

Metropolitan and Rural Water Resource Information Management System

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Abstract— The sustainable exploitation of water resources, as well as the economic and ecological benefits that come with it, can be promoted through water resources management, the foundation of which is urban and rural water resources management. This is because water resources management promotes sustainable exploitation of water resources. The administrators of water resources require greater information on a variety of topics, including water consumption, water supply, water use, water loss, and drainage, specifically as they relate to geographic regions and economic fields. The urban and rural water information management system provides assistance for an integrated approach to the management of data pertaining to water resources. This system structures a three-tier client/server (C/S) architecture with five modules consisting of data entry, data query, statistical charts, report management, and system management. The goal of this architecture is to provide water managers with more accurate information to help them make managements and decisions. This system is highly suited for wider use and additional development as a result of its capabilities of reusability, flexibility, and generalizability, as well as its extensibility for future extension.

Keywords-Delphi; C/S; urban and rural; water resources information management; database; system design

I. INTRODUCTION

A discrepancy between the amount of available water and how much is being used has arisen as a direct result of the concurrent rise in both social and economic growth. It is an essential method for reconciling the conflict, and it involves managing the water resources in a scientific manner and allocating the water resources in an effective manner. The foundation of water resources management is the regional management of the number of water users, the types of water sources, the quantity of water supply, water use, loss, and drainage. This management plays an essential role in the rational development, optimal allocation, comprehensive saving, and effective conservation of water resources.

II. SYSTEM OBJECTIVE

The system aims to systemize, normalize and automate water-users management. The water-users database facilitates the input, storage and management of water-users' basic information including water supply quality, usage, loss, drainage, and the water bill payment. It provides the technique support and basis for regional water exploitation and utilization, optimal allocation and scientific management, and a rich and intuitionistic Man-computer Interaction System for Water Resource Management decision makers and users through the statistical analysis of water-users information.

III. SYSTEM DESIGN

A. Structural Design

Taking the features of large amount of water users, fast updated speed, required high safety and high reliability into C/S, the system adopts the three-tier C/S architecture, i.e. data access layer (DAL), business logic layer (BLL), and user interface (UI). DAL, using Microsoft SQL Server 2000, manages the data transfer. BLL, the core of the system, makes the business logic for the implementation of the entire system. UI is responsible for displaying the user interface,

providing a good environment for man-machine dialogue, and achieving operational functions of the system. The system architecture was shown in figure 1.

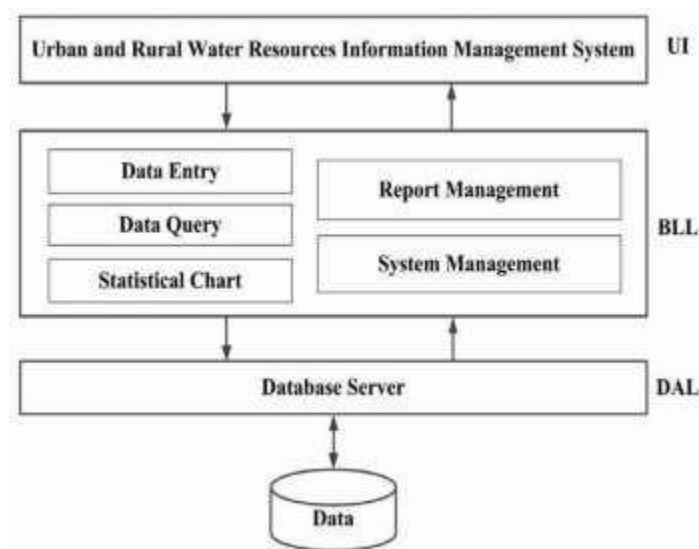


Figure 1. The architecture of urban and rural water resources information management system

B. Functional Design

As a basis for water resources management system, water-users management requires mainly:

- Integrity and accuracy of data entry
- Speed and convenience of data query
- Thoroughness and easy use of statistical analysis

It is convenient for the development, maintenance and expansion of the system to divide the abovementioned requirements into several basic modules with clear function. In order to implement these functional requirements, the system contains five modules:

1) *Data Entry Module*: To handle the diversity and timeliness of the water-users data, the module enables both automatic and manual data entry modes, guaranteeing accuracy of data. The system could check all data up automatically from backend database before the data being entered into the database, which guarantees the uniqueness of data. These all provide reliable data for better decisions.

2) *Data Query Module*: Query module includes basic query and advanced query. Basic query is simple query of single field consisting of administrative division, the name of water-users, legal representative, industry category and the type of water-users. Advanced query defines as query composition with multi-fields, which includes date, administrative division, the name of water-users, legal representative, industry category, the type of water-users, the registration of water use and discharge permit, etc.

3) *Statistical Charts Module*: Charts module includes transverse statistics and longitudinal statistics. Transverse statistics mainly provide the different data of types of water-users, administrative division and industry category on the same date. Longitudinal statistics mainly provide the data of certain water-users, type of water-users, administrative division, and industry categories at different time periods.

4) *Report Management Module*: in order to manage reports quickly and easily, the data and the form are separated completely. The system can implement the location, output and printing of data, according to the date and order that user requires.

5) *System Management Module*: System Management module implements some functions including user management, permission management and log management.

The function modules diagram of this system was shown in figure 2.

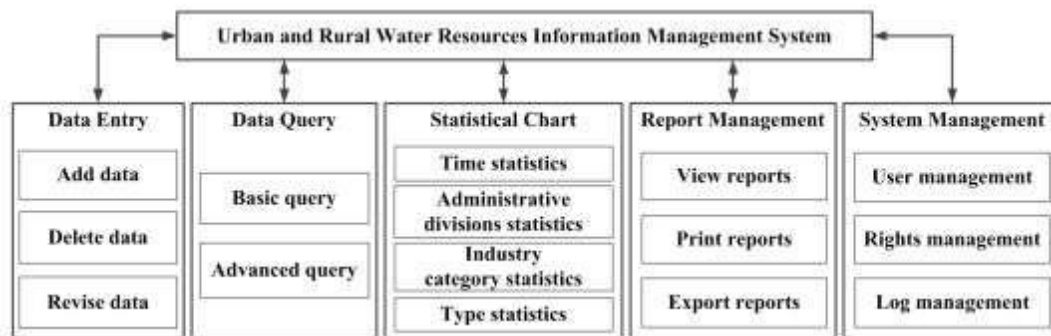


Figure 2. The function module diagram of urban and rural water resources information management system

IV. SYSTEM IMPLEMENTATION

A. Database Design

Due to the fact that managed data are of great variety, quantity and complexity, the database structure has a direct impact on the data query, retrieval methods, access speed, and the reliability of the data. Therefore, the database design is significant for the system development. The traditional file database, also known as tabletop database, is weaker in processing the share file than that of C/S database. When used in network, it will increase the transmission amount of network and reduce the system stability. While in C/S database, data processing is put on the server and only the data are returned to client, which speeds up the processing. Also, C/S database has detailed competence and log-in permit control, log-in without permission can be avoided.

Microsoft SQL Server, as a typical C/S system, is a relational cross-platform database management system, information exchanging between client and server is performed by the Transact-SQL statement, with better security, reliability, scalability and high-performance. This management system adopts SQL Server2000 as the backend database management the characteristics of water-users management, including.

- Public base information.
- Essential information of water users: water user id (WU_id), water user name (WU_nm), legal representative name (LR_nm), administrative division id (AD_id), type id (Type_id), ownership form id (OF_id), industry category id (IC_id), industry category scale (IC_sc), water supply of the population (WS_pop) and remarks.
- Water sources information: water source id (WS_id), water source name (WS_nm), water source address (WS_addr), water source type id (WT_id), well elevation (W_elev), well sinking depth (WS_dep), groundwater level depth (GL_dep), drill hole diameter (DH_diam), water yield (W_yield).
- Monitoring equipment information: monitoring equipment id (ME_id), installing date (ME_date), monitoring equipment type (ME_type), operation condition (ME_oc).
- Water resource fee information: year, bill to be paid (B_tbp), bill paid (B_paid).

At the same time, on the basis of database design principles such as consistency, integrity, integrity, this system was constructed with the basic conceptual model of the database system, including the entities of water-users, water resources, monitoring equipment and water resources acquisition fees, expressed by the entity-relationship diagram shown in figure 3.



Figure 3. The entity-relationship diagram of rural water resources information management system

B. Development and Application

The foreground application was developed by using Delphi7.0, connected with the background database by ActiveX Data Objects (ADO). Based on the user interface design principle, the interface of this system was designed with the modules of entry, query, charts, reports and system management. The ADO Connection object is used to link to the background database dynamically, and then the data of the database are retrieved, organized and managed with ADO Command object. Finally, the needed information, with ADO RecordSet object, can be returned to the clients, showing in the user interface.

The application taking into account of the usability on user interface design has the following points:

- Classify the mass of information, making the information quantity within user's acceptable range, such as data entry interface, shown in figure 4.
- Offer error messages when system operates anomalously, a help for easy operation.
- Enhance the availability of application using similar tone and standard front. The data query module interface of this system was shown in figure 5. The report management module interface of this system was shown in figure 6.



Figure 4. Data entry interface of rural water resources information management system



Figure 5. Data query module interface of rural water resources information management system



Figure 6. Report management module interface of rural water resources information management system

It is demonstrated that this system has the following virtues.

- Friendly in user interface, clear in modules, and easy in operation.
- Easy to improve, update, and maintain. The integrity of the information can be ensured.
- Effective in data query and statistical analysis.

V.

CONCLUSION

Rational development, optimal allocation and efficient use of water resources have been the focal points of the water resources management. Therefore, to know well about the information relevant to the water users will be beneficial to the management. Based on the problems encountered in Gujiao water management, we developed this system, which provides an effective emergency responding and routing management. This system has the following virtues. (1) It not only reduced the cost on building large water resources information management system, but also overcame the disadvantage that small universal information management system won't fit in with water resources management. (2) It was developed according to the specific characteristics of water resources management and deserves wide application in this field. (3) It has user friendly interface. (4) It can be upgraded to network database under the supporting of network information security technology. This is also an area in which further study is needed.

REFERENCES

1. Wu Jisong, Water Resources Management Methodology. Beijing: China WaterPower Press, 2002. *(in Chinese)*
2. Liu Qianjing, The Delphi database programming technology. Beijing: The People's Posts and Telecommunications Press, 2003. *(in Chinese)*
3. Qian Xuezhong, Luo Haichi and Chen Guojun, Database Principle and Curriculum Design. Beijing: Tsinghua University Press, 2009. *(in Chinese)*
4. Liu Lixia and Zhuang Yiqi, Database Technology and Application Based on SQL Server. Xi'an: Northwestern Polytechnical University Press, 2007. *(in Chinese)*
5. Huang Xiaozhang, Information System Analyse and Design. Beijing: Tsinghua University Press, 2010. *(in Chinese)*