Design and Implementation of Remote Data Exchange System for Celestial Tracking Observation

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**Abstract.** In the process of astronomical research, interaction of remote data is needed during celestial tracking and observation, and the system described in this paper has achieved this goal. There are three different roles in the system: task makers, observers, and data analysts. The task maker releases information about the celestial objects to be measured, and the observer records the logs online and updates them in real time. The data analyst can process data, analyze the results and publish them. The system realizes remote and real-time tracking of candidate celestial bodies conveniently and quickly. In this paper, key technologies used in the system are briefly introduced, and the analysis and design of the system are rendered by UML. Finally, the implementation and operation of the main functions of the system are described. After a period of practical application, the system runs stably and efficiently, and has reached the goal of tracking observation of candidate celestial bodies and remote data exchange, which achieved the anticipated effects.

1. Introduction

Remote data exchange system for celestial tracking observation serves the project "screening rare celestial bodies and variable source candidates with LAMOST data" supported by National Natural Science Foundation of China. In this project, we need to realize the interaction and management of data about the celestial objects to be measured between three locations. First, the LAMOST releases information about objects to be observed, and the staff there can publish their observations and comments on the subject. Then, observers use the observatory at the university to track observations, release and manage the observation logs, and finally analysts process the data and publish the results. The data need to be transmitted frequently in Beijing and Weihai, which is very inconvenient. Therefore, it is urgent to develop a system to solve this problem.

The main goal of this system is to realize the remote tracking of objects observed and the interaction of data from observations. The publishers of the celestial bodies, celestial observers and the personnel of data processing can exchange data conveniently and quickly, and greatly improves the timeliness of the data.

The users of this system can be roughly divided into four categories: celestial publishing personnel, celestial observation personnel, data processing personnel and super administrators. Different types of users have different permissions.

Publishing personnel can publish and manage detailed information about objects to be observed, give comments on the plan of observation, and export detailed information, records of observation and data processing. Observers are people who can manage observation logs, give comments on observations plan, and export the same information as the publish personnel can export. Data processing personnel have permission to manage data processing and record logs, and also can give comments and export information like the two types of users mentioned earlier. The super administrator has all permissions and manages information about all other roles.
2. Techniques Adopted

JSP. Java Server Pages released by Sun Microsystems is a technology that helps software developers respond to requests of clients, and create dynamically generated Web pages based on HTML, XML, or other document types[1]. It uses Java as scripting language, and its Web pages provide an interface for the entire Java library in server to serve HTTP applications. JSP allows Java code and certain pre-defined actions to be interleaved with static Web markup content, such as HTML, with the resulting page being compiled and executed on the server to deliver a document, and its tag library provides a platform independent approach to extending server performance[2]. In this system, JSP is mainly used as the display layer, which is responsible for displaying and interacting with the user directly.

Servlet. Servlet is a Java application on server-side that is platform and protocol independent, and it’s for generating dynamic Web pages[3]. It acts as the middle tier of client requests (Web browsers or other HTTP client programs) and server responses (databases or applications on the HTTP server). Located inside Web servers, different from the traditional Java application starting from the command line, servlet is loaded by the Web server, and the Web server must contain a Java virtual machine to support servlet. In this system, servlets act as controllers, accepting requests and processing requests.

MySQL. MySQL is a small relational database management system[4], developed by Swedish company MySQL AB. Acquired by Sun company in January 16, 2008, it now owned by Oracle Corporation. MySQL is now widely used in small and medium sites on Internet for its small size, fast speed, low cost, and especially the open source spirit[5]. Therefore, it is used as the database to store data in the system.

3. Analysis and Design of the System

Module differentiation. According to the demand, Remote data exchange system for celestial tracking observation is divided into four modules as follows.

1) Information release and management module. Authenticated publishing personnel can publish and manage information about celestial objects, give comments on the plan of observations, and export detailed information, records of observation and data processing in the form of Excel.

2) Observer management module. After celestial objects to be observed are released, tracking observation is carried out by celestial observers according to the plan of observations provided by the publishing personnel and the indicators used during observations. After logging into the system, observers can publish their logs and results online for other people to use, and they also can give and manage their comments on the plan of observations, and export detailed information, records of observation and data processing in the form of Excel.

3) Data processing management module. Data processing personnel can carry out processing and analysis according to the observation data from observers, upload processing results to the server, and record logs of data processing and results. They also have the permission to release and manage their own comments on observations, and export celestial information, observation logs and data processing results in the form of EXCEL.

4) Detailed information management module for roles. The users of this module are super administrator. All roles in the system are managed by super administrators. Super administrators can change the relevant information and have the privileges of all other users.

The specific system module is divided as shown in Figure 1.
Design of database. The database of the system consists of seven tables, as shown in Figure 2.

4. System Implementation

The system uses B/S structure, deployed in the Linux, Apache Tomcat 6 server, can operate normally on IE5 or above and Mozilla Firefox. The database is deployed on MySQL5.0. JDK1.5 or above is needed to be installed in the running environment.

The main interface of the system is shown in Figure 3.

After the publishing personnel log in, the upper left corner changes, showing User: pan1 Logout | Modify Password that can be used to exit the system and modify the password. Click on the small red "++" will enter the page for adding celestial information. Click on the ID in the column of Target will pop up the page for modifying the information of what you choose. Click on the red fork will delete the record. In the column of Obs Schedule, -note (1) is for giving comments on the plan of observations. The symbol of "color pen" is for managing your own comments, and the download tag in yellow is used to export detailed information, records of observations and data processing in the form of Excel.
After the observer log in, the pages displayed are almost no different from what the publishing personnel get, except that part of the functions is blocked and its own permissions are added. Click on the ID in the column of Target will pop up a dialog box for adding logs of the observation, and you can only manage logs that you own add. Other features are the same as functions of the publishing personnel.

As for the data processing personnel, if they click on the ID in the column of Target, it will pop up a dialog box for adding results of data processing. The page of adding results of processing can release logs of data processing and corresponding results, and you can only manage what you own added before. Other features are the same as functions of the publishing personnel.

In detailed information management module for roles, super administrators after authentication gets a list of users by clicking User list, maintain information by clicking Edit, create a new user by clicking Add user, and what's more, they have the functions of all other users.

The operation interface of the system is shown in Figure 4.
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