Laboratory chemical reagent management system based on Hadoop framework

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Abstract

At present, high-risk chemicals in many chemical laboratories are randomly transferred, stored and placed. Many mismanagement problems have led to some serious dangerous accidents. Through strict and efficient management in the transfer link, the probability of this problem can be reduced from the root, and the personal and property safety of laboratories and testers can be effectively protected. The system includes seven modules: user login module, application initiation module, approval return module, feedback information module, data statistics module, warehouse processing module and identity management module. The system is based on big data technology and uses Hadoop platform to store data. The back end uses SSM framework to horizontally layer the system, making the system structure clear. The front end uses HTML5 and JavaScript to complete page design and data verification.

Keywords

Chemical reagent, Hadoop framework, Laboratory, Spring + Spring MVC + MyBatis (SSM), JavaScript.

1. Introduction

Many of the chemical reagents often used in chemical laboratories have high risk and pollution. At present, many pharmaceutical companies and laboratories do not have an efficient and safe management model and pay little attention to the management of high-risk chemicals [1-2]. For overcoming this problem, this paper designs and implements the laboratory chemical reagent management system to strengthen the protection of some high-risk chemicals and the management of users at the management level. The design of the system is based on the following five characteristics, convenient system operation, separation of call and return business, providing feedback submission channel, limiting the number of applications, and strict user data management.

2. Requirement analysis

Some reagents used in the laboratory have different characteristics from other general articles, including large quantity, high threat, difficult preservation, classification and so on. These characteristics determine that the management of chemical reagents is different from other general articles, and the requirements for safety and reliability are higher. After analyzing the current situation of the management system of some pharmaceutical enterprises, the chemical reagent management system needs to have the following functions.

2.1 Easy to operate

The frequent calling of chemical reagents is a very common phenomenon in the Research Institute. It can be said that every experiment every day is inseparable from the calling of different chemical reagents. It is also inevitable that there are still residual reagents after each use, which leads to reagent data operation at least twice in each experiment. If the operation of calling reagent each time is too cumbersome, it will seriously affect the work efficiency. Therefore, convenient operation is the basic requirement of chemical reagent management system.

2.2 Separate the rent and return business

Some reagent management systems rent and return two parts of data at the same time, which leads to the current situation that the application can only be submitted after the reagent is used, which affects the accuracy and reliability of the data. Therefore, the call application and return application are divided into two independent operations, which is an important step to standardize the use of chemical reagents and the only way to improve the data quality of the management system.

2.3 Effective feedback channel

In many enterprises, the management mode is rigid, the vertical information channel is blocked, and the laboratory operators cannot provide feedback information to the upper personnel in time after discovering the problems of reagents, resulting in waste and pollution of chemical reagents and even safety accidents. Therefore, providing a stable feedback channel is of great significance to improve management efficiency and safety guarantee. It is an indispensable part of reagent management system.

2.4 Limit the number of applications

Due to the unidirectional nature of the application behavior, the same administrator may have to process a large number of application forms, which greatly increases the possibility of errors in the processing process. The applicant's wrong operation will lead to data redundancy in the application form, which will bring unnecessary trouble to the server and managers. Limiting the number of applications can effectively improve the seriousness and inspection times of the applicant when filling in the application, and try to ensure that each application is completed in strict accordance with the filling specifications.

2.5 Strict user management

Many chemical reagents used in the laboratory have strong risks. If the strictness of user data management does not meet the corresponding standards, serious problems may occur in the reagent management process. Therefore, the user data of pharmaceutical enterprises and research institutes must be imported from the inside, and the general administrator of the system shall conduct macro-operation on the user data, so as to eliminate the possibility of damage to the database caused by illegal users at the source by closing the external registration channel.

3. System design

3.1 Outline design

According to the demand analysis, the system divides users into administrators, warehouse administrators, call administrators and ordinary users. In terms of functional areas, the system can be divided into seven parts: user login module, application initiation module, approval return module, feedback information module, data statistics module, warehouse processing module and identity management module.
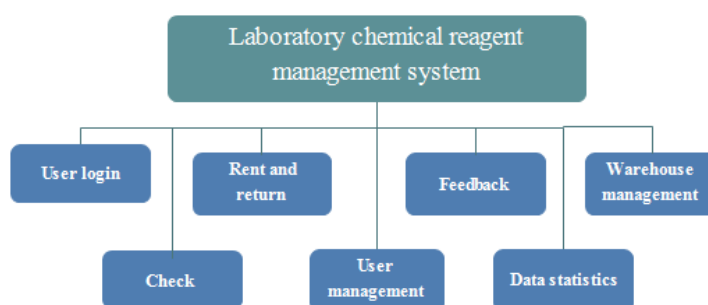

Fig. 1 System architecture

3.2 Module design

3.2.1   User login module

Many chemical reagents used in the laboratory mentioned above are highly dangerous. If the strictness of user data management does not meet the corresponding standards, serious problems may occur in the reagent management process. Therefore, the user data of pharmaceutical enterprises and research institutes must be imported from the inside, and the general administrator of the system shall conduct macro-operation on the user data, so as to eliminate the possibility of damage to the database caused by illegal users at the source by closing the external registration channel.

3.2.2   Rent and return module

The user initiates the application and submits the call to the administrator. Call application includes laboratory, reagent type, storage warehouse, current remaining quantity of applied reagent and applied quantity. After the application is submitted, the calling administrator selects whether the application is successful or failed. When an accident or accident occurs, the specific person in charge and operator can be retrieved by querying the specific table. When an application is initiated, the background automatically generates an application information log to record the call application information.

3.2.3   Check module

The administrator handles all user requests. The administrator can request or reject the user's request through the user.

3.2.4   Feedback module

During use, users can submit feedback information to administrators. The information that can be included in the feedback is very important. There are many problems related to chemical reagents encountered in the laboratory, which cannot be fed back to the management personnel, and eventually waste the experimental products or delay the experimental progress, or even cause serious accident consequences.

3.2.5   Data statistics module

For data statistics, you can select any two dates to make statistics on the synthesis of reagent data classified by laboratory or reagent type between the two dates. This function can help managers visually view the specific quantity of various reagents used in each laboratory, so as to find problems.

3.2.6   Warehouse management module

The administrator, calling operator and warehouse administrator can process the warehouse. Its functions shall include reagent warehouse in management, reagent warehouse out management and reagent warehouse transfer management. The essence of reagent transfer is the combination of reagent delivery and reagent storage.

3.2.7   User management module

The administrator can add, delete, modify and query the data of other users, including calling operator and warehouse operator. The only way to import user data reserved in advance at design time only exists in the identity management module of the administrator. The administrator directly imports user data at all levels, including operators, from the background, so that the user data can be entered when the registration channel is closed.

3.3 Data storage

HDFS, the core component of Hadoop, realizes data and storage management in distributed computing.
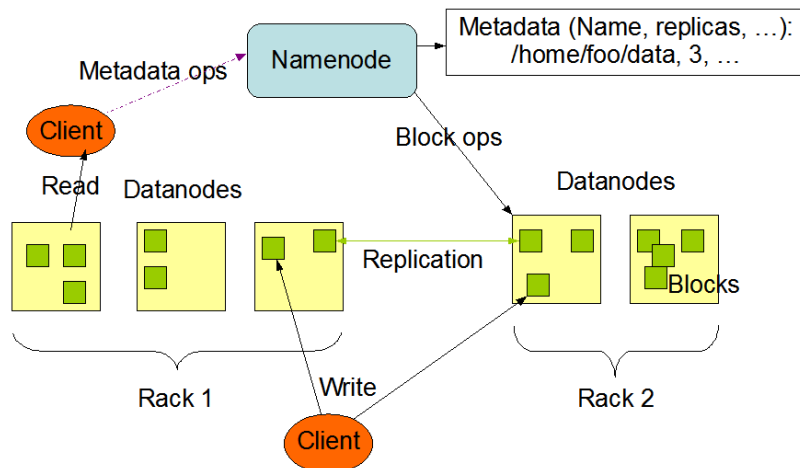
Fig. 2 Hadoop storage framework

It has the characteristics of high error tolerance, high reliability, high availability, high scalability and high throughput [3]. The platform calls the API interface of HDFS to realize various operations such as file reading and writing [4]. In order to ensure the authority of borrowing and return, all borrowing and return processes need to take photos for retention. Photos and other system files are stored on the HDFS cluster to ensure the reliability of data.

4. System implementation

The system development adopts SSM (Spring + spring MVC + MyBatis) framework to realize MVC mode, and integrates Ajax and ECharts library to realize page display [5-6]. The user sends a request and judges the permission through the permission interceptor. The request of the authorized user will be forwarded to the dispatcher servlet, the core component of spring MVC. Configure the directory where the controller is located in spring.xml, scan all Java class annotations in the directory, and obtain the matching relationship between the controller and the access path. According to the matching relationship between the access path and the controller, the DispatcherServlet will call the methods of the corresponding controller. The controller returns the view or JSON data according to the business layer. For example, if users borrow chemical reagents, they will first determine the user's permission, enter the control layer of the authority, match the corresponding business according to the annotation, then call the database and save the data to return to the view.
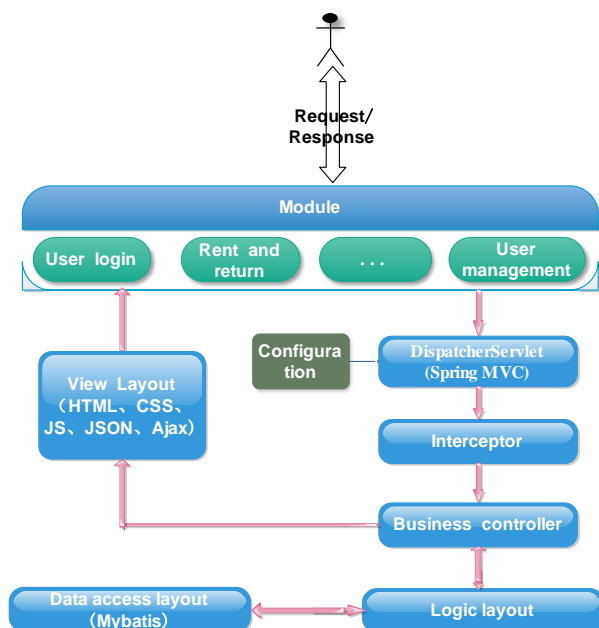

Fig 3 Business execution flow chart

5. Conclusion

This paper completes the development of laboratory chemical reagent management system through the steps of demand analysis, function design and system implementation. Key technologies such as SSM framework and JavaScript are used in the development process, and a concise and clear user interface is designed. Combined with the characteristics of large quantity, high threat, difficult preservation and classification of chemical laboratory reagents, all aspects of the management system are improved.

Acknowledgements

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