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The establishment of the pavement management system based on GIS

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Abstract
In recent years, highway infrastructure construction has been rapid development in our country, the highway mileage increasing, highway maintenance task gradually aggravate, highway maintenance management level is an urgent need to improve, to meet the needs of the development of highway construction. Highway as the main management object of pavement management system, has the typical linear characteristic, has the rich spatial information. For spatial information into the collection, management and analysis, it is the geographic information system (GIS) technology. Blend in GIS technology in highway management, the establishment of road information management system based on GIS is the trend of the development of the highway maintenance technology. Using GIS technology, can realize the seamless connection of spatial data and attribute data of highway, can realize data management, condition evaluation and maintenance plan in the whole process of the highway maintenance management work such as visualization, thus greatly improving the efficiency of the work of highway maintenance management department.

Keywords: pavement management system; Geographic information system; Highway maintenance

1. Introduction

1.1 Study abroad the research status at home and abroad

Pavement management concept originated in the 1960 s, the goal is to eliminate the road surface, linear, and capacity of road network technology defects such as roads, providing optimized design scheme. Since the late 1970 s, the United States, Germany and some other developed countries after a large-scale highway construction, faced with a lot of road management and maintenance work. In order to accurately evaluate the breakage of the highway network, to raise limited to protect the funds allocated to the most in need of maintenance road, road pavement damage data researchers developed testing equipment, set up the database, make evaluation methods, standards, and preferred maintenance model. The computer as the tool of pavement management technology is called the pavement management system. More representative include: California in 1978 to be built and put into practice of pavement management system and the alberta Canada road information system and demand.

1.2 research situation at home

Domestic research on the road information management system started relatively late, began in the 80 s, to introduce the British BSM FPMS road surface pavement evaluation system, Finland and the world bank HDM - Ⅲ highway information management system investment benefit analysis model, etc. In China during the period of "seventh once organized the research and scientific research of PMS, the ministry of communications highway research institute of Dr Yuu pan, put forward the basic framework of information management system for highway pavement, roughly including database management, the pavement performance evaluation, pavement performance prediction and pavement maintenance decision four parts, and on the basis of the reference model methods abroad, conform to the reality of our country some of The model is established. Yuu pan was proposed based on regression analysis of the pavement performance evaluation model, think there are two factors influencing the pavement performance of flatness and breakage, it assumes that the first forms of function on the single parameter correlation analysis respectively, and finally choose better correlation regression equation as the pavement performance of the model variables. During the period of "seventh, on the basis of learning from foreign experience, the national key research project" (province, city) highway Pavement maintenance evaluation System technology development "by the ministry of communications highway research institute, tong ji university and other scientific research units, common research and development, set up our country's main highway Pavement maintenance System, namely the road information Management System, marked the our country on the road Management has reached a new level. In 1991 through the national identification, the project is during the period of "five-year" national key promotion project and the ministry of communications, 29 provinces and cities began to popularization and application in our country, highway informationization and management is a major symbol of modernization. Its function mainly includes: data automatic detection, condition evaluation, maintenance requirements analysis, maintenance budget forecast, control, maintenance, investment benefit analysis, maintenance fund allocation optimization, automatic maintenance plan, daily maintenance and management, etc.

Overall, the domestic research of information management system for pavement in recent 20 years has made great progress, studies the theoretical level of close to or reach the level of developed countries, at the same time for applying GIS technology to the road information management problems also made beneficial exploration, but to the latest theoretical research results and further application of the latest technology in daily management, is still a lot of work to be performed.

2 the road information management system design and implementation

2.1 system design principles

1) The principle of completeness

One is the completeness of data: the system database should contain attribute data, and to include spatial data; Contains data for this year and will contain historical data; should not only contains the core of the road test data, and to include road section appendages, maintenance, etc.

The second is the function completeness: the function of the system design must be after carefully research conducted on the basis of user requirements, to ensure data and system function can meet all of the user's requirements.

2) The principle of practicality

System uses interactive way, user friendly interface, simple operation, easy maintenance management, has rich help functions and provide enough hint information to guide the user to carry out the work, the wrong operation of the user should provide reference solution.

3) The principle of economy

System construction requirements on the basis of the practical minimizing costs, with the minimum input for maximum output. In hardware and software configuration, choice of system development platform and the database design should be able to realize the system function on the basis of all try to save the economic cost.

4) The principle of standardization

In order to ensure the system's basic, realize the basic information sharing, from system design to test for the execution of corresponding national and industry standards, such as data classification, data coding, database design, data input and output, etc. System development and the types of data, code and graphic symbol to strictly follow the existing national standards, industry standards and other relevant standards and regulations.

5) Scalability principle

System of data, system function, network structure can be according to the actual need of the development of the situation and expand, regardless of the application software or hardware, expansion should be convenient and simple.

6) Safety principles

Security must consider two issues: one is the security of data: data security is the first former title of system security, the system must have enough security permissions, keep the data from unauthorized access, theft and destruction, and fully guarantee the logic of system data accuracy. The second is the security of the system operation, system should have security permissions, don't let the illegal user the tolerance of the operating system at the same time to have a strong enough, so as to guarantee the legal user actions cannot cause the system error. In addition, still should consider modular principle, independence principle, the principle of intelligent subsystem and so on.

3 system overall design

3.1 The system structure design

Through to the system of the project background, system target, system design principle, system total body function demand analysis, puts forward the overall logical structure of the system.

The architecture is mainly divided into three layers: data service layer, application logic layer and application layer. Among them, the data service layer to provide the required data service for application logic layer, is the basis of the whole system run the underlying data, including the massive amounts of data collection, pretreatment, daily maintenance and update, management, and other functions, to realize the seamless connection of spatial data and attribute data; Application logic layer using GIS component technology and system, the mathematical model of library, the raw data processing and analysis of the application service layer of the user to perform the operation of the conversion for the request of the data service layer, and will return to the results of the data service layer to submit application service layer, is the "brain" of the whole system. Application service layer or user client, is composed of a series of application services, access to various components of the application logic layer, response to a user action, query, statistics, analysis, prediction, result output, and other functions, to provide auxiliary decision for highway maintenance management department.

3.2 system function design

According to user requirement analysis, system logic structure, carries on the system overall design, the system is divided into four subsystems, each subsystem consists of several functional modules to achieve overall system function.

1) Data management subsystem:

(1) Data acquisition module, the road network spatial data and attribute data of original data collection, pretreatment, stored in the database.

(2) Data management module: management system of spatial data and attribute data; Including maintenance, update, backup, restore, etc.

(3) Data query module: provides administrative areas according to highway mileage pile number query, according to the query, according to the grades of path query query a variety of ways, for road network data query.

(4) Module in the chart, will express highway information in the form of table or thematic map.

(5) Output module, the output of the form and thematic map.\

2) Traffic evaluation subsystem

(1) the traffic evaluation module of traffic data (pavement performance index PQI, damaged pavement condition index PCI, RQI ride quality index, index RDI, pavement anti-sliding performance of pavement rutting depth SRI, pavement structure strength index PSSI, etc.).

(2) As the attribute data of road traffic evaluation data, under the unified management maintenance data management subsystem.

(3) Traffic evaluation data provide query, form and thematic map display, output, and other functions.

(4)System model management module: modify and perfect system of traffic evaluation decision model.

3) Decision forecast subsystem

(1) Maintenance decision module: according to the system maintenance decision-making model in the model, to generate

the optimal maintenance plan, provide scientific decision for highway maintenance management department.
(2) The traffic prediction module: on the basis of the existing pavement condition data, maintenance plan and system forecasting model, to forecast the future n years of road data, convenient highway maintenance management departments have intuitive rational knowledge to plan execution effect, strengthen the highway maintenance management department in long-term road maintenance investment work.
(3) Traffic forecasts by chart module and output module expressed in the form of tables, thematic map, input and print.

4) Network management subsystem
(1) Display module: combines network spatial data and attribute data, in the form of digital map expression. Support amplification, narrow, roaming, query positioning map operating functions; Have simulated driving function, can through the toolbar control pause, stop, speed regulation, and other functions, test sections of start-stop pile number can be specified by simulating driving way dynamic information browsing path, such as road surface images, the landscape ahead, to the main road data, simulating driving, such as PQI, PCI, dynamic mapping graph display.
(2) Spatial analysis module: the road network to provide a buffer analysis, overlay analysis of spatial analysis function.
(3) Provide the attribute data in the form of table or thematic map expression and printing function, space data to map the function of the form and print.

4 summary and outlook
With the rapid development of our country highway infrastructure construction, highway mileage increasing, highway management is more and more complex, highway maintenance task gradually aggravate, highway maintenance management department for the reform of the management modernization and scientific. Because of the highway data has obvious space characteristic, and GIS technology characteristics and strengths is for the management of spatial data analysis, so building the road information management system based on GIS can meet the demand of the reality of highway management, in line with the current GIS technology into various industries were the developing trend in practical application.

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