Design of Water Quality Monitoring Visualization System Based on Cloud Platform

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Abstract: In response to the problem of domestic and severe water pollution control, in order to help the water environment monitoring department, this paper proposes a structure of B/S/D architecture, Spring Boot + MyBatis + MySQL + CXF for the programming framework Water quality visual cloud monitoring system. The system abandoned the traditional method using Spring/Spring MVC as a program framework, using the Spring Boot new frame structure, which greatly enhances the readability of programming simple and program, and changed the lengthy, low running rate, and front end of the web page. Slow disadvantages. The system is actually developed, and the deployment results show that the system operates stable, and can perform long-term continuous, real-time monitoring, and can send real-time data and historical data to the information terminal to provide reliable cases and solutions to strengthen water quality supervision.

1. Introduction

With the continuous improvement of environmental water conservancy towards the process of informationization, through Internet access, big data, cloud computing, artificial intelligence, etc., the basis for the development of wisdom, is a benign circulation of the watershed, and improves the level of ecological environmental supervision road. In the early days of the cloud platform, the single-machine version of the water environment model is deployed in the cloud, and the conceptual breakthrough of the aqueous environment simulation and cloud computing platform is realized. With the development of data integration, data visualization, high performance computing[2], the main service development of the flood forecast is gradually mature, and some have been actually deployed, and its application is concentrated in a single short latte flood. Process forecast and flood level release. Perez et al[3] constructs a Tethematic flood forecast visualization platform to achieve a global wide range of binding forecasts. MURE-RAVAUD[4] built a multi-source data assimilation, hydrological model operation and information released by flood forecast cloud platform visualization system, providing a multi-city in France to Future 48H flood forecasting services. At this stage, the cloud computing, data visualization, the Internet of Things is provided for the construction of water quality regulation, urban management, atmospheric pollution monitoring, but existing research is more limited to frame design[5-6]. Manna et
al[7] proposed a cloud-based cloud intelligent irrigation system to enhance water saving and irrigation efficiency. However, relatively lack of local water, water ecosystem regulation and integrated management of cloud platform research, and its application should have multiple properties such as time performance, accuracy, stability, and convenience. This paper proposes a cloud platform-based cloud platform visualized water quality monitoring system, which is generally consisting of a detection end, data center, and control terminal. The water-ambient water ecological visualization management cloud platform is built, and the entire chain path from the top-level design to the experimentation is built to the actual application, which provides an effective solution for the difficulty of the local water body is difficult to realize real-time supervision.

2. System structure design

2.1. System overall framework
The water quality monitoring visualization system is mainly composed of three parts of the front-end measurement transmission, cloud service platform and application layer, and the overall framework of the system is shown in Figure 1. The measurement transmission portion consists of a signal base station near the water quality monitoring probe, 4GDTU and observation point. Monitoring probes can arrange real-time transmission of monitoring data in a water source that needs to be monitored, showing that the cloud platform uses Alibaba Cloud computing platforms, which provides security. Reliable data storage and computing services, and facilitate remote monitoring to provide technical support for various required application services. The application layer is primarily based on the BSD (Browser Server Date-base-server) architecture, the BSD architecture is shown in Figure 2, which constitutes a managed run window to realize the visualization of the data in the cloud.

![Overall framework of the system](image)
Application Integrated layer is a business module divided according to water quality data, such as water quality forecasting, data management, water environment, etc., while encapsulating platform applications in the platform, providing a unified user operating interface switching entry. The visual platform mainly includes: fast query, data retrieval, data processing and other functional components, used to provide a platform for application-based data exchange, analysis and other application services [8].

Figure 2 B/S/D architecture pattern diagram

(1) The Browser layer is in the user interface part, which is a medium that performs data traffic between users and systems. The part of the function is to check the data input by the user, display the data output from the system. When the user operates in the service layer, only the control information and data are required to be inspected and updated, and there will be no two layers.

(2) The Webserver layer is the core part that covers all the handlers, which can not only pass the data, but also process the data, and the layer is also responsible for checking the security of the system.

(3) The DatabaseServer layer is also the data service layer, which is functional to increase, delete, change, check, and other operations for the data of the database.

3. Water quality monitoring visualization system design

3.1. Development frame design
In order to build big data, large platforms, large integration, large-sharing information application patterns, the cloud platform visualization system is formed by cloud computing technology structures. Its technical architecture is logically divided into six layers: infrastructure layer, basic service layer, data resource layer, platform component layer, service support layer, and application. The monitoring cloud platform based on the cloud computing structure can meet its high demand in performance, scalability. The overall architecture map of the platform is shown in Figure 3.
Figure 3 Overall architecture of the platform

3.2. Programming Framework Design

Traditional cloud platform visualization systems are mainly used for front-end design using HTML5/CSS3/JavaScript. The backend development technology mainly uses JSP, servlet, and the like. The overall system frame structure typically uses the Javaee application architecture combined with Spring MVC and MyBatis. Since the water quality monitoring point will increase with the increase in monitoring range, the new monitoring point's data will continue to be entered into the database, considering the scalability and coupling of the system application, combined with the actual situation in the development, considering the scalability and coupling of the system application, combined with the actual situation in the development, The system architecture uses a framework that is integrated by Spring Boot + MyBatis + MySQL + CXF, which is a comprehensive lightweight framework that realizes various business functions of a specific water environment based on the architecture model of the system. The architecture has a good hierarchical mode, isolating the code dependence, easy development, low cost between layers and layers, will explain the core part of this design using the core part of the frame structure:

(1) Springboot frame: Springboot is an extension of the Spring framework, which greatly simplifies the process of Spring Application, development, and deployment, which provides the POM.xml configuration function to simplify the Maven configuration, as long as the configuration is configured by an annotation, Spring Boot is also automatically embedded in Tomcat containers, developers can pack the project into JAR packages through the "package" function, do not need to be deployed in the form of a WAR package.
(2) Persistent layer frame MYBATIS: Mybatis is an open source project of Apache, which is an excellent persistence framework that avoids almost all JDBC code and manual setting parameters and the process of obtaining result sets, you can use simple XML Or annotations to configure and map native information, map interfaces and Java's physical classes (PlainoldJavaObjects, normal Java objects) into records in the database.

(3) CXF Introduction: Apache-CXF is an open source WebService framework [9], CXF can be used to build and develop WebService projects, CXF integrate two mainstream WebService open source frames for CELTIX and XFire, with WebService high performance Good scalability, simple development, convenient deployment, etc. [10]. Using the CXF framework for WebService deployment, you need to configure the CXF framework in the configuration file to configure the requestor to intercept information in the method of configuring the CXF frame interceptor. The process of client access request service is shown in Figure 4.

![Figure 4 CXF Interceptor](image)

The web client sends a request to the server. After receiving the service request, the web service request forwards the WebService request to the CXF framework by configuring a configuration file in the network, and the CXF framework defines the interface according to the client and the server. Implemented by code, then the resulting result is fed back to the client [11].

4. System Visualization Implementation

4.1. Water Quality Monitoring Database Design
The platform uses SQLYOG software to create and edit the database. According to system requirements, the three databases are mainly designed, named, Experimental_Record, and Measured_Data, respectively, respectively, respectively, respectively, respectively, respectively, and experiment records, and real-time measurement data. The library admin contains ID, username, password, creat_time, update_time, name, tel, email, sex, and is_delete field, the function of the is_delete field is used for front-end delete information, but reserves record in the database original library, which can be mishandled recovery case where original data, database experimental_record contains id, title, progress, person, question, creat_time, update_time, note and is_delete field, library measured_data comprising id, creat_time, update_time, note, integral_time, cod, light_intensity, ph, temperature, and Wavelength field.

4.2. Web page front and back interaction
Two major modules are divided into the page development design, namely the front-end information show module and the background information management module. The main function of the front-end information display module is to provide information to the user, which is convenient to browse, which is rendered in the backend, mostly static text resources. The user front-end display page is implemented by Ajax technology, and the working principle of Ajax is similar to the addition of an intermediate layer (AJAX engine) between the user and the server, and the user action is asynchronous. Not all requests are directly submitted to the server. For example, the implementation of functions such as data authentication and data processing will be completed by the AJAX engine, and only when it is determined that the new data needs to be read from the server, then the Ajax engine is submitted to the server. The page is refreshed, simply, AJAX technology can realize updates to local web information and will not reload all the web pages, which is also an advantage over traditional web applications. Traditional web application models and AJAX works are shown below 5 and 6.
4.3. Data Transfer And Equipment Control

The visual platform measurement end data is uploaded primarily by 4GDTU, and the sensor connects 4GDTU through serial communication, and then uploads the measurement data to Alibaba Network through wireless transmission. Similarly, the front end control can also be implemented via 4GDTU, as shown in Figure 7 is a parameter such as the integration time, acquisition mode of the device in the front-end web page.
4.4. **Data Visualization**

The data visualization function module is used to realize real-time monitoring and display of water quality data information, providing the most intuitive water quality monitoring information. In response to the characteristics and demand analysis of various observative parameters such as turbidity, water temperature, COD, pH, etc., the platform uses trend graphs and cake maps, etc. to display real-time information of water quality. According to relevant national surface water quality standards, lake reservoir standards, etc., users judge the water quality and sensor measurement equipment of the monitoring area through the current data analysis, providing a reliable basis for subsequent water quality analysis. Figure 8 is a water quality monitoring visualization case interface.

5. **Data Analysis**

The design of water quality monitoring in this system is mainly based on Long Bill Law. The principle of measurement of Langbert-Bill's law, as shown in Figure 9. When the beam is transmitted to be tested, the degree of light absorbed is related to the concentration of water contaminants to be tested, and the
two are proportional to the relationship, which is also the theoretical basis for the quantitative analysis of water quality.\(^9\)

![Figure 9 Measurement schematic diagram of Lambert-Beer law](image)

The mathematical expression of Langbert-Bill's law is:

\[
A = \frac{I}{I_0} = aLC
\]  \((1)\)

Where: \(A\) indicate absorbance; \(I_0\) indicate incident light intensity; \(I\) indicate transmit light intensity; \(L\) indicate optical path length; \(C\) indicate Measuring the concentration of solution.

By collecting the light intensity data of the monitoring point, the water quality COD parameters of the monitoring point can be calculated directly in the cloud server, and the judgment according to the national "surface water environment (GB3838-2002)" standard is determined. Figure 10 Real-time measurement data for water quality monitoring points.

According to the actual operating feedback, the visualization system can implement real-time data display and historical data query, etc., and the system is stable, and the desired purpose of design is achieved, and all the functions of system design.

Users can also view real-time water quality information published by the provinces of the country through the query function of this system. Figure 11 is a national floor water quality monitoring real-time data.

![Figure 10 Real-time measurement data of water quality monitoring points](image)
6. Conclusion
This article is based on the Water quality monitoring visualization system for cloud platform, design and implement a visualization system for easy operation and conciseness. The system implements real-time display, historical queries, etc. of water quality monitoring data. This design system operates a concise interface, user-interacting interface is friendly, monitoring data in real time. The entire process from the measurement end to present the user is described in detail, and the various functions are tested. The test results show that the system is easy to operate, the measurement is stable and reliable, and the water quality data can be effectively visualized. It has achieved design expectations and has better market application value.

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