Research on geographic information servicing construction plan and application of urban and rural water conservancy

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Abstract: With the vigorous development of digital and smart cities in China, the digitalization and informationization level of various industries have improved. However, the level of informatization in the township area and below is relatively low, and resources are relatively scarce. Remote sensing and geographic information technology can provide diversified products, services and interconnections for urban construction, planning, management, environment, water conservancy, electricity, pipelines, and transportation. In view of the application requirements of the water conservancy department, this paper discusses the construction framework design of the grid-based fine management service platform and the urban and rural water conservancy management system, in order to provide scientific reference for the water resources information management of relevant departments.

1. Application and development trend of RS, GIS and water conservancy

As an important means to master the distribution of natural resources, ecological environment, social sustainable development and scientific management & decision-making, geographic information can provide strong technical support for promoting the construction of water conservancy information in urban and rural areas. The traditional information management methods do not meet the needs of modern water resources management. The informationization development has higher and higher requirements for the accuracy and real-time of information. Water conservancy informationization has become an important measure for career development and optimization. RS and GIS are widely used in water conservancy. From the classification, it can be divided into: water body information extraction, water resources management, water pollution prevention, flood disaster monitoring, soil and water conservation monitoring, water resources development and utilization, disaster loss assessment, vulnerability assessment and decision-making. It can technically realize functions such as water body information extraction, data management, spatial analysis, simulation prediction, visual expression, statistical analysis and data mining.

With the continuous development of remote sensing technology, new remote sensing data such as hyperspectral, radar and microwave are gradually applied in the water conservancy industry, and a comprehensive trend of multi-source, multi-scale and multi-temporal phase is gradually formed. At the same time, the use of remote sensing information for quantitative inversion, simulation of rainfall, soil water content, evapotranspiration, water quality, ecological environment, river geomorphology process, evolution process, water pollution process, soil erosion, soil and water conservation and
desertification process are also gradually unfolding. In addition, the networked, componentized, integrated, multi-dimensional, and virtualized geographic information provides powerful technology support for warehouse management of water conservancy data, remote calls, on-demand assembly of functions, integration of applications and virtual simulation of scenarios. Combining RS, GIS with network computer, artificial intelligence and other high-tech can better serve the water industry.

2. Township grid management service platform framework design

The town is the functional department of the grassroots government, and it is also the collection and gathering place of a large amount of data at the grassroots level. The goal of the platform is to realize the fine management of township grid through the integration and mining of multiple information, tourism providing geographic information services in many aspects such as water conservancy management, precision poverty alleviation, agricultural management, social management, characteristic industry, planning and construction, environmental protection, emergency rescue, agricultural modernization, ecology.. Based on basic geographic information and thematic data, this paper designs a township grid management service platform to realize data input and output, editing processing, query statistics, visualization, update, spatial analysis, 3D simulation, on-demand assembly, and secondary development and other functions, in order to provide a one-stop management and service model for grassroots governments, departments and people, promote the level of informationization in grassroots water conservancy, serve the people's livelihood and deepen application.

2.1 Construct township grid management service platform

Based on an open service-oriented architecture (SOA) design concept and service aggregation technology, a township grid management service platform is established to provide basic services such as two-dimensional maps, three-dimensional maps, place name addresses, data application analysis, and integrate, manage, share, service and updates geographic information resources with government and industry topics. It can provide government departments, industry and the public with geographic information services in a networked operating environment, in order to realize data sharing, and promote informationization in areas below the township level.

The platform mainly includes two parts: data set construction and management service software system development of township grid management service platform. The platform dataset is service-oriented product data, catalogues and elements data such as geographic entity data, image data, map data, place name address data, three-dimensional landscape data and Industry thematic data formed by data extraction, expansion, and reorganization on the basic geographic information data. At the same time, according to the relevant regulations and requirements of the state, the confidentiality processing of the dataset of the township grid management service platform is completed, and the special information and points of interest are added to provide public welfare geographic information services for social groups and the public through non-confidential networks. The platform management service software system consists of a portal, a data management system, an information service management system, and a platform security management system, which is a centralized display center for data and functions. Township grid management service platform architecture[^4], as shown in Figure 1:
2.2 Platform function
The platform has data services such as directory services, map services, image services, and feature services, as well as functional services such as map services, analysis services, and interface services. The directory service can obtain the data classification information and the description information of the data provided by the system, and can query the metadata information according to certain conditions. The map service primarily provides an interface for external application systems to access map data. The graphic service mainly provides an interface for accessing image data to an external application system. The element service mainly provides the element service of the geographic entity data in the data set for various users. The map service mainly provides users with view operation services, measurement, conversion, query, location, retrieval, geocoding, customization, publishing, monitoring and statistics. The analysis service mainly provides users with various analysis services such as data overlay analysis, buffer analysis, and path analysis. The interface service application programming interface (API) should include basic classes, map classes, event classes, control classes, data parsing classes, 3D classes, specialized classes, perceptual device classes, historical analysis classes, comparison analysis classes, and simulation derivation classes.
2.3 Service direction
Based on the platform, service systems of various fields and directions can be designed. As shown in Table 1, the application system can call resources and functions in the platform. The specific service content can be selected and expanded according to the actual situation and needs of the region.

| Classification       | Thematic direction                                                                 |
|----------------------|------------------------------------------------------------------------------------|
| Water conservation   | Flood control and drought control scheduling decision, soil and water conservation, optimal allocation of water resources, water quality monitoring, water conservancy administration, water conservancy project construction management, soil and water conservation, water quality monitoring, etc. |
| Business class       | Water resources management, planning and construction(water conservancy, industry, agriculture, forestry, etc.), facility management(water conservancy facilities, energy facilities, power facilities, etc.), land housing and population management(confirmation and circulation), refined crop management, quality of agricultural products Security, agricultural Internet of Things, e-commerce, etc. |
| Economics            | Featured industries, specialty products, agricultural services, investment promotion, tourism, modern agricultural experience, etc. |
| Environmental class  | Environmental monitoring, ecological protection |
| People's livelihood  | One-stop convenience service: social security, health care, pension, education, employment, event management |

2.4 Operation and maintenance mode
Since most of the township-level existing foundations and resources are limited, the operation and maintenance model needs to be adapted to local conditions, supply and demand should be combined. At first, daily management of server purchase, database construction, platform deployment, system operation and maintenance: places with suitable conditional and capabilities can be self-managed; unconditionally area can be entrusted to manage, centralized management at county level and above; in principle, it is not recommended to purchase software and hardware devices. At the county level, the client and the APP are used for service. Second, the operation and maintenance methods are as follows: basic geographic information data is implemented in multiple levels of linkage update, sharing and using; thematic data is updated by professional departments, exchanging and sharing; vertical public service platform is installed to solve the problem of updating and maintaining basic geographic information data; horizontal public service platform of each professional department solves the problem of updating thematic data. Third, the confidential data is physically isolated and managed, and the confidential processed data runs on the Internet.

3. Design urban and rural water conservancy information management application system
The urban and rural water conservancy information management application system can call the data and services in the township grid management platform, and the data and functions in the urban and rural water conservancy information management system can also be integrated into the township grid management platform. According to the different contents of the system, it can be divided into several subsystems. The subsystems are relatively independent and related to each other, including water resources management subsystem, hydraulic engineering monitoring subsystem, flood disaster monitoring emergency subsystem, pollutant monitoring subsystem and flood disaster assessment subsystem. The overall structure of the system is shown in Figure 2:
3.1 System construction principles
System construction should follow the principles of advanced nature, safety, efficiency, reliability, scalability, and standardization. It should adopt the current more general and advanced hardware platform and GIS platform. The hardware and software configurations are coordinated with each other. The inbound data conforms to the specifications. It has certain scalability to ensure data security and reliability, and the system runs efficiently.

3.2 System function design
The function of the water resources information management system is mainly determined for the main aspects of management and different needs. It can assist the management of water conservancy departments, improve the level of water conservancy information, and have positive meaning to reasonable development, effective protection, efficient use and disaster prevention and reduction of water resources. The basic functions of the system include basic GIS functions such as user identification, data import, export, modification, query, retrieval, statistical analysis, report generation, and spatial analysis. In addition, it can also call the functions of township grid management service platform: location service, service loading, layer overlay, statistical analysis, buffer analysis, thematic map, geocoding, path analysis, various APIs, etc.

3.3 Subsystem design

3.3.1 Water resources management subsystem. Establish a water resources information database, including: natural geographic information (water resources zoning status, river shape, river location, river length, reservoir shape, reservoir location, socio-economic information, water resources information, ecological environment information), socio-economic information (population) Information, various economic and social indicators, etc.), water resources information (atmospheric precipitation information, surface water information, groundwater information and water resources engineering information, etc.), ecological environment information (ground subsidence information, polluted river information, landing funnel information, seawater Intrusion information, desertification information, etc.), dynamic monitoring information (real-time collection and monitoring of water resources data based on the Internet of Things). Develop functions such as query, statistical analysis, assessment, prediction, and early warning of water resources data to achieve water resource monitoring, water supply, water use, water consumption and drainage, to achieve monitoring of water volume in key river control sections, which can provide scientific evidence for decision making.

Figure 2. Overall structure of urban and rural water conservancy information management application system.
3.3.2 Hydraulic engineering monitoring subsystem[8]. Establish a water conservancy project monitoring information database, design data transmission, call, comparative analysis, assessment, early warning and other functions to achieve a comprehensive grasp of engineering information. For the key water conservancy projects, establish a video surveillance system and an Things of sensing system to monitor the project location, surrounding environment, auxiliary facilities, project progress, etc. in order to facilitate the discovery of problems and timely processing or reporting, to monitor the safety of hydraulic engineering and Early warning, to monitor the progress of the project implementation, which can timely adjust the plan and make scientific decision.

3.3.3 Flood disaster monitoring emergency subsystem[9]. Establish an emergency database, design a flood disaster monitoring emergency subsystem, realize data integration & emergency information inquiry, inquire about flood disaster events & hidden danger points & threatened populations & geological structures & flood disasters and flood-prone areas & monitoring historical data such as site data, rainfall, weather forecast information, weather cloud maps and flood warning events. Monitor and forecast of displacements, stresses and strains of monitoring points placed at hidden points of flood disasters. Establish emergency plans for disasters and incidents, and conduct unified manageme-nt of rescue agencies, emergency materials and rescue personnel. In the event of a flood disaster, the disaster information is obtained through the monitoring system, and the emergency work is carried out with the incident as the core, and the dynamic situation of the emergency rescue team and emergency reserve materials is quickly grasped.

3.3.4 Contaminant monitoring subsystem[10]. Design the pollutant monitoring subsystem, use high-resolution remote sensing images, sensors to acquire, process, store, measure and transmit from time to time, in order to realize the perception and monitoring of water quality, pollution sources, ecology, radiation and other information; Obtain spatial distribution, pollution source location, severe pollutant determination, dynamic change, statistical analysis, migration impact, in order to achieve deep mining and model building; combine with business needs, establish object-oriented business application functions for environmental quality, pollution prevention, ecological protection, which can provide decision-making basis.

3.3.5 Flood disaster loss assessment subsystem[11]. Design the flood disaster assessment subsystem, obtain the flood inundation range based on different periods and different types of remote sensing data sources; calculate the spatial distribution of flood information based on GIS and hydrodynamic model; analyze the flood submergence situation and characteristics based on the unified GIS spatial information grid; combine with socio-economic data, select or estabilish a suitable disaster risk assessment model to accurately assess the damage caused by floods and predict trends, which can provide important support for the scientific formulation of rescue programs.

4. Outlook
At present, it is a crucial period for building a well-off society in an all-round way and accelerating the process of modernization. It is an important period for strategic adjustment of the economic structure and reform and opening up. It requires all levels and departments to make outstanding efforts to solve outstanding problems and promote population through rational planning and scientific management. The coordinated development of resources and environment has led to a development path of sustained economic development, comprehensive social progress, sustainable use of resources, and continuous improvement of the ecological environment. The state has paid unprecedented attention to geographic information work. The development of new technologies such as big data, Internet of Things, cloud computing, and mobile Internet has become a new driving force for water sector reform and innovation. The service targets involve the government, departments, and the public. The service direction involves management, decision-making and forecasting. Application depth shifts from single application to integrated
integration. Therefore, it will be an arduous and a long-term mission task to carry out in-depth mining, comprehensive analysis, smart application, and continuous improvement of the scientific level of management decision-making through the integration of remote sensing, geographic information, and special data to support the healthy development of service-oriented government.

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