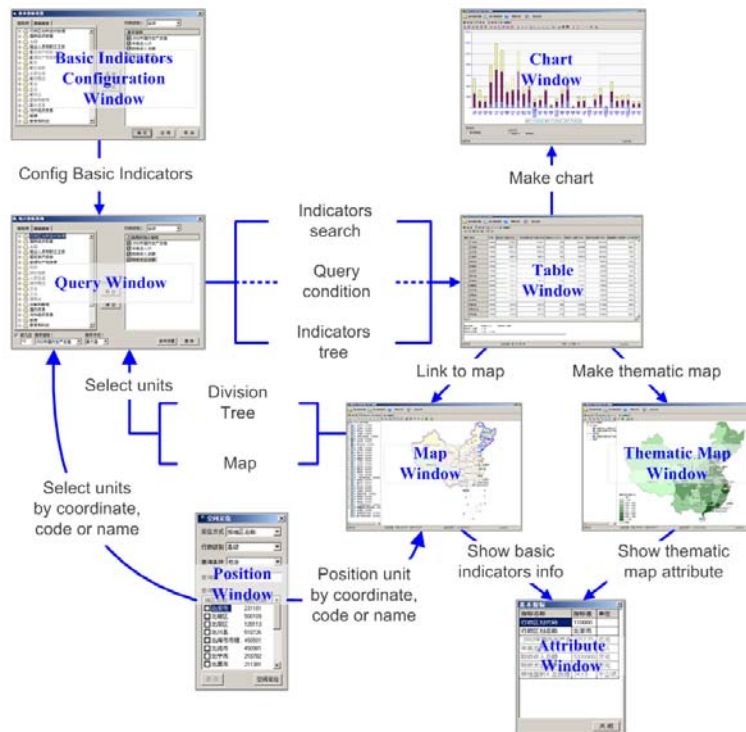


Fig.3 The flow chart of main functions

6 CONCLUSION

NESSEA is used to query, analyze and visualize statistical data both in traditional mode, including tables and charts, and GIS mode, such as maps and thematic maps. GIS plays an important role in this system to integrate statistical data in spatial information framework and visualize spatial characteristic of national economic and social phenomena by spatialization of the statistical data.

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