

Innovative Research on Water Regulation and Management Information System

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Abstract

In the context of the most stringent water resource management system, in order to better solve the problem of unreasonable allocation and under-utilization of water resources, the rational allocation and efficient use of water resources. This paper uses computer application technology, internet of things technology, digital communication technology and other technologies to realise information technology for water resources regulation and control, and designs and develops a water resources regulation and control management information system to realise information management and full process control of water resources regulation and control. The system uses information technology to realise information, problem diagnosis, plan recording and control of water resources, and facilitates scientific control of water resources in the area under management by managers.

KEYWORDS: *Water regulation and management; information system; internet of things technology*

1. Introduction

Water resources play a very important role in human social life and production, and are one of the most important material resources indispensable for human survival and development. However, the spatial distribution of water resources in China is uneven, and the water resources situation varies greatly between regions, which restricts the socio-economic development in the process of social development, the problem of water resources has not only aroused concern in China, but also all countries in the world attach importance to the use of water resources [1]. At the same time, the issue of water security is also affecting the use of our water resources. People's uncontrolled use of water, wasting water and polluting water all pose a great threat to water resources. In order to solve the above problems China has solved the problem of uneven spatial distribution of water resources in China by implementing the South-North Water Transfer Project and promulgated the most stringent water resources management system in order to better solve the problem of water security in China.

In order to further strengthen the management and control of water resources, it is convenient to supervise and control the management behavior of water safety. The Water Resources Control Management Information

System was designed and developed to keep data on the long-term control of water resources by means of information technology and to formulate corresponding control measures in a more scientific manner, which is conducive to the information management and full process control of water resources control, improving the efficiency of water resources management, making full use of the results brought about by the South-North Water Transfer Project and better implementing the most stringent water resources management system.

2. System composition and function

The water resources regulation and management information system consists of five sub-systems: the water resources information document management system, the hydrology - water resources - water environment - water ecosystem management system, the water resources monitoring and evaluation system, the water resources early warning and diagnosis system and the water resources programming and rehearsal system. The water resources information document management system and the hydrology - water resources - water environment - water ecosystem management system are the fundamental parts of the overall information system. The water resources monitoring and evaluation system will continuously correct the data collected in the field

and evaluate the water resources situation in the field. The water resources early warning and diagnosis system is a solution and early warning system for water resources problems. The water resources programming and

rehearsal system simulates scenarios to control water resources. The five systems work together to achieve full cycle control of water resources. The system composition is shown in figure 1.

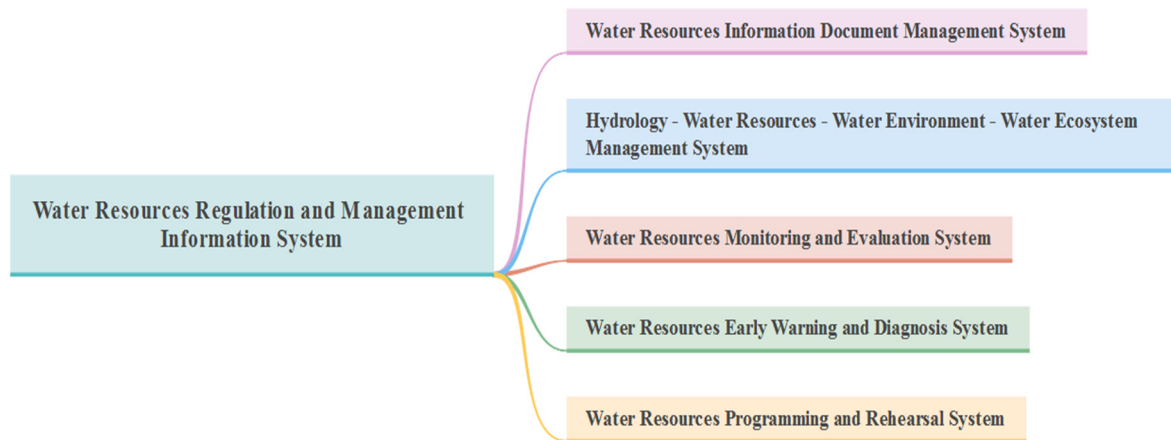


Figure1. Water resources regulation and management information system composition diagram

2.1. Water resources information document management system

The system is responsible for collecting information on water quantity, water quality and water environment on site for archiving and storage, making it easy for administrators to find, update and delete operations. Administrators can search for information by searching for the name of the water intake, or by the type of intake, or by searching for relevant keywords through advanced queries. For deleted data, the system supports recovery of the returned data within 7 days, avoiding the consequences of the administrator accidentally deleting the data. Staff on site can fill in the relevant data information by logging into the system and the information will be automatically saved to the database.

2.2. Hydrology - water resources - water environment - water ecosystem management system

The system is mainly to understand the mechanism of the coupling effect of on-site hydrology - water resources - water environment - water ecosystem, and to make a reasonable allocation of water resources on site, while the macroscopic nature of multi-source satellite remote sensing data, the real-time nature of UAV remote sensing data, and the accuracy and continuity of ground-based online monitoring data can be used to build a three-dimensional monitoring system of sky-air-ground [2]. Through the analysis of field data collected in the water resources information file management system, the mechanism of the coupling of field hydrology - water resources - water environment - water ecosystem is discovered from the multi-dimensional and multi-temporal scale data of hydrology, water resources and water environment, so as to avoid the disconnection

between the allocation of water resources and the health of field wetlands, rivers and estuarine ecosystems, in order to achieve a water resources control method that takes into account water quantity - water quality - water ecology, and to improve the efficient use of water resources and optimize the ecological management effect.

2.3. Water resources monitoring and evaluation system

The system focuses on real-time updating of collected water resources information, regular sampling of surveyed sites to ensure that the data in the database still matches the actual situation on site, as well as dynamic monitoring of areas where water resources regulation is taking place to understand the impact that water resources regulation is having on the local area and to evaluate the water resources situation on site. If site staff make changes to the water resources information collected, the system will automatically separate the new file and alert the administrator that the information has been updated, making it easy for the administrator to manage changes to water resources at the same water point over time. The data is also automatically added to the original map, updating the data information on the original map. The evaluation uses a comprehensive evaluation model based on artificial neural networks to evaluate the effectiveness of local water resources regulation [3].

2.4. Water resources early warning and diagnosis system

When the system is used to dynamically monitor areas where water resources are being regulated, if the water resources in some areas are abnormal, the system will send a message to the administrator to remind him to pay attention to areas where problems may occur.

Therefore, abnormal areas can be checked in advance and analyzed. The cause of the problem, take appropriate solutions to avoid further deterioration.

The system diagnoses and classifies problems in water resources regulation, and administrators can develop targeted solutions based on the different categories of problems. If there is serious groundwater over-exploitation in a particular area, the system can facilitate water resources regulation by limiting groundwater extraction and increasing the use of local unconventional water to promote a virtuous cycle of water resources [4].

2.5. Water resources programming and rehearsal system

The system develops a regional water resources control plan. Once the plan has been developed, staff can exercise the plan to minimise possible adverse impacts on regional water resources control and then screen the best plan for implementation in the area. If the regional water quantity and quality is to be regulated, a joint water quality regulation model can be used, calculating the regional pollution level, calculating the optimum supply and demand for the water allocation system, considering the control factors for water quality compliance, and

finally measuring the water quality method, and then preparing a plan to observe the effect of water resources regulation through previews [5].

3. System architecture

3.1. Software architecture system

The system software is horizontally divided into a five-layer structure: platform layer, core business layer, data management layer, business logic layer and presentation layer. The platform layer includes a unified interface, various sensors and drones. The core business layer includes the five sub-systems of the water resources regulation and management information system. The resource layer includes the database management system, Tomcat server and MySQL database. The interactive processing layer includes HTML, PHP and CSS. The presentation layer includes PC and mobile terminals. The platform layer transmits the data from the project site to the core business layer, and after processing by the core business layer, the data information is transmitted to the resource management layer, and after the data is collated, the information is transmitted to the presentation layer through the interaction processing layer, and the presentation layer. The software architecture diagram is shown in figure 2.

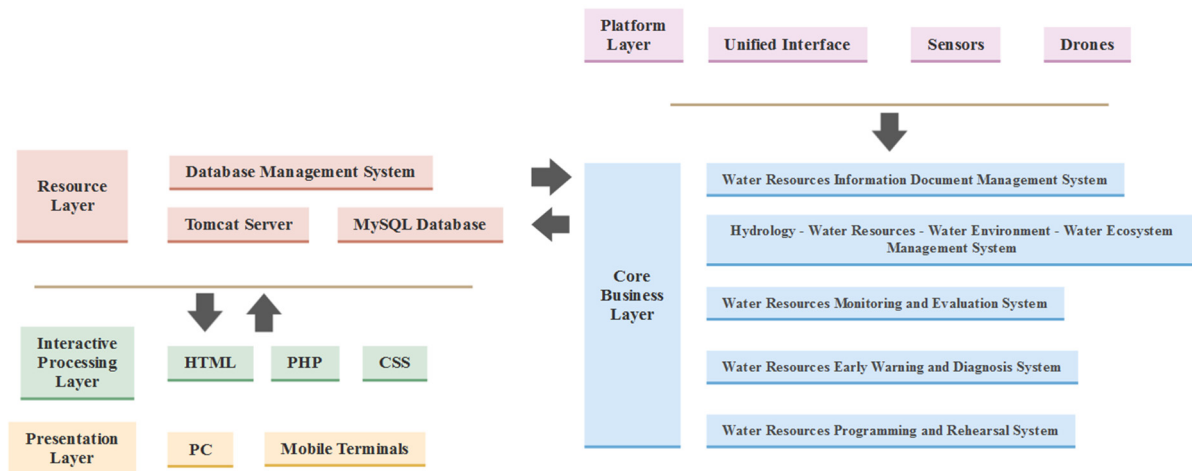


Figure 2. Software architecture diagram

3.2. Hardware architecture system

The system's hardware architecture system is based on cloud services, which stores data from the survey site in the on-site data collection system, and ultimately stored in the central database through cloud services, in order to facilitate the user side of the data information

retrieval and viewing, the central database will send the information required by the user to the Web database, the Web database will send the information to the user. The network topology of the system implementation is shown in figure 3.

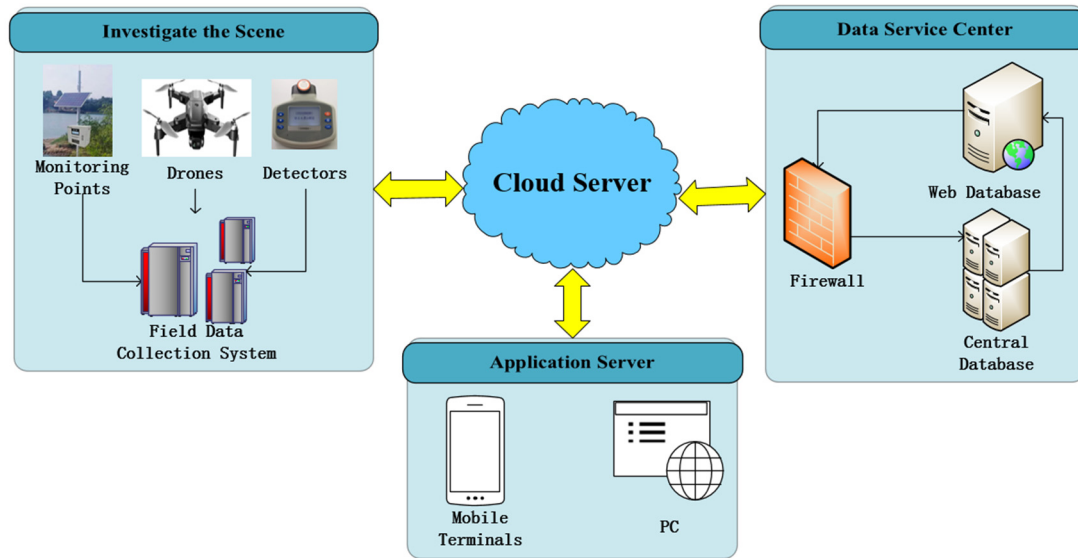


Figure 3. Network topology diagram

4. System implementation

4.1. Water resources information document management system interface

The system interface is divided into three areas, with the title bar and function selection area at the top, the system function partition on the left and the content display area on the right. The top part includes water

intake query, sewage outlet query, water intake detection, statistical analysis, report customization and map query. The real-time data on the left is all the data in the database, and the data can be queried by abstract types. Advanced query allows more restrictions on the queried information, and thematic analysis queries the data information for a specific abstract time period. The content display area on the right shows real-time data information. It has been shown in figure 4.

Water Resource Information Document Management System

Sewerage Search

Outfall Search

Vent Search

Statistical Analysis

Statement

Map Search

Real-time data

Thematic analysis

Search

Statistical Analysis

Water Intake Type

No Limit

Search

Advanced Query

Name of water intake units

Pump status

Water collection time

2021/07/07 - 2021/07/22

Search

Real Time Data

Index	Company	Water Intake Time	Meter Data	Monthly Water Amount	Meter Type	Pump State
1	Company A	2021-07-26 12: 12	88916489	1532151	Flowmeter	✓
2	Company B	2021-07-26 13: 12	78916489	3532151	Flowmeter	✓
3	Company C	2021-07-26 15: 12	110916489	5532145	Flowmeter	✗
4	Company D	2021-07-26 17: 12	70966599	4432415	Flowmeter	✗
5	Company E	2021-07-26 18: 12	40066599	2232415	Flowmeter	✓
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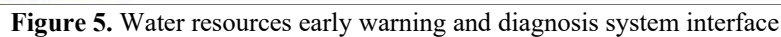
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Figure 4. Water resources information document management system interface

4.2. Water resources early warning and diagnosis system interface

When the administrator switches to the early warning and diagnostic system for water resources regulation issues, the right hand side can display the water quality of a particular river section. If there is an abnormality somewhere in the river section, the early warning

information will show the abnormal river section and the administrator can contact the field personnel to test the abnormal river section. If a problem arises, the staff on site can fill in the corresponding situation in the cause analysis, while the experts will also give their opinion. The light yellow button at the top left allows you to select the section of river to observe. It has been shown in figure 5.



The system uses HTML, PHP and CSS language to build the interface and the interaction of functions, while the data is supported by MySQL database as a resource to design and develop the information system. Some of the code is as follows:

```
'apps' => [
    ['title' => 'admin',
     'path' => 'app\admin\controller',
     'folder' => 'admin',
     'groups' => [
         ['title' => ' File Management ', 'name' =>
          'adminFile'],
         ['title' => ' Settings Management ', 'name'
          => 'adminSetting'],
         ['title' => ' System Management ', 'name'
          => 'adminSystem' ] ],
     'headers' => [
         ['name' => 'AdminToken', 'type' =>
          'string', 'require' => true,
          'desc' => 'admin token']] ],
```

This paper applies computer application technology, internet of things technology and digital communication technology to water resources regulation and control, and designs and develops a water resources regulation and control management information system for the relevant authorities to manage water resources information. form

With the application of information technology in water resources regulation and control, China can better co-ordinate domestic water resources regulation and control, collect information on local and national water resources regulation and control, and summarise the problems in water resources regulation and control. This will ensure the rational allocation and full and efficient use of water resources, make full use of the results of the South-North Water Transfer Project and alleviate the contradiction of water shortage, while achieving a virtuous cycle of water resources under the strictest water resources management system and further promoting the sound development of China's water ecosystem.

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