Analysis and Design of Training Room Reservation Management System Based on SSH Framework

Ting Wang¹ and Chuanfeng Bie²

¹ Department of Mechanics and Electronics, Wuhan Railway Vocational College of Technology, No. 1, Canglong avenue, Jiangxia district, Wuhan, China
Email: 1419985334@qq.com

² Hubei Academy of Scientific and Technical Information, No.2 hongshan road, Wuchang district, Wuhan, China
Email: 272978472@qq.com

Abstract. In order to improve the management and service quality of the training room, we designed and established a reservation management system to solve the problems in manual reservation management. These problems included low reservation efficiency, information asymmetry of whether the training room was free or not, inability to uniformly manage the data of all training rooms, and so on. In this paper we analysed the functions of the system, and designed the system’s business process, database, system architecture, etc. The training room reservation management, reservation record timeout processing, user role authority management, query and statistics and other functions were realized. The construction and application of the system had transformed the training room from paper-based reservation management to online reservation management, which improved the efficiency and specification of the training room reservation management.

1. Construction Background
The rapid development of information technology has brought about the reform of education and management mode. With the continuous expansion of the school scale and the continuous improvement of teaching management demand, it is an inevitable trend of teaching reform to realize the networking and intellectualization of teaching management by the advanced information means. As the main place for experimental teaching and the most important teaching part of the whole teaching system of vocational college, the training room provides a practical base for cultivating students’ working quality and exercising their practical working ability, as well as a good condition for students to carry out competitive activities [1].

The increasing utilization rate of laboratory equipment in colleges brings great challenges to the service and laboratory management [2]. At present, our school has built more than 200 vocational skill training rooms. The management mode of the training room is as follows: The teacher makes an appointment by phone or in the training room. The training room administrator manually records the reservation information in the appointment book, and then assigns the training room according to the specific content and time of the teacher's application. This manual reservation management method has problems, such as low reservation efficiency, information asymmetry of whether the training room is free or not, and unable to manage the data of the training room uniformly throughout the school. For the above problems and contradictions, the original management model has been far from meeting the needs of reality. In order to complete the training task of the school, it is necessary to make full use of the campus network resources and apply the information technology to the management of the training
room. This management method will improve the reservation efficiency of the training room, coordinate the user's appointment time, and facilitate the maintenance and management of the administrator [3]. Therefore, based on the campus network and system construction, we developed a set of training room reservation management system to solve the dilemma of reservation queuing, and improved the efficiency of training room reservation and management.

2. Requirement Analysis

The construction of the system should cover all the training rooms of the school horizontally, and vertically cover the business support of teachers, training room administrators, department administrators and school-level users, so as to realize the reservation management of all the training rooms. The system functional structure is shown in Figure 1.

![Diagram](image)

**Figure 1.** System Functional Structure

2.1. Functional Requirements of Teachers

As the main service object of the system, the teacher is responsible for making an appointment for the training room of the class. After the appointment is successful, the teacher will inform the students to come to the training room to do practical training at a fixed time. The teacher or the administrator of the training room will give guidance to the practical training content of the students. Therefore, the functions of teacher users include reservation, cancellation, improvement of reservation information, query of reservation records, etc.

2.2. Functional Requirements of the Training Room Administrators

The training room administrator is an important part of the teaching and scientific research team of the school. He is responsible for the daily maintenance and repair of instruments, equipment, tools and materials, as well as the maintenance, repair and testing records. When necessary, he shall assist the teacher to make all preparations in advance, including the preparation of instruments, equipment and other auxiliary materials. After the teacher's appointment is successful, the administrator of the training room can prepare training equipment and materials in advance by inquiring the appointment record of the training room. In special cases, the administrator can also allocate the appointment record of the teacher.
2.3. Functional Requirements of Department Administrators and School-level Users

The department administrator manages the training room information and the user accounts of the training room administrators and teachers; they are responsible for allocating the administrators to the training room; they can flexibly allocate the administrators when the training room administrators take leave or leave their jobs. At the same time, they can query the frequency and period of appointment of the training room.

School-level user needs to know all the appointment and management data of the training room, including the information of the training room, the number of appointments and the utilization rate.

2.4. Functional Requirements of System Administrators

The system administrator mainly manages users, roles, permissions and logs in the system, and initializes the operating parameters of the management system, including term parameters, calendar, department management.

3. System Business Process Design

Business process is a series of customer-oriented activities accomplished by different people in a period of time to achieve specific value goals [4]. Therefore, in order to clarify the responsibilities and functions of different user objects, we designed the business process of the system according to the demand analysis of the system, as shown in figure 2.

![System Business Flow Chart](image-url)

**Figure 2. System Business Flow Chart**
1) The system administrator adds the school calendars of the current semester, sets the total number of weeks and the corresponding date to Monday in the first week, and initializes the account of the department and the department administrator in the system.

2) The department administrator manages the accounts of faculty members, maintains the basic information of the training room owned by the department, and assigns administrators to each training room.

3) The training room administrator manages the opening date, inquiries about and allocates the reservation record. The management of opening date is that the training room administrator sets the opening date of the training room managed by himself according to the school calendar. The appointment record query is the appointment record of teachers inquired by the administrator of the training room, and the query result is presented in the form of class schedule. The class, name, equipment and materials required for the training and other appointment information are included in the class schedule. The administrator can quickly master the relevant information and make preparations in advance by looking at the class schedule. Reservation allocation management refers to that when the teacher's appointment operation is successful and the teacher is unable to cancel the reservation. After the offline communication between the teacher and the training room administrator, the training room administrator rearranges an appointment date for the teacher or cancels the appointment record in the system.

4) The reservation is one of the most important functions of the system. The teacher first selects the training room and the week to be booked. The reservation schedule is dynamically generated in the system according to the opening date and appointment record of the training room. The teacher locks the required appoint time in the course schedule. After locking the time, the teacher needs to complete the appointment information within 24 hours, that is, to fill in the training content, class, required tools and equipment and other information, and to submit the appointment later. If the reservation information is not completed within 24 hours after the reservation is locked, the system will automatically cancel the locking due to timeout, and then the date can be used for other teachers to make an appointment.

4. System Architecture Design
The B/S structure system based on J2EE and SSH (Struts 2 + Spring + Hibernate) framework was adopted in the system. SSH framework is a popular open source framework for web applications at present. Struts is used to realize MVC separation of the system. As the infrastructure of the whole application system, Struts is used to coordinate the business jump for the model. The persistence layer is primarily captured by the Hibernate framework. As the administrative centre, The Spring framework is used to coordinate the normal operation of Struts and Hibernate [5]. The JSP, HTML, CSS, jQuery EasyUI, JavaScript and other technical means were used to achieve human-computer interaction functions in the system interface. Oracle relational database system was used to store data. Tomcat was used as a container for the system, which could be deployed on Windows or Linux servers.

The system architecture design is shown in Figure 3. In the Web presentation layer, the interaction interface is implemented by JSP pages, which is responsible for receiving requests and transmitting responses. Then Struts delegates the requests received by the Action Servlet to the corresponding Action processing according to the configuration file. In the service business layer, the Spring container that manages the service components is responsible for providing the business model components and the collaboration object data processing components to the Action to complete business logic, as well as providing container components such as transaction processing and buffer pool to improve system performance and ensure data integrity. In the persistence layer, data persistence depends on Hibernates object mapping and database interaction. The basic CRUD operations area encapsulated by BaseDao interface, which process the requested data and returned the processing results.
5. System Database Design

According to the analysis of the system business process, 15 tables were involved in the system. The most important data tables were the training room information table, reservation record table, opening date table, term table, school calendar table, department table, user table, role table, module table, authority table, etc. The E-R relationship of some entity is shown in Figure 4.

6. The System Function Realization and Key Technology

6.1. Reservation Function

Reservation function was one of the core functions of the training room reservation management system. Its main business logic was as follows:

1) The administrator of the training room installed the opening date of the training room according to the school calendar.

2) After searching the training room of the department, the teacher selected the teaching week that needed to be reserved. The reservation schedule was generated in the system according to the opening date of the training room, class hours, and the record of excluding the reserved and locked classes, as shown in Figure 5. In the reservation schedule, there were 7 reservation states, and the meanings of each state were as follows:

   - ‘Expired’ and ‘Not open’ mean that the time period cannot be reserved.
   - “Booked” and ‘Locked’ mean that the time period has been booked or locked by other teachers and cannot be booked.
   - “Lock” means that the time period can be reserved. Click “Lock” to enter the state of ‘Perfect information, Unlock’.
   - ‘Perfect information, unlock’ means that the reservation has been locked, but has not filled in the
reservation information. Click "perfect information", fill in the reservation information and submit it, then the reservation is successful. Click "Unlock" to cancel the reservation.

"Modify information, cancel reservation" means that they have been successfully booked. Click "modify information" to modify the training name, training required materials and other relevant reservation information, click "cancel reservation" to cancel the appointment.

3) The training room reservation should be made at least 24 hours in advance. The teacher made "lock" in the course schedule to be reserved. The reservation was successful after the teacher improved the reservation information. If the booking information was not filled in within 24 hours after locking, the booking record was automatically cancelled by using a timer in the system, and the time period was available for other teachers to make an appointment. At the same time, the locked time period can be cancelled by himself. However, the teacher could cancel the reservation at least 24 hours in advance after successful booking.

From the above description, the key process of reservation was to generate the reservation timetable dynamically according to its business logic. The key steps were as follows:

1) JavaBean, which was used to store the lesson, the dates from Monday to Sunday, the reservation status, and the related reservation number in the timetable.

2) According to the semester, training room and teaching week, the list of 7 days’ opening date of that week was inquired.

3) According to the course timetable, iteratively judge the appointment status of 7 days a week. The judgment conditions include: whether the date is open for appointment, whether the lesson has been reserved, whether the reservation date has been expired; If the lesson is booked, determine whether it is locked or booked by yourself or someone else.

4) The data generated by the above process was displayed and rendered in JSP pages, and the effect was shown in Figure 5.

5) AJAX technology was used to achieve local page refresh when the teacher operated "lock" and other related functions.

6.2. Reservation Record Timeout Processing
The teacher needed to make an online appointment 24 hours in advance, so that the training room administrator had enough time to prepare necessary equipment and tools. If the teacher didn’t improve
the reservation information and cancel the reservation record after the "lock", then the other teachers could not make an appointment for this period of time in the same training room. Therefore, the timer task was designed to avoid the above problems. The timer automatically worked every hour to determine whether there were records in the reservation record table that had not been booked successfully for more than 24 hours. If so, the reservation records were automatically cancelled and the time resources were released for other users to make reservations in the system.

Annotation was used to start the timer in the system. The scanning annotation < task: annotation-driven/> and scanning location < context: component-scan base-package= "com.booking"/> were configured in the Spring configuration file. A custom timer task class was compiled in this package. The timer task class was executed once per hour to determine whether there were records of more than 24 hours and failed appointments. If so, the status of the record was changed to "timeout automatically unlocking" through the timer task class to release the reserved resources for the period.

6.3. Reservation Record Query Function

Oracle relational database system was used for system data storage, and data query results were usually presented in the form of tables. When the administrator of the training room managed several training rooms, it was not intuitive to present appointment records in the form of tables. Therefore, the reservation record query results were directly displayed on the class schedule, so that the administrator could quickly understand the reservation information by viewing the class schedule. The key steps of implementation are as follows:

1) The number of the reservation records which has been successfully reserved and has not been completed is calculated.

2) The administrator of the training room selects the training room with reservation record and inquires the reservation record in the reservation table and the date in the calendar table according to the current semester.

3) In the JSP page, the class hour, school calendar and appointment record array are iterated, and the teacher's appointment information such as the appointment person, training class, training name, required equipment and materials are displayed on the class schedule. The administrator can quickly grasp the relevant information and make preparations in advance after checking.

7. Conclusion

A reservation management system for training room based on SSH framework technology was introduced in this paper. The functions of basic information management, school calendar management, opening date management, reservation and allocation management, user role authority management, inquiry and statistics, etc. were realized in the system. We had achieved the transformation of the training room from paper-based appointment management to online appointment management, and established a good interactive platform between teachers and training room management. The test showed that the system had reached the design requirement. There are two main points in the next step: One is to integrate the system into the campus network business system to realize the unified authentication of user identity. The second is to develop a mobile training room reservation management system to improve the convenience of using the system.

8. References

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