Design and Implementation of Harmful Algal Bloom Diagnosis System Based on J2EE Platform

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Abstract

According to the shortcomings which are time consuming and laborious of the traditional HAB (Harmful Algal Bloom) diagnosis by the experienced experts using microscope, all kinds of methods and technologies to identify HAB emerged such as microscopic images, molecular biology, characteristics of pigments analysis, fluorescence spectra, inherent optical properties, etc. This paper proposes the design and implementation of a web-based diagnosis system integrating the popular methods for HAB identification. This system is designed with J2EE platform based on MVC (Model-View-Controller) model as well as technologies such as JSP, Servlets, EJB and JDBC.

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1. Introduction

Algae are vitally important to marine and fresh-water ecosystems, and most species of algae are not harmful. However, a harmful algal bloom (HAB) can occur when certain types of microscopic algae grow quickly in water, forming visible patches that may harm the health of the environment, plants, or animals. HABs can deplete the oxygen and block the sunlight that other organisms need to live, and some HAB-causing algae release toxins that are dangerous to animals and humans. HABs can occur in marine, estuarine, and fresh waters, and HABs appear to be increasing along the coastlines and in the surface waters of China, as well as many other countries in the world. [1] [2]

Therefore, many countries arranged researched on formation mechanism, early warning, forecasting, preventing and controlling methods of HAB on different levels such as the fundamental research and high-technology development, which aims to establish operational monitoring system of HAB. In addition, identifying the dominant species of HAB rapidly and effectively plays an important role in automatic monitoring of HAB. [3]
And the traditional HAB diagnosis method is using microscope by the experienced experts which are time consuming and laborious, therefore, all kinds of methods and technologies to identify HAB emerged such as microscopic images [4], molecular biology [5], characteristics of pigments analysis [6], fluorescence spectra [7], inherent optical properties, etc. This paper proposes the design and implementation of a web-based diagnosis system integrating the popular methods for HAB identification. This system is designed with J2EE platform based on MVC (Model-View-Controller) model as well as technologies such as JSP, Servlets, EJB and JDBC.

2. The Design of HAB Diagnosis System

Functionally this project implemented an online HAB diagnosis system. This system used the modular design and included the following modules: the module of species’ information database, the module of identification & quantitative determination standard technique, the module of Harmful Algal Bloom diagnosis online, the module of the study of Harmful Algal Blooms and detect material service center and the module of system management. The following figure 1 provides a picture about the system function structure.

2.1 Database of Alga Apecies’ Information

This module integrated databases of algal species, images, funded retrieval, molecular fingerprint, pigment, fluorescence spectrum, standard material and constructed searchable database of alga species’ information for comprehensive research and harmful red tides monitoring and management, provided the omni-directional support.

2.2 Identification and Quantitative Determination Standard Technique

The module Integrated various appraisal and testing technology, carried on the standardization, studied the characteristics and advantages and application method (temporal-spatial scales and accuracy), the combination pattern of selection, etc.

2.3 Harmful Algal Bloom Diagnosis Online

Combined with "database of alga species’ comprehensive information" and " Identification and quantitative determination standard technique " , established a data acquisition and diagnosis system based on Web, which can provide remote analysis and processing according to the monitoring data according to the regulations.
2.4 The Study of Harmful Algal Blooms and Detect Material Service Center

Based on network information technology, provided "one-stop" material supply virtual center for users. In accordance with the requirements of business, optimized the links such as preserve, package and transportation of base material of alga species, cyanobacteria toxin standard material, molecular diagnostic identification. Conveniently provided basic experimental material for national related departments and researchers.

2.5 Management System

The diagnosis system has functions as follows:

User management: this module manages all user’s information with the functions of add users, delete users, modify users, reset user’s password, set user’s roles and query the user’s information.

Role management: according to the function of the system modules, this module set up the different roles manage different modules, easy to authorized users.

Sector management: this module manages the departments which use this system, it has the functions such as add sectors, delete departments, modify department’s information and query the department’s information.

Module management: this module manages the system’s directory tree, make it easy to manage the functional modules. It has the functions such as add a module group, modify module, delete module and
change the display order, etc.

3. The Implementation of HAB Diagnosis System

3.1 The Architecture of HAB Diagnosis System

A classical J2EE application structure includes four tiers: Client tier, Web tier, Business tier and Enterprise information system tier (EIS tier). Client tier can be web browser, applet or other applications. It always support the HTTP protocol so that it also called client agent. The second tier and the third tier here are called by a joint name-Middle tier. They are deployed on Application Server, implemented by some normative J2EE groupware such as JSP, Servlet and EJB etc. EIS tier is mainly applied to the management of enterprise information frequently. [8] Then the paper narrates the technologies provides by J2EE which are applied to the system in detail as follows. For the HAB Diagnosis System structure shown at Figure 2, the Servlet and JSPs are used to the web client request.

3.2 The Implementation of HAB Diagnosis System

The MVC architecture maps the traditional input, processing, and output tasks to the graphical user interaction model. However, it is straightforward to map these concepts into the domain of multi-tier enterprise applications. The model represents enterprise data and the business rules that govern access to and updates of this data. The view renders the contents of a model. It accesses enterprise data through the model and specifies how that data should be presented. It is the view’s responsibility to maintain consistency in its presentation when the model changes. The controller translates interactions with the view into actions to be performed by the model. In a stand-alone GUI client, user interactions could be button clicks or menu selections, whereas in a Web application, they appear as GET and POST HTTP requests.

Struts is a free OpenSource J2EEWeb layer of application architecture, it inherits the MVC framework, including the properties, help and customization of JSP tags, and all J2EE Model2 design model based on the application of technology. The goal is to fully reduce component of a enterprise Web application. When the client makes a request to the system, the Servlet handles the request and deliver the request to the business access interface component. In the meantime, the Servlet dispatches the corresponding JSP view to the user. The JSP view gets the view content returned by the business access interface component which calls the business services provides by the business tier.

3.3 Integrated Development Environment (IDE)

We choose MyEclipse + Eclipse as the integrated development environment. An Eclipse is open source for Java development of free open source framework, has a lot of user groups and powerful third-party plugin integrated ability, can quickly developed J2EE application. MyEclipse is the collection development of Eclipse platform, can easily plugins add Struts, for Java engineering support to Hibernate and are automatically generated Hibernate configuration files and Object Relational Mapping files, support for Web Service configuration of Struts visualization development.

4. Conclusion

The Diagnosis System of Harmful Algal Blooms is designed using MVC model and EJB components of J2EE Platform. With high performance, high scalability and high safety features, this model will
isolated business logic from display pages, simplified system development, management and maintenance, improved the system efficiency and reflected the excellence advantage of J2EE technology. This system integrated the popular methods for HAB identification. Marine environment monitoring center at all levels could make use of this system to identify the red tide in real-time and provide some technical supports such as early warnings and forecasts to the decision-makers before the red tides appear.

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References

Figure 2. J2EE structure of HAB diagnosis system