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A New Method in Urban Planning Based on GIS Technology — Conservation and Rehabilitation Analysis of Xijin Ferry District in Zhenjiang*

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Abstract: In this paper, we identify the geographic information systems (GIS), discuss the components of GIS, which integrates five essential components: hardware, software, data, people, and methods. Present the relations between computer and urban planning, urban planning and GIS. Moreover, the main discussion on a case study that explores the possibility of using ArcView GIS software to assemble, store, manipulate, and analyze historic site — Xinjin ferry district in Zhenjiang.

Key words: GIS, database, computer, arcView, analysis, urban planning

Geographic information systems (GIS) were developed in 1960s, but in the early days very few planners used it in their work. Many people think GIS is complex and crude for site work, none of those concerns is true any longer. The software has become easier to learn, easier to use, less expensive, and it can be operated on a PC.

1 GIS Definition

GIS is a computer-based tool for mapping and analyzing things that exist and events that happen on earth. GIS technology integrates common database operations such as query, statistical analysis with the unique visualization and geographic analysis benefits offered by maps. These abilities distinguish GIS from other information systems and make it valuable to a wide range of public and private enterprises for explaining events, predicting outcomes, and planning strategies. GIS gives us the power to create maps, integrate information, visualize scenarios, solve complicated problems, present powerful ideas, and develop effective solutions like never before.

2 Components of GIS

GIS integrates five essential components: hardware, software, data, people, and methods.

2.1 Hardware

Hardware is the computer on which a GIS operates. Today, GIS software runs on a wide range of hardware types, from centralized computer servers to desktop computers used in stand-alone or networked. The hardware required to develop, operate and generate such information includes input devices, storage devices, and output devices(see Fig.1).

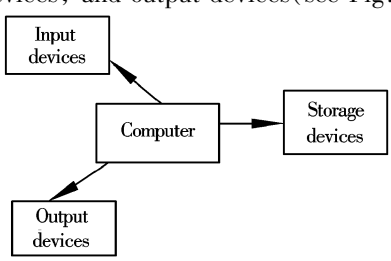

Fig.1 The major hardware component of GIS

Input devices Data can be input in these ways:

1) Manual digitizing of maps using a digitizing table;

2) Digital scanning using a scanner;

3) Reading of computer compatible tapes or other storage media that contain map data already in digital format;

4) Remote sensing and GPS receivers.

Storage devices The main storage device in a computer is the hard disk drive, which is comprised of a stack of magnetic disks.

Output devices Output can be presented in two ways: softcopy and hardcopy. Softcopy has no physical output and is generally displayed on computer screens. Hardcopy is printed or plotted onto paper or other media. The output devices are: ① Colour display devices; ② Printers; ③ Plotters.

2.2 Software

GIS software provides the functions and tools needed to store, analyze, and display geographic

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information. The software for a GIS consists of five basic technical modules(see Fig. 2).

1) Data input;

2) Data storage and database management;

3) Data output and presentation;

4) Data transformation;

5) Interaction with the user.

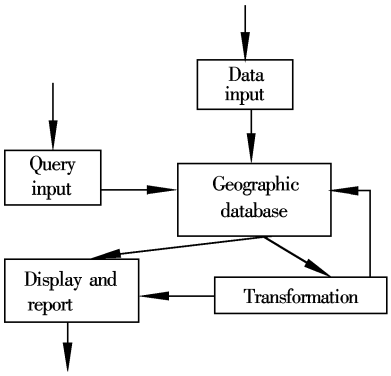

Fig.2 The major software component of GIS

2.3 Data

The most important component of a GIS is the data. The data for a GIS comes in two forms:spatial data, and attribute data.

1) Spatial data are data that contain geographic location in the form of a set of coordinates.

2) Attribute data are descriptive sets of data that contain various information relevant to a particular location, e.g. depth, height, sales figures, etc. and can be linked to a particular location by means of an identifier, e.g. address, zip code, etc.

GIS data is organized into two operation formats, or models vector and raster. These two data models describe events that happen on the earth.

Vector A vector based system displays graphical data as points, lines or curves, or areas with attributes.

Raster A raster based system displays, locates, and stores graphical data by using a matrix or grid of cells.

2.4 People

GIS technology is of limited value without the people who manage the system and develop plans for applying it to real-world problems.

2.5 Methods

A successful GIS operates according to a well-designed plan and business rules, which are the models and operating practices unique to each organization.

3 Using GIS in Urban Planning

Planning and GIS have a long history together. In fact, GIS traces its roots to Ian McHarg's classic, design with nature. Earlier, in 1912, city plans for both Dusseldorf and Billerica, Massachusetts, extracted data from one map and added it to another. Today, planners around the world use GIS in their daily work, so most of our applications of computers for understanding and planning cities have been for purposes of analysis, modeling, design, storing data, communicating data and ideas.

GIS is one of the formalized computer based information systems capable of integrating data from various sources to provide information necessary for effective decision making in urban planning. GIS serves both as a database and toolbox for urban planning.

1) As a database, spatial and textual data can be stored and linked using the geo-relational model. This supports efficient data retrieval, query, and mapping.

2) As a toolbox, GIS allows planners to perform spatial analysis using geoprocessing function such as map overlay, connectivity, and buffer, of all the geoprocessing functions, map overlay is probably the most useful tool.

Nowadays, GIS has become an invaluable planning tool because it is the most productive environment for processing spatial data. The planning activity can be divided into two classes of operations.

1) The use of data representations of discrete features or objects such as roads, bridges, or buildings represent them with the vector (point, line, and area) data model.

2) The use of data representations of continuous surfaces such as soil types or land cover classes generally make use of the raster (cellular) data model.

Database management, visualization, spatial analysis, and spatial modeling are the main uses of GIS in urban planning. Planners can extract useful information from the database through spatial query. Mapping is the powerful visualization tools in GIS. It can be used to explore the distribution of socio-economic and environmental data, and display the results of spatial analysis and modeling exercises.

4 Case Study (Rehabilitation Analysis of Xijin Ferry Historic District in Zhenjiang)

Xijin Ferry is an interesting place to examine

politics and power relationships arising from the use of GIS technologies. The municipal authorities of Zhenjiang have come to realize the significance of preserving this historic district and understand its relationship with tourism. In this project we use GIS to analyze this historic site to recognize valuable traditional buildings for protection and redevelopment, also, the bad structural buildings, which must be demolished and rebuild new buildings with traditional architectural style for good tourism environment.

4.1 Background of Xijin ferry

Xijin Ferry was built in the sixth dynasty (222—589 AD) at the foot of Yuntai Hill, west of Zhenjiang city. In the Yuan dynasty (1271—1368 AD), a street came into being gradually after the water receded. Now the zigzag ancient street stretches hundreds of meters on the mountain slope. Its five arches divided the street into different scenic sights. At the end of the street stands a lama pagoda of five meters high, pagoda which was built in the Yuan Dynasty. The bottle-shaped pagoda stands on a platform supported by four stone columns. It is the only stone pagoda arching over the street in China.

4.2 Study area

Xijin ferry district, which is located at the historical and geographical northwest of Zhenjiang city at the bank of the Yangtze river has an area of 47.2 km^2, at the core of this site stands a mountain with green cover, around it there is residential area which has this kind of land use.

1) Habitation

① Habitation buildings with Chinese architecture style built from later Qing dynasty to the republic period.

② Building with western style architecture built in the British period.

③ Habitation buildings with new style and have no cultural value built after 1949.

2) Cultural

① Stone pagoda was built in the Yuan dynasty (See Fig.3).

② Temple beside the stone pagoda originally was built from the Song dynasty.

③ Chaoansi Temple was built in the Ming Dynasty (See Fig.4).

3) Commercial: There are many small shops and small restaurant inside the site.

4) Industrial: There are many factories within the site (plastic factory, chemical factory, wood factory, and so on).

5) Educational: There are two schools within the site.

The buildings within this site are 1 to 7-floor tall, and most of these buildings have bad structure condition. In addition there are some new buildings within the site, which is in contrast to the ancient style architecture.

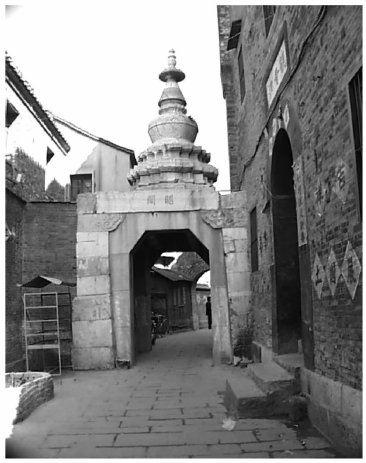

Fig.3 Stone Pagoda

Fig.4 Chaoansi Temple

4.3 ArcView GIS selected

ArcView GIS software was selected as the basic supporting software due to its powerful capabilities of large-scale database management and spatial analysis. The other software, including AutoCAD, is incorporated into the system to support the operations based on microcomputers. ArcView GIS can support the user to query information about land use, city roads, construction status on the screen, and so on. The user can also choose to display the data stored in a different layer overlapped on the screen according to different requirements, making various comparison and comprehensive considerations, and can make various classified statistical summaries on land use.

4.4 Analysis

After we got the database (2004 database entries), we integrate the database into the ArcView software, and then start making analysis for the study area. The objective of the analysis was to produce maps that indicated the cultural value, function, structure, and height, of the land use within the study area.

1) Cultural value condition analysis map

The cultural value condition defined three categories, low, high, and very high, each one indicated various cultural values(See Fig.5). According to the Fig.5 9.69% of study area has good cultural value and need protection, as explained in Fig.5 and Fig.6.

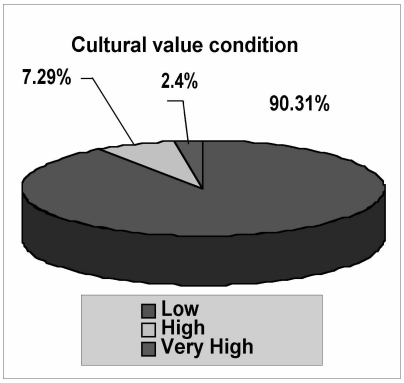

Fig.5 Chart of cultural value condition analysis

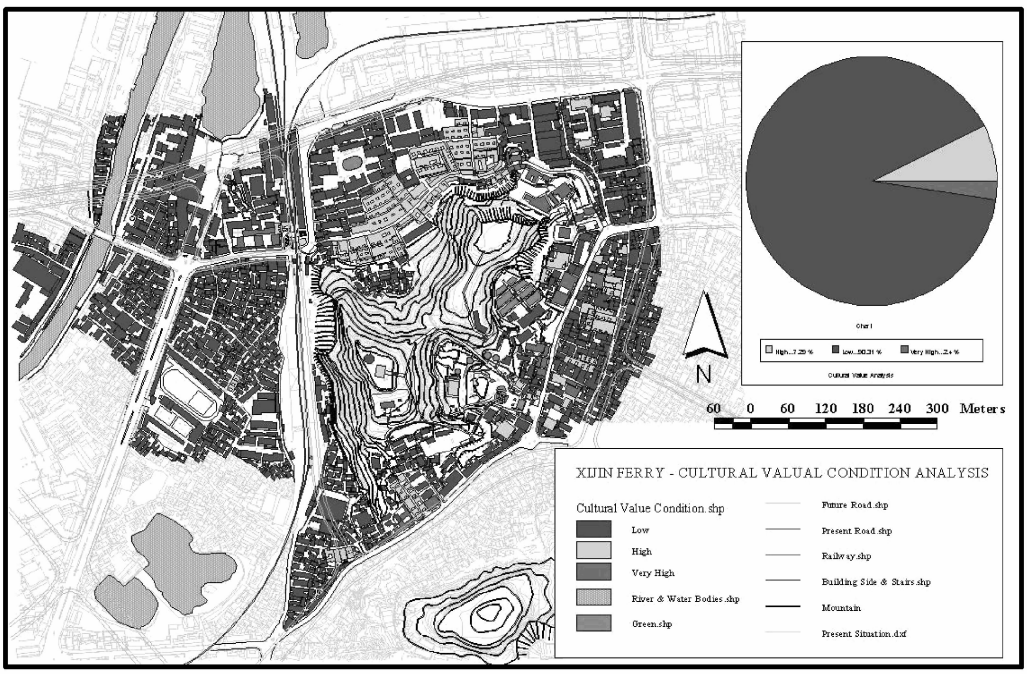

Fig.6 Map of cultural value condition analysis

2) Function condition analysis map

The function condition defined twelve categories, from Fig.7, 76.64% of study area is residential and 5.53% is industrial. Here we can see majority of the study area is residential (See Fig.8), so the industrial building must be shifted to new site.

3) Structure condition analysis map

With the total of 2004 entries of database, the structure condition defined three categories, bad, good, and very good. It can be seen in Fig.9, 77.89% of the study area has a bad structure condition, and unsuitable for human habitation. Fig.10 shows us that most of these buildings must be demolished and rebuild new buildings with good structure condition and Chinese architecture style.

4) Height condition analysis map

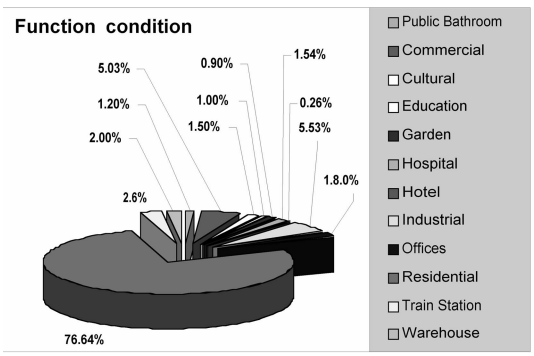

Fig.7 Chart of function condition analysis

The height condition defined seven categories, as we can see in Fig.11, 76.54% of the study area is one storey, that means majority of the building in the study area are not so high (See Fig.12), so the few high buildings must be reduced to three floors, or demolished

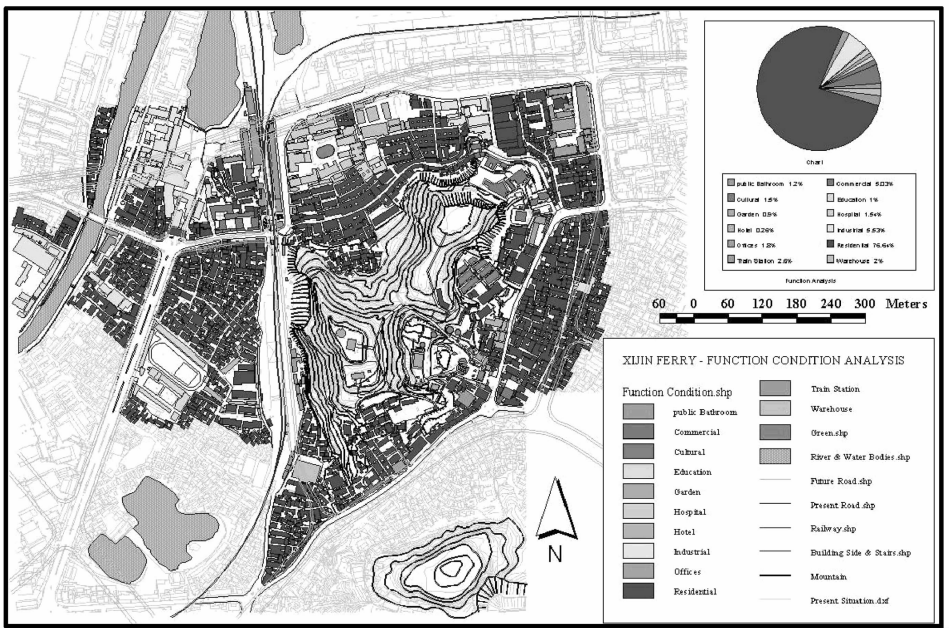

Fig. 8 Map of function condition analysis

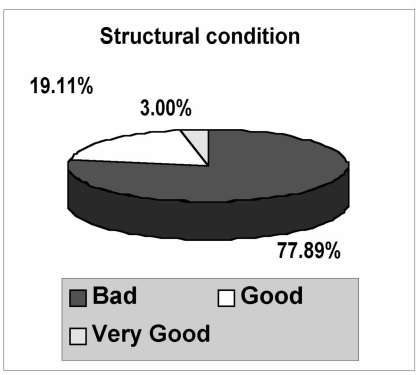

Fig. 9 Chart of structure condition analysis

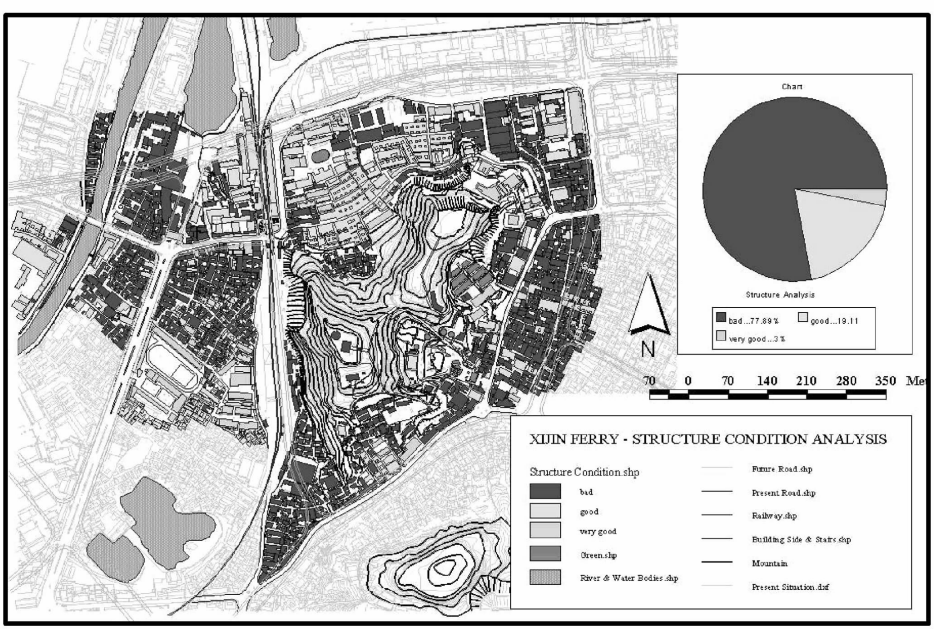

Fig. 10 Map of structure condition analysis

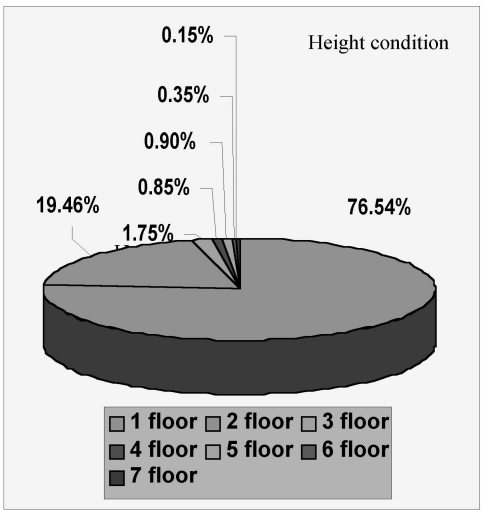

Fig. 11 Chart of height condition analysis

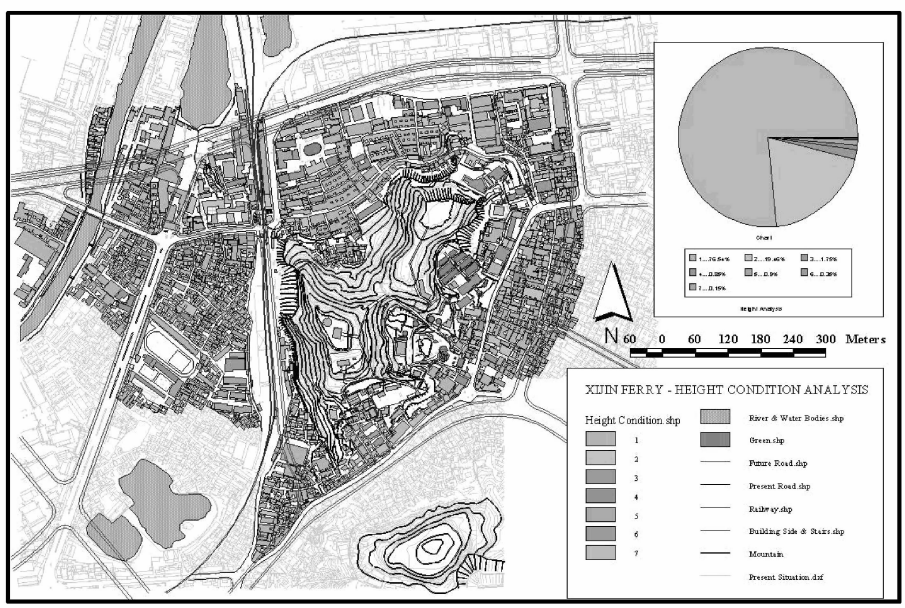

Fig. 12 Map of Height condition analysis

5 Conclusion

It is not too bold or sweeping a statement to argue that one single GIS is never likely to be applicable to all problems in urban planning. GIS has capability to provide necessary physical input and intelligence for preparation of base maps, formulation of planning proposals and act as monitoring tool during implementation phase. Using GIS in this project to make analysis has the following advantages when compared with conventional ways.

1) Improved mapping: better access to maps, improved map currency, more effective thematic mapping and reduced storage cost;

2) Greater efficiency in retrieving information;

3) Faster and more extensive access to the types of geographic information;

4) Improved analysis;

5) Better communication to the public and staff;

6) Improved quality of service;

7) Faster analysis;

8) Less time and low cost;

9) Easier upgrade because the change in database will reflect directly to the map.

Finally, even if GIS does not lead to new types of solutions, it has changed the approach to planning and has created an elite group of land planners who have something unique to offer their clients and constituents.

Thus, GIS has capability to provide fourth dimension to the city.

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基于 GIS 的城市规划方法

——以镇江西津渡地区保护与整治为例

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摘　要　以地理信息系统(GIS)技术的 5 个主要组成部分,即硬件、软件、数据、使用者及使用方法为内容,简要介绍了该技术的基本原理及其在城市规划中的应用.着重讨论了在历史遗产保护规划中使用 ArcView GIS 软件的可行性,并以镇江西津渡历史街区保护规划为例,分析了编制基于 GIS 技术的规划管理系统时所采用的具体方法.

关键词　GIS, 数据库, 计算机, ArcView, 分析, 城市规划

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