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Design and Optimization of Intelligent Water Affairs Platform Based on Geographic Information System

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Abstract: Smart water mainly includes water safety, water environment and water resources industry, covering automation and information application in water resources planning and utilization, urban flood control and drainage, sewage treatment, water production and supply, engineering facilities management and other fields. Smart Water can sense the running state of water system in real time through online monitoring equipment such as water regime, water quality and water pressure, and organically integrate water management department and water supply and drainage facilities through data acquisition instrument and wireless network. This paper designs and optimizes the intelligent water platform based on GIS(geographical information system), and builds a unified operation and management platform for the pipe network system, pressure monitoring system, water quality monitoring system, waterworks production management system and sewage plant production management system distributed throughout the city. The data layer integrates the data of various industries, and analyzes and processes the integrated data. Based on GIS, the reservation of related services by wireless terminals has changed the previous service mode, made the service more convenient, improved the service level of staff and provided better services for the public.

1. Introduction

With the continuous development of economy and society, the development of smart water has become a very important aspect in the process of smart city construction. At present, China is promoting the construction of “smart cities”. Beijing, Shanghai, Shenzhen, Kunming, Ningbo and other cities have started or are ready to start smart city construction, and relevant plans, projects and activities are gradually introduced[1]. Smart water affairs mainly include water security, water environment, and water resources industries, covering automation and information applications in the fields of water resources planning and utilization, urban flood control and waterlogging drainage, sewage treatment, water production and supply, and engineering facility management[2]. The subsystem of water affairs data center includes a series of basic information supporting security, operation, dispatching, users, authority, production process and resource management. Build pipe network geographic information database, equipment asset management database, production operation database, etc. The water equipment is widely distributed, geographically dispersed, the monitoring system has a large amount of data, and the real-time requirements are high. Building a

smart water affairs platform based on GIS is an inevitable choice for the management and operation of the water affairs group.

The intelligent water affairs can perceive the operation status of the water system in real time through online monitoring equipment such as water regime, water quality and water pressure, and integrate the water affairs management department and water supply and drainage facilities organically through the data acquisition instrument, wireless network and visualization, so as to process the data based on real-time perception. Analyze water conservancy big data, integrate relevant data, and provide data basis for intelligent decision-making. Through the real-time and automatic provision of urban water affairs basic data, business system association can be better carried out, and the integration of government administration and people's livelihood services can be effectively realized[3]. Intelligent water affairs software is based on GIS platform. As an effective tool for spatial information management, GIS plays an extremely important role in social economy and construction. As a new frontier discipline integrating computer science, mapping and remote sensing, geography, environmental science, space science, information science and management.

A unified operation management platform will be built for the pipe network system, pressure monitoring system, water quality monitoring system, water plant production management system, and sewage plant production management system distributed throughout the city. The data layer will integrate the data of various industries, analyze and process the integrated data, and use the cloud computing resource management system to compare with the database for data fusion to promote more scientific water management[4]. The monitoring nodes are deployed in the water affairs pipe network, combined with the Xianyang Smart City Cloud GIS platform, and the pressure, flow, turbidity, residual chlorine and other conditions inside the pipes at any position in the urban water supply system are obtained through hydraulic calculation. The impact of different events such as pump startup and shutdown, switching valve, leakage, pipe explosion, pipe network transformation, etc. on the pipe network is analyzed, and various production and operation data are collected and analyzed in real time to achieve intelligent production and operation scheduling and management. Based on GIS, wireless terminals are used to make reservations for related services, which changes the previous service mode, makes services more convenient, improves the service level of staff, and provides better services for the public.

2. Design of Intelligent Water Affairs Platform Based on Geographic Information System

2.1 Platform Function Design

As a service center, the smart water platform supports data center business applications by providing information and information processing services, and also provides platform-based application generation, security, optimized configuration and other multi-faceted and all-round services for various businesses. In the future, it can also provide customized knowledge and resource custody services for business applications. The intelligent water information system is based on the data center, with the help of information technologies such as GIS, Internet of Things, cloud computing, etc., to realize intelligent dispatching system, refined enterprise management and standardization of water supply service[5]. Assisting enterprise decision makers and related personnel to take corresponding measures is a strategic platform for the company's core asset management and enterprise informatization, and also a window for public wading information services. The visual display method based on GIS is adopted to organically integrate the functions of various management departments of Xianyang Water Group with water supply and sewage facilities. It is composed of two guarantee systems, namely, data management and maintenance system, technical specification and security system, based on the GIS intelligent water system

platform. The overall architecture of the system platform is shown in Figure 1.

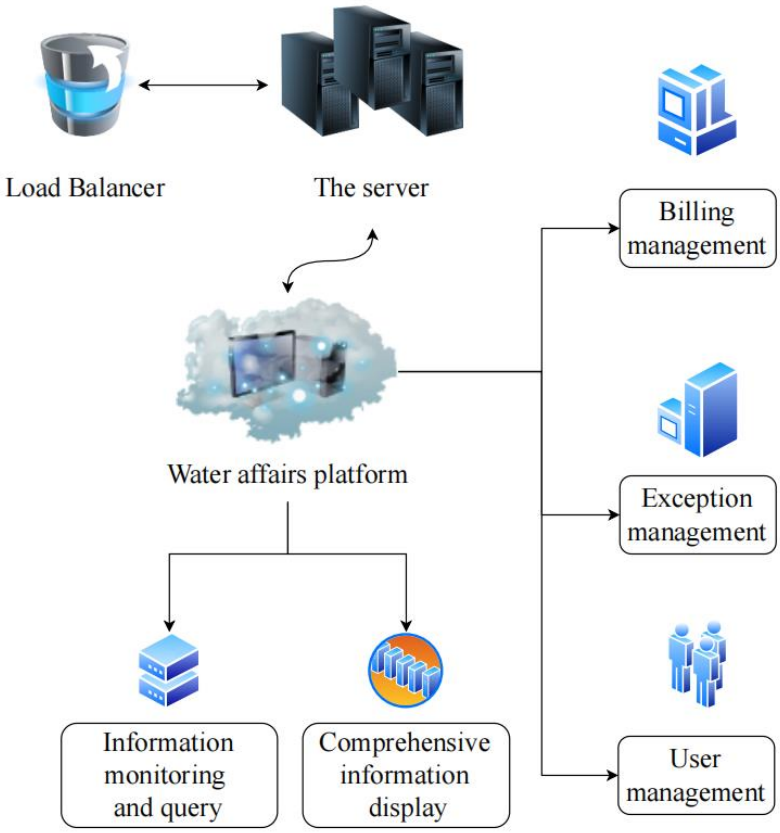

Figure 1: System Platform Architecture

The massive water affairs information is analyzed and processed in time to assist the management decision-making. At the transmission layer, the intelligent flowmeter collects the water use data and transmits it to the server through the 5G network. The data access mechanism mainly provides standard database data middleware, shields database differences, improves access security and read-write efficiency, and maintains the openness of the system data interface to facilitate system expansion applications and access to third-party systems[6]. Due to the large number of flowmeters in this project, the load balancer is used to reduce the pressure on a single server, and the production, management and service processes of the water system are managed in a more refined and dynamic way to make it “smart”.

2.2 Network Structure

The data exchange between the water data center of the group and Xianyang Smart City is realized through the government private network. To ensure the security of data transmission on the Internet, an encrypted transmission channel is established on the Internet by using GIS, and all data is transmitted through encrypted VPN tunnel. This service adopts hierarchical management mode. There are four kinds of users in the system: super users, water meter factory administrators, waterworks administrators and ordinary users. Each kind of users has different rights, among which super users have access to all data.

As a collection of resources, the intelligent water platform gathers common or reusable processing logic in various applications of data centers. GIS provides shared access to databases and information exchange with outside industries, and the application service platform forms a set

of widely shared information resources, which improves the efficiency of data center applications. GIS Water Data Center has opened a 2 M data APN dedicated line to China Mobile, and the data acquisition server can also be used as a GPRS server[7]. The platform processes the water data stored in the database, and provides services such as water monitoring and data analysis. Implement related applications of water management in application layer, including user management, billing management, abnormal alarm and so on. Data presentation and analysis technology adopts multidimensional data presentation, data intersection, data mining and other data presentation means. Statistical analysis methods such as data grouping statistics, data feature statistics, trend volatility analysis and development analysis are adopted. While using the smart city GIS platform, the water group also transmits the water production data to the smart city data center, realizing the release and sharing of information. The government functional departments can query and browse the water information according to their authority.

3. Optimization Path of Intelligent Water Affairs Platform Based on Geographic Information System

3.1 Optimizing Water Affairs Geographic Information System Platform

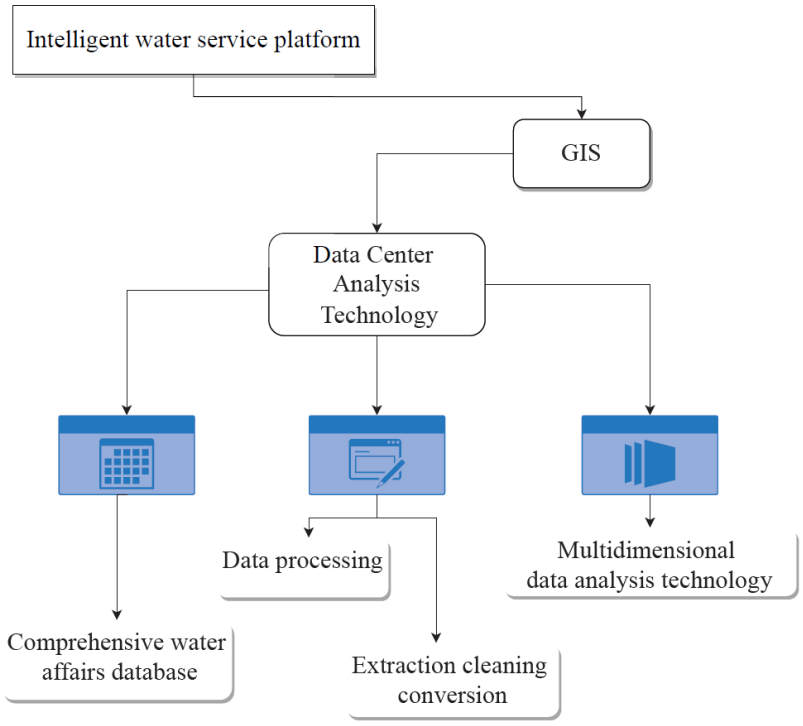

Figure 2: Analysis of Data Center of Intelligent Water Affairs Platform Based on Gis Optimization

Through the water affairs GIS platform, users can query and browse water affairs information on a variety of clients, such as browsers, smartphones and traditional desktop systems, for further optimization. The system can also push water information and water cut-off announcements for users, and provide timely and comprehensive information services for enterprise management, water users, equipment manufacturers, power supply bureaus, municipal and other government departments [8]. Building the water affairs platform system depends on sensor technology and control system, but the key technologies of these systems in China still have some defects. Therefore, long-term import of foreign technologies is not conducive to the rapid development of the system due to high costs. The graphical data and attribute data of the pipe network can be input

and edited, and the attribute query, map positioning, qualitative and quantitative statistics and analysis of pipelines and equipment can be carried out. The cost management, basic data, and process supervision of water enterprises can be digitalized through GIS, so as to prevent the bad situation of information islands and business estrangement, realize the resource connection of water enterprises, and promote better service to the city. The data processing of the intelligent water affairs platform based on GIS optimization is to process, clean and convert the data of the business system, that is, to unify the dictionary, index and caliber. After the data is standardized and normalized, it enters the comprehensive data center, as shown in Figure 2.

Through the optimized water GIS platform, users can form various specific applications on this carrier according to the application requirements and business development needs. Support the application platform to build a unified technical architecture, ensure that it becomes an organic whole logically, and realize the sharing of data, software and hardware resources. Water supply revenue service platform is the core system of water fee management in water supply enterprises, which is used to establish and manage user files, pre-storage management, cost management, meter reading management, charge management, statistical report, financial management, bill management, interface management, system management, etc. Through the water GIS platform optimized by GIS, the platform data acquisition service and the software and hardware systems such as on-site intelligent control equipment, intelligent measuring instruments, online analysis instruments, wireless sensor network equipment and other network facilities, etc., real-time data acquisition is carried out for plant-level and site-level equipment.

3.2 Application Case

This system platform realizes efficient water management. The system is deployed on Alibaba Cloud servers. Administrators can use the management platform website on the PC or mobile phone to manage users. End users can query, pay fees and other functions on WeChat official account. Based on the intelligent water affairs cloud platform optimized by GIS, all the data monitored in the urban water supply management process can be recorded in the cloud data center, so as to provide corresponding production indicators and production operation data for the water supply pipe network and the water plant pump station. The basic equipment of the information acquisition and transmission layer are data acquisition equipment and wireless network equipment, through which the status, drainage and water supply of urban water can be understood. The system will save the automatically collected data and transmit it through wireless network. The management platform website of GIS provides user management, account management, recharge management, query statistics, price management, operator management, abnormal account and other module entries, and users can access relevant information of each module after registering and logging in. At the same time, we should also absorb foreign advanced technology and promote technology development and integration based on our specific national conditions.

Establish R&D institutions, transform mature technologies into physical equipment and systems, apply them to practice, and solve the technical problems that restrict water management in China. In this mode, all system functional modules are a kind of service, which can be shared and reused by multiple systems. Each service module is a standard service component. The overall information platform, just like building blocks, can combine a bunch of service components arbitrarily to form a new business system. The intelligent water affairs platform based on GIS optimization will help water supply companies to manage assets to the greatest extent, improve the operation, office and public service efficiency of water supply enterprises, make the services of water supply enterprises open and transparent, make public information symmetrical, and make the society more harmonious.

4. Conclusions

In this paper, a GIS-based intelligent water platform is designed, which solves the problems of low management efficiency and poor load capacity of the traditional water platform, and further optimizes it. By collecting water conservancy, hydrology, environmental protection, meteorology and other data, the intelligent water platform software builds a reliable and complete information data center with strict data standard system and perfect management system. Monitor the change of water quality in real time, prevent water pollution, and solve the water problem of residents to the greatest extent. Our government should pay attention to the construction of intelligent water affairs, arrange special personnel to study key technologies, and realize efficient management of water affairs. The master-slave structure is adopted to provide a reliable data base for the platform. The server provides services such as remote meter reading, user management, abnormal alarm, billing management, etc., and gradually forms a standard and open service window of information resources, providing data support for various business application systems, and serving as an authoritative way to obtain water information from inside and outside related industries. The platform has been successfully put into operation in Xianyang Water Group. The successful implementation experience of this project has popularization value in the construction of similar projects, and also has certain reference value for the unified planning and construction of other smart city geographic information platforms.

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