Research on intelligent water platform based on Cloud Computing

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Abstract. Intelligent water platform is based on cloud computing and big data to build a comprehensive water management system. The system can analyze and process massive water information in a timely manner through cloud management, and make corresponding processing results to assist decision-making suggestions, so as to manage the whole production, management and service process of water system in a precise and dynamic way, so as to reach the intelligent state.

1. Introduction

1.1. Research background
Nowadays, the shortage of water resources and the pollution of water resources are becoming increasingly prominent in the world. People gradually realize that the future development direction is to strengthen the management of water resources and realize the effective utilization and scientific allocation of water resources. With the development of cloud computing, internet of things, big data and the expansion of water supply radius faced by the city, the traditional water management system has been unable to meet the needs of the city. Building an intelligent water platform based on Internet of things and cloud computing has become the only way of information construction.

The current meter reading management system only provides the basic functions of manual meter reading and water fee settlement, which is difficult to meet the requirements of efficient water management. Therefore, it is an urgent need to design and develop a set of water management information system with more comprehensive functions to achieve the goal of "safe water, high-quality service". This paper aims to study an intelligent water system based on cloud computing, which integrates data collection and communication, and can realize the informatization and intelligence of residential water data management.

1.2. Research meaning
Building a smart water cloud platform can optimize the allocation of urban water resources, facilitate the transformation of old and new kinetic energy, and help to build a smart city. It is of great significance in realizing the sustainable development of the city, leading the application of information technology and promoting the comprehensive competitiveness of the city. With the expansion of the city scale and the transformation to a smart city, with the rapid expansion of water supply and drainage pipes, in the face of decentralized management of pipe networks, users, pump stations, the management means and work efficiency of water affairs are required to keep up with the development
of the city. Therefore, an intelligent water affairs platform is needed to achieve the strategic objectives of information sharing, process improvement, management standardization, safe production, scientific scheduling and cost control, so as to comprehensively improve the operation ability and customer service awareness and risk control ability [1].

2. Water model analysis
At present, there are the following problems in the National Water Information Construction: (1) Information collection is difficult due to the scattered application system, which is difficult to meet the needs of water management. (2) There are barriers to information sharing. (3) The existing IT management mode is out of line with business requirements. The existing water authority information system is complex. There are redundant construction and waste of resources. (4) Information statistics and analysis business lack platform and support ability, and various IT resources have not been effectively utilized. (5) Daily work and business process of water management still rely on traditional information acquisition methods, and the accuracy and reliability of information sources in each link are not high.

With the development of modernization, it is necessary to concentrate and integrate the isolated information resources and build the regional water operation system [2]. The construction of intelligent water platform is based on the water supply network. Through the internet of things sensing technology, cloud computing technology and GIS geographic information technology, the platform can realize the automatic collection, information interconnection and fusion analysis of production factor data such as infrastructure and equipment of water supply industry. It can establish a "one-stop" service system of real-time monitoring and intelligent control.

After active research, we have explored an intelligent water system model, as shown in Figure 1.

![Figure 1. The intelligent water system model](image)

The model is mainly divided into three levels: collection level, management level, application level, including data collection, data processing, data maintenance and other modules. One of the very
important modules is the charge system management, which can complete remote payment management through WeChat and other three-party platforms. The model has several large-scale characteristics, which include the omnipresent comprehensive perception of the internet of things, the cross business, big data concentration, the comprehensive application analysis of interdisciplinary, the intelligent management control of high coupling multi-system and the multi-level intelligent application.

3. Key theory and technology of the system
Intelligent water platform is a large-scale platform, involving many theories and technologies. On this platform, the most important realization is the management and payment of smart water meter. The system uses the guns open source system based on SSM as the background framework and MySQL database as the persistence layer software. Because of its lightweight architecture and free open source characteristics, it has the advantages of strong usability, powerful function, low cost and distributed construction. For managers, it can easily help managers to achieve real-time supervision, intelligent management and control. It can directly present the water data in the form of reports, real-time data analysis, real-time online monitoring, so as to make the water more worry free and more reliable. Users can easily query and pay through WeChat applet. Here are some of the key theories and technologies used.

3.1. Cloud computing
Cloud computing is also called grid computing. Through this technology, it can process tens of thousands of data in a very short time, so as to provide powerful network computing services. With the cloud computing technology gradually entering people's vision, the application of cloud computing technology to water management can optimize and improve the problems existing in traditional management, bring great convenience to water work, reduce water management costs, and realize the sharing of water data resources. For example, according to the total amount of water consumption, water resources can be timely and intelligently dispatched to make full use of resources and reduce waste. It can connect tens of thousands of computers together. So that even if a device has problems, cloud computing can ensure that the entire system can run orderly. When users stay at home, they can get information such as water and fees, and can quickly complete the payment only through the mobile terminal.

3.2. WeChat developer tools
As a third-party platform, WeChat applet is a new way to connect users and services. Users can scan online or official account to get applet. The small program takes up little memory space and it is very fast. Users can get a good experience. The framework of the applet consists of three parts: logic layer, view layer and system layer.

3.3. MVC framework
MVC architecture is adopted for system architecture. Its full name is model view controller, a software design model. It organizes code with a method of separation of business logic and data and interface display, and gathers business logic into a component. While improving and customizing interface and user interaction, it does not need to rewrite business logic. The system logic business framework is shown in Figure 2.

4. Partial function realization

4.1. Function module
As for the payment module, it needs to have the following functions: user management, water meter management, water fee management, announcement management and other modules. The module framework is shown in Figure 3.
4.2. **Applet** function design

The system adopts the distributed architecture design. In order to achieve "one login, multiple uses", a single login system is required to do the login operation of the whole system and maintain the login status of users. The single sign on subsystem is based on Redis to maintain the login status. When the user opens the image sharing applet for the first time, he needs to log in. After the login request arrives at the back end, the database needs to verify the user name and password. After the verification is passed, the back end will randomly generate a string as the token for the user to log in. The token is as the key and the user information is as the value to redis. It will set an expiration date, and finally return the token to the WeChat applet, which will save the token locally.

![The system logic business framework](image1)

**Figure 2.** The system logic business framework

![The module framework](image2)

**Figure 3.** The module framework
4.3. Database design

MySQL is an open source relational database management system, which uses the database management language named structured query language (SQL) for database management. All data in the relational database will be stored in the form of tables. This design pattern improves the speed of data query and operation, and also greatly improves the flexibility of data operation. Mybatis used in the platform is an excellent persistence layer framework, which supports customized SQL, stored procedures and advanced mapping. The user information is shown in Table 1.

**Table 1. User_info sheet**

| FIELD NAME | DATA TYPE | LENGTH | NULL OR NOT | PRIMARY KEY | DESCRIPTION |
|------------|-----------|--------|-------------|-------------|-------------|
| user-id    | int       | 11     | N           | Y           | ID          |
| user-name  | varchar   | 255    | N           | N           | name        |
| avatar     | varchar   | 255    | Y           | N           | display or not |
| population | int       | 11     | Y           | N           | family population |
| address    | varchar   | 255    | Y           | N           | family address |
| city       | varchar   | 255    | Y           | N           | city        |
| county     | varchar   | 255    | Y           | N           | district/county |
| province   | varchar   | 255    | Y           | N           | display or not |
| tele_number| bigint    | 100    | N           | N           | Tel         |
| gender     | int       | 1      | Y           | N           | male or female |
| nick_name  | varchar   | 255    | Y           | N           | display or not |
| power      | int       | 1      | Y           | N           | white or black list |
| type       | int       | 1      | Y           | N           | user type   |
| watermeter_ID| int    | 11     | N           | N           | foreign key |
| xcx_open_id| varchar   | 255    | N           | N           | applet openId |
| xcx_session_key| varchar | 255    | N           | N           | applet session_key |

4.4. Results of some functions

According to the analysis of system requirements and user requirements, the system must have the following basic functions.

1. User login and registration
   When the user has no information in the system, the user can complete the registration by entering the information and clicking registration, and then enter the registered user name and password to complete the login.

2. User information
   After the user logs in, he can click to query the basic information of the user, and then he can query his basic information.

3. Water meter information
   Users can click the water meter information to query the relevant information of the water meter of the user.

4. Water fee information
   Click water fee query, you can see the water consumption of user this month and the corresponding water fee.

5. Announcement management
   Users log into the applet to get real-time information published by the water supply company.
   The server can carry out the management function of each module, and the front end can realize the application of each module, as shown in Figure 4 and Figure 5.
5. Conclusion and Expectation

We build the intelligent water research model, and make a detailed elaboration on the design and implementation of the payment module. It can rely on advanced computer network technology, cloud technology, internet of things technology, large-scale database management technology. It can realize the efficient management and scientific statistical analysis of urban water resources. The goal is to build a practical, safe and efficient urban intelligent water information system. Due to the lag of information sharing and work coordination between different departments, information island and process island are prevalent, and we still have a long way to go.

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