

Intelligent Optimization Platform for Biological Fermentation

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Abstract: This system is suitable for use in general biological fermentation companies for scientific research tasks and cultivation and fermentation scenarios. The bio-intelligent fermentation platform based on Java uses Vue technology for the front end, with the primary programming language being Java and the backend database being MySQL and This system has implemented real-time monitoring based on different user needs; Data management; Early warning and alarm; Fermentation formula management; Laboratory management; This system provides great assistance in simplifying operations and achieving informatization for traditional biological fermentation companies, and can achieve the goal of improving production efficiency.

Keywords: Java, Biological intelligent fermentation platform, MySQL database, system design.

1. Introduction

1.1. Background

With the flourishing development of biological fermentation technology and computer networks, today's intelligent biological fermentation has evolved into an integrated computer network technology, computer communication technology, information processing technology, and data processing technology. Having multiple processing capabilities for information or data. An efficient and technological computer system is used to assist researchers in management.

Therefore, with the development of technology, biological fermentation should be based on network technology to achieve macro level regulation, utilizing the interdisciplinary knowledge of computer science and bioengineering, optimizing the biological fermentation process through intelligent algorithms, improving production efficiency, reducing production costs, and improving product quality [1].

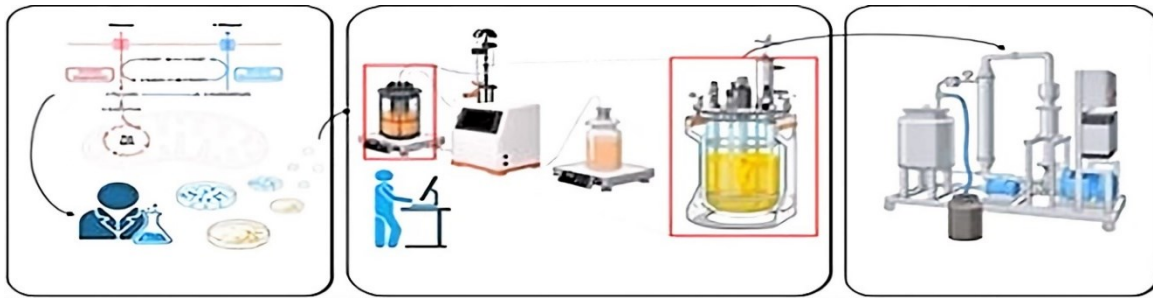


Figure 1: Schematic diagram of the biomanufacturing industry chain

There are many bios intelligent fermentation systems in today's market, and most of them use C/S architecture. These systems are limited by specific operating system environments and have poor portability and practicality. In addition, these systems have security issues in terms of permission verification, menu visibility, and data manipulation. Therefore, for most biological fermentation units, the best choice would be a lightweight and independently deployable biologically intelligent fermentation system

1.2. Current research status at home and abroad

1.2.1. Domestic development status

In China, some universities and research institutions have developed intelligent optimization platforms for biological fermentation based on Java, which are used for data analysis, optimization, and control of biological fermentation processes. [2] These platforms typically combine artificial intelligence, machine learning, and optimization algorithms to achieve real-time monitoring and regulation of biological fermentation processes, improving the efficiency and quality of fermentation production [3].

1.2.2. Current Development Status Abroad

Taking LabVIEW, developed by National Instruments in the United States, as an example, it is an operating environment for integrating virtual instruments in laboratories. LabVIEW is currently the fastest developing, most widely used, and most powerful graphical software development integration environment. Both the industrial and academic communities have universal recognition and unanimous praise for this integrated environment.[4]

2. Main application technologies

The biological intelligent fermentation system uses IntelliJ IDEA as the integrated development environment (IDE) and runs on the Windows 10 operating system. The backend development mainly uses Java language, version 1.8 of the Java Development Kit (JDK) [5]. The database part uses MySQL database, with a specific version of 5.7.34. The front-end technology adopts the latest version 3 of Vue.js. The overall architecture design follows the B/S (Browser/Server) architecture pattern, where the client is primarily responsible for displaying the user interface, while the server is responsible for data processing and business logic.

3. System analysis

3.1. System requirement analysis

By studying other excellent biological intelligent fermentation systems, the system users are divided into three categories: ordinary users, expert users, and system administrators. This section mainly analyzes the requirements of the system through the analysis of the main functions, scenario diagrams, and use case diagrams provided by the system for users

3.1.1. System Use Case Diagram

The requirements analysis section mainly focuses on the classification of users using the system, the functions required by users, and the daily maintenance of the system.

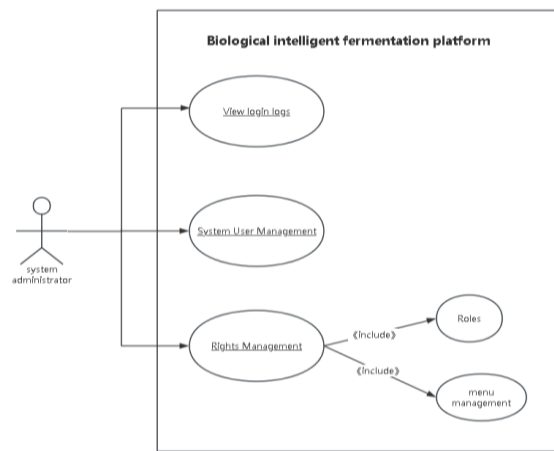


Figure 2: Expert User Use Case Diagram

Expert users. You can upload, manage, and view data related to biological intelligence optimization, including experimental data, model parameters, optimization results. As for Ordinary users. This type of user has the lowest level of permissions and can only view basic information during the fermentation process

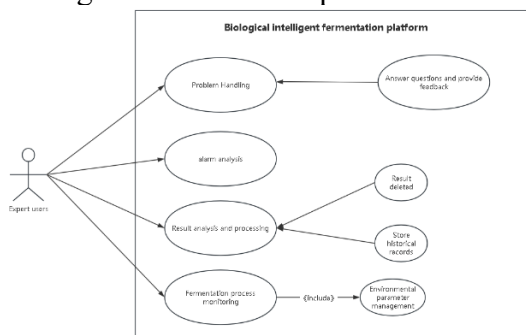


Figure 3: Expert User Use Case Diagram

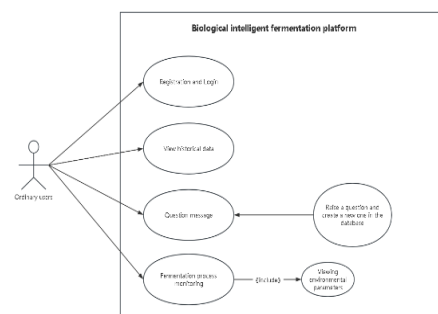


Figure 4: Common User Use Case Diagram

4. System Design

4.1. System User Management

All user-related operations within the system must be carried out through the system administrator. The function of this module is to add basic information of system users, such as username, contact

information, user role, and password, displayed in non-plaintext. The system administrator can modify and delete this information as necessary and can also disable and enable system accounts while retaining their basic information. The flowchart of this module is shown in Figure 5.

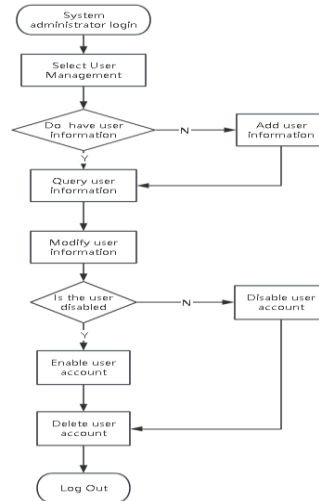


Figure 5: System User Management Flow Chart

4.2. Role - Menu Management

Users within the system are divided into different roles based on their access permissions to menus and data operations. For example, expert users and regular users cannot access the system user management menu. Regular users do not have operational permissions for data and only have viewing permissions, while expert users have modification permissions for data within the system. System administrators can assign permissions to these roles, and the role management flowchart is shown in Figure 6. The system administrator can manage all menus and submenus within the system, setting their names, access paths, and icons. The menu management flowchart is shown in Figure 7.

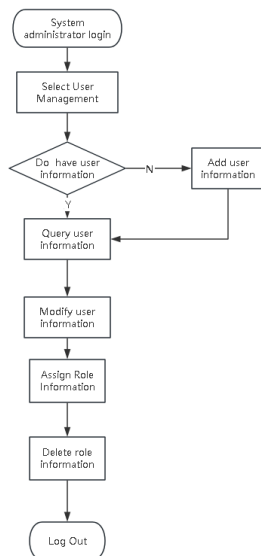


Figure 6: Role Management Process Diagram

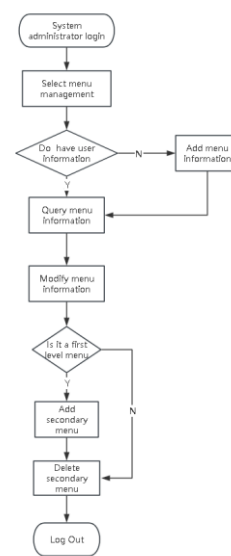


Figure 7: Role Management menu management flowchart

4.3. Database design

According to the above system requirements analysis, the system uses the relational database MySQL to store persistent data. Due to the functional requirements of the biological intelligent fermentation system, MySQL database will be used for data storage and processing. Through My Batis dependency, Java-based projects can connect to local MySQL services through IP and port, allowing direct access and manipulation of database tables through code. The database mainly stores basic information for regular users, expert users, system administrators, announcements, work orders, and system configuration variables.

Table 1: List of database table names

number	Chinese table name	English table name
1	发酵_数据	fermentation data
2	发酵_反馈	fermentation feedback
3	发酵-参数	fermentation data
4	发酵记录	fermentation record
5	登陆表	Sys login Infor
6	建议表	suggestion

5. System Implementation

The system has implemented the ability to add expert users, regular users, and other system administrators to the system, initialize the information of new roles, add and delete system menus, and manage menus for different permission roles. It can also upload, manage, and view data related to biological intelligence optimization.



Figure 8: Results Display

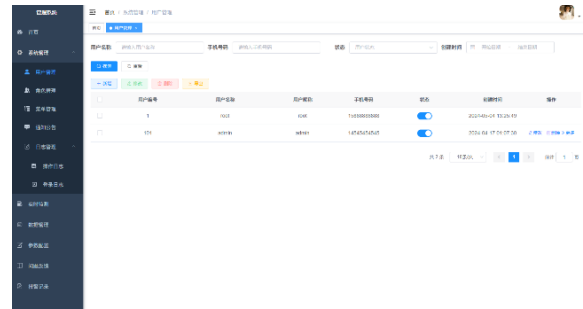


Figure 9: Results Display

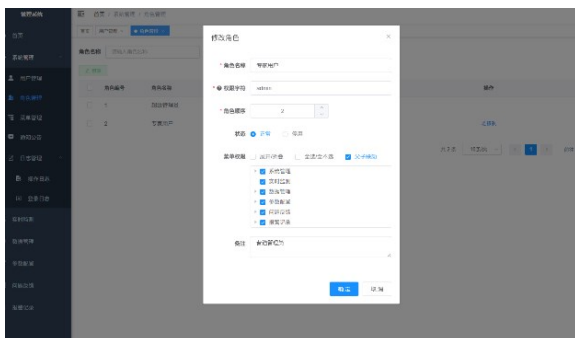


Figure 10: Results Display

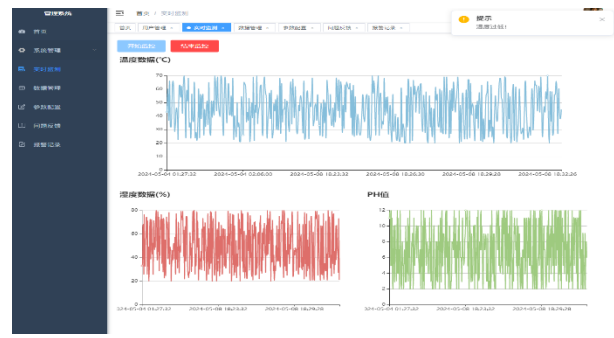


Figure 11: Results Display

6. Conclusion

The use of a bio intelligent fermentation platform means that the biotechnology industry will also move towards standardization and clarity in the process of participating in system development, I have accumulated rich knowledge of Java programming and proficiently mastered how to interact with MySQL backend databases, as well as a deep understanding of the use of the Struts framework.

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