Design and Implementation of a Student Management System Based on Springboot Framework Technology

Yichun Tang

{TangYichuncq@21cn.com}

Chongqing College Of Architecture And Technology, Chongqing, China

Abstract. Nowadays, the scale of schools is constantly expanding. The number of students is constantly increasing, and information related to students is also exploding. However, the traditional student information management model is inefficient and may result in the loss of student information. How to efficiently manage such a large amount of student information has become a problem that must be paid attention to at present. With the development of computer technology, many types of information management systems have emerged one after another. In order to efficiently manage student information, save manpower and resources, and prevent student information loss, this article designed a system through research on Springboot, which was mainly used to manage student information. This enabled administrators to perform CURD (CREATE, UPDATE, READ and DELETE) operations on student information, enabling efficient management of student information. This article conducted experiments on the system, designed four detection indicators: CPU usage, memory usage, Disk time, and network bandwidth, and configured a quiet testing environment to conduct experiments on them. The experimental results showed that the average occupancy rates of various indicators of the system were 42.3% and 84.725%, respectively, under normal and high-voltage operating conditions. By analyzing the experimental results and testing environment, it could be concluded that the system had excellent performance and could efficiently manage student information.

Keywords: Springboot Framework Technology, Mysql Database, Development Tool Intellij idea, Student Information Management System

1 Introduction

With the development of computer technology, many types of information management systems have emerged one after another. The purpose of designing and developing this type of system is to achieve efficient information management. Based on this, this article designed a student information management system by studying Springboot technology in computer technology.

Many scholars have conducted research on Springboot technology. Scholar Yang

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Minxu designed and implemented a conference management system based on SpringBoot. Through studying the SpringBoot framework, he implemented a management backend that could manage meetings, upload materials, and other operations [1]. Scholar HUANG Ruiquan used Spring Boot to design and implement a system that could monitor maps online in multiple scenarios [2]. Scholar Zeng Jintao designed and implemented a Jinggang honey pomelo management system using Spring Boot, which was deployed on Tencent Cloud and tested in enterprises [3]. Scholars have achieved good results in developing systems using Springboot.

This paper analyzed the functional requirement of the student information management system, and then studied the Springboot framework technology to design and develop a student information management system. The system used front-end and back-end separation development technology, using Idea as the development tool and MySQL as the database to maintain data, achieving the administrator's CURD operation on all student information. The experiment proved that the system had very impressive performance, with an average occupancy rate of 42.3% and 84.725% for various indicators under normal and high-voltage operating conditions, respectively.

2 Introduction to Springboot, MySQL, and IntelliJ IDEA

2.1 Springboot

Springboot is a backend development technology that integrates the Spring technology stack. It has many advantages such as fast generation of Spring and its mainstream framework integration projects, built-in servers, and many automatic configurations, greatly simplifying system development [4].

Spring is an open source framework and a lightweight development framework technology that emerged in 2003. The purpose of the author's creation of Spring is to address the complexity of enterprise level application development. Spring reduces the complexity of Java development through Dependency injection and aspect (AOP) programming [5].

The function of Springboot is actually to assist developers in quickly building the Spring framework. Its design is to minimize the tedious configuration files of Spring projects and enable them to run as quickly as possible [6].

The core of Springboot is the rapid integration of third-party frameworks. The principle is based on the original Maven relationship, inheriting the original Maven, simplifying XML file configuration, and embedding servers (such as Tomcat) [7].

2.2 MySQL

MySQL is a relational Database management system, which creates tables to store data instead of using large warehouses to store data, greatly increasing the speed and flexibility of storing data. It optimizes SQL query algorithms and can effectively improve query speed [8].

In MySQL databases, data is presented in the form of tables. The behavior in the table is the names of various records, and the columns in the table represent the data fields corresponding to the record names. Multiple data tables form a database [9].

2.3 IntelliJ IDEA

IntelliJ IDEA is an integrated environment for Java language development and is recognized as one of the best Java development tools in the industry. Its unique functions include:
Intelligent editing: During the process of inputting code, it would automatically supplement the written methods or classes.

Prefabricated templates: The commonly used method of writing is edited into templates. When writing code, only a few letters need to be input to complete the entire code. For example, code with very high usage rates: public static void main(String[] args){} and System.out.println("") can be automatically completed by simply entering psvm and sout.

Code check: It can automatically check for code that does not comply with coding standards and is at risk, and provide prompts [10-11].

3 Information Management System

With the progress of computer technology and continuous updates, information management systems are also constantly developing. An information management system is a system composed of people, computers, and other peripheral devices that can manage information [12]. Information is the most important part of an information management system, so the storage of information is very important. Therefore, when designing an information management system, special attention needs to be paid to the design of the database.

4 System Design Evaluation

4.1 Evaluation of Functional Requirement

The main functions of the student information management system include user login to the backend and CURD operations for student information (adding, modifying, searching, and deleting) [13]. The CURD operation is subdivided:
Addition: This includes batch addition, reading Excel tables for addition, and adding separately.

Query: This includes querying by criteria (administrator enters or selects criteria) and querying all.

Modification: This includes batch modification, individual modification, and automatic modification (For example, after a student upgrade, the system would

automatically modify the grade in the student information).

Delete: This includes batch deletion and individual deletion.

The specific manifestations of CURD operation in the system include student enrollment (increase), expulsion (deletion), repetition (modification), and viewing all students in a certain class (query) [14-15].

Teachers mainly have functions such as viewing courses, classes, students, etc. They can enter their own conditions for querying or select conditions from the condition check box for querying. Administrators can perform operations such as dismissing students, repeating students, transferring students to different classes, offering courses and classes, and teachers' employment and resignation. All users can log in, and only super administrators can log out users [16].

There are other operations such as exporting student lists (to Excel spreadsheets), printing, and so on.

4.2 Feasibility Evaluation

The information management system designed in this article already has many templates, and the development of Springboot technology is basically mature, with a good ecosystem. There are no technical difficulties and it is completely feasible. The development environment used in this article is Windows 10, and the system does not have significant requirements for the operating environment. There are no difficulties in development, so it is completely feasible economically [17].

5 Detailed System Design

When designing a system, it is necessary to analyze each function of the system and divide it into several functional modules. The functional modules should be interconnected but not coupled too high, so it is necessary to conduct sufficient research on the division of the system's functional modules. The operational process of a system is also related to its operational efficiency. A reasonable operational process can avoid many unnecessary calculations, thereby saving resources and improving efficiency [18-19].

5.1 Functional Module Design

According to the analysis of Functional requirement, the functions of the system are designed as shown in Figure 1.

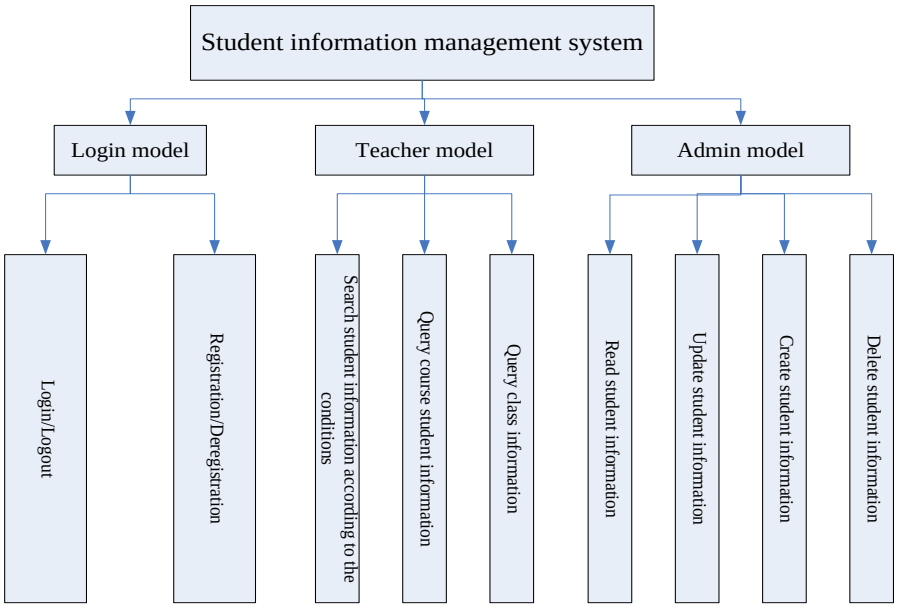

Fig.1 System function diagram

The functions of the system can be divided into three modules: login, teacher, and administrator.

The login module mainly includes login and logout, registration and logout operations. The teacher module mainly views class student information, course student information, and query student information according to conditions. The administrator module mainly performs CURD operations on student information, such as expelling students, enrolling new students, transferring students, repeating students, etc. [20]. Administrators can also conduct CURD operations on teachers and courses, such as teacher entry, teacher turnover, adding courses, deleting courses, modifying courses, and so on.

5.2 System Process Design

According to the analysis of system functional modules, the system operation mode shown in Figure 2 is designed.

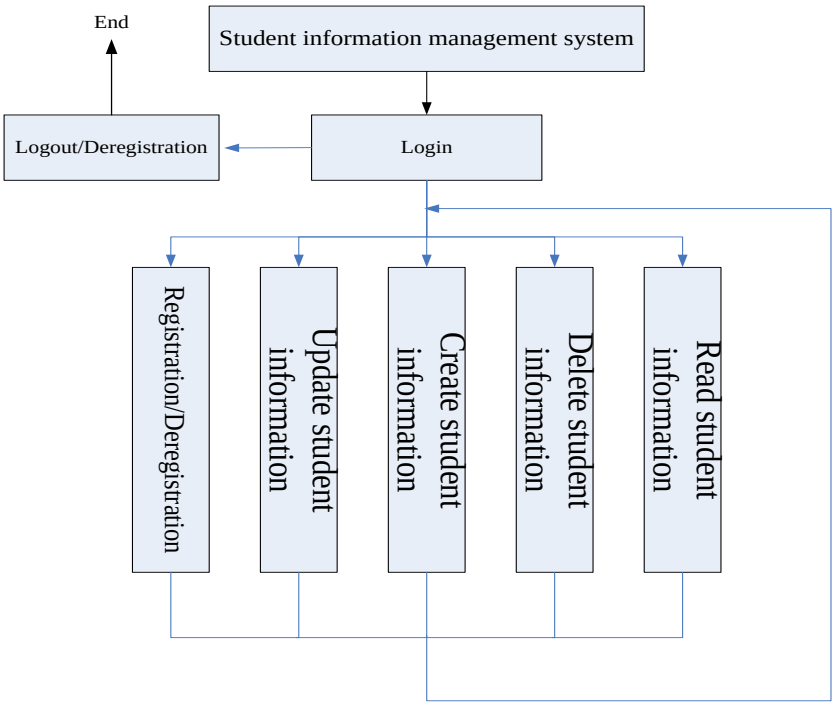

Fig.2 System Operation Mode

As shown in Figure 2, users can log in to the system for operation. After logging out, they would exit the system. After logging out, the system would permanently delete the account. When logging out, they need to use the account of a super administrator to log out. After logging into the system, users can operate on various information of students until exiting the system. Administrators can manage all kinds of information about students, courses and teachers after logging in; After logging in, teachers can manage their personal information and view information about courses, classes and students.

5.3 Database Design

In order to ensure the storage and utilization efficiency of data, the operational efficiency of the system, and the utilization of resources, as well as the completeness of describing students' learning, it is necessary to design the database reasonably and scientifically.

The E-R diagram of database design is shown in Figure 3.

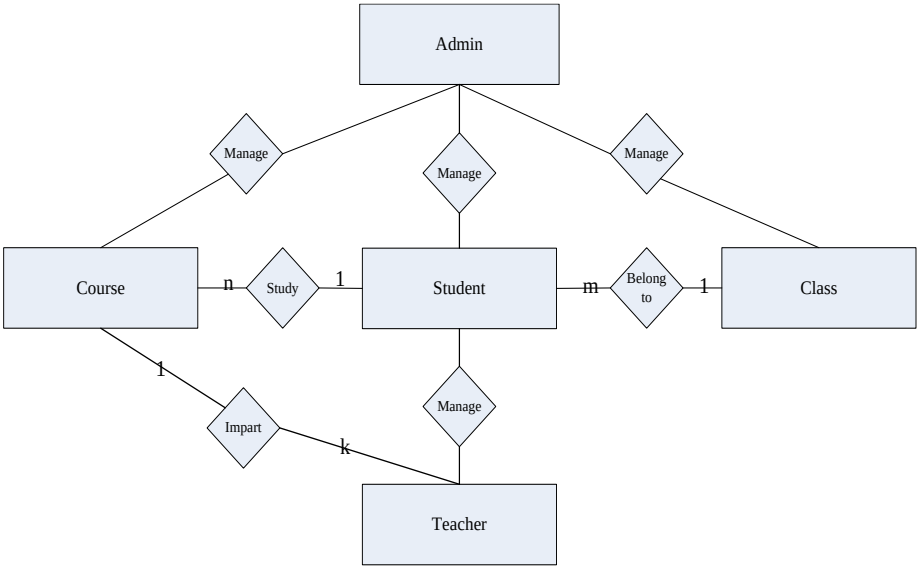

Fig.3 E-R diagram

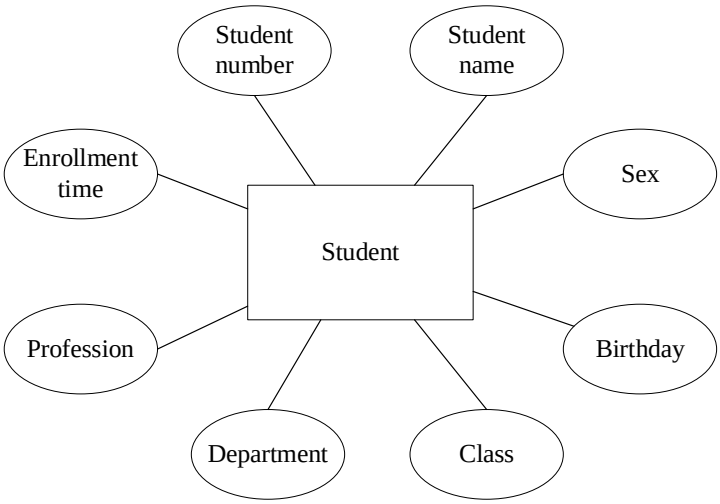

Fig.4 Student entity map

The E-R diagram is a graph that reflects the relationships between entities. In the figure, for example, n: 1 represents many to one. For example, a class contains more than one student, one student is studying more than one subject at the same time, and so on.

There are course, student, teacher, and administrator entities in the database, such as the student entity shown in Figure 4.

6 System Testing

6.1 Performance Testing

In order to verify the performance of the developed system or software and ensure that it can meet the expected working environment, it is necessary to test it. The types of tests include scenario, stability, stress, load, limit testing, and so on. The purpose of testing varies depending on the type of testing. The test is as follows:

Stress testing: The system is tested to see if it can still handle business under the specified saturation state, mainly to test the system's stress resistance.

Load testing: Load testing is generally placed together with stress testing, but there is a significant difference between load testing and stress testing. Load testing is continuously pressurizing the system until a critical point of saturation is found.

Stability testing: In a specific operating environment (such as limiting network speed, hardware configuration, etc.), the system is subjected to pressure and does not stop running to verify its stability.

Extreme testing: Excessive user usage of the system is used to verify the maximum number of users the system can carry.

There are also throughput testing, concurrency testing, and so on, which are used to test the performance of the system.

6.2 Functional Testing

Functional test mainly tests whether the functions of the system can be used normally. The main contents of the test include whether the system can be logged in and out normally, whether the administrator can carry out normal CURD operation on all information, whether the teacher can normally query the information of students and courses according to the conditions, and whether the teacher can manage personal information.

In the process of functional testing, it is necessary to input various irrational data to test the system and observe how the system handles these abnormal data. For example, when entering a password with characters during login, can the system give a prompt "Please enter the password in the correct format" or "The password you entered does not meet the format requirements", can a confirmation box pop up during the CURD operation, and so on.

6.3 Student Information Management System Testing

In order to verify whether the system designed and implemented in this article can operate normally and achieve efficient management of student information, thereby saving manpower and material resources, it is tested. This mainly tests the stability, load capacity, and pressure resistance of the system. The indicators tested include CPU usage, memory usage, Disk time, and network bandwidth.

System testing environment: MySQL 8.0 database, PC client, Windows 10 system, LAN (10M) network environment, IntelliJ IDEA version 2022.

Under the specified testing environment, the system is constantly subjected to

increased pressure, and various indicators of the system during operation are monitored and recorded during the process of increasing pressure. The performance of the system is evaluated based on the results of the indicators. The indicator records of the system are divided into normal state and high pressure state (not limit state). The experimental results are shown in Figure 5.

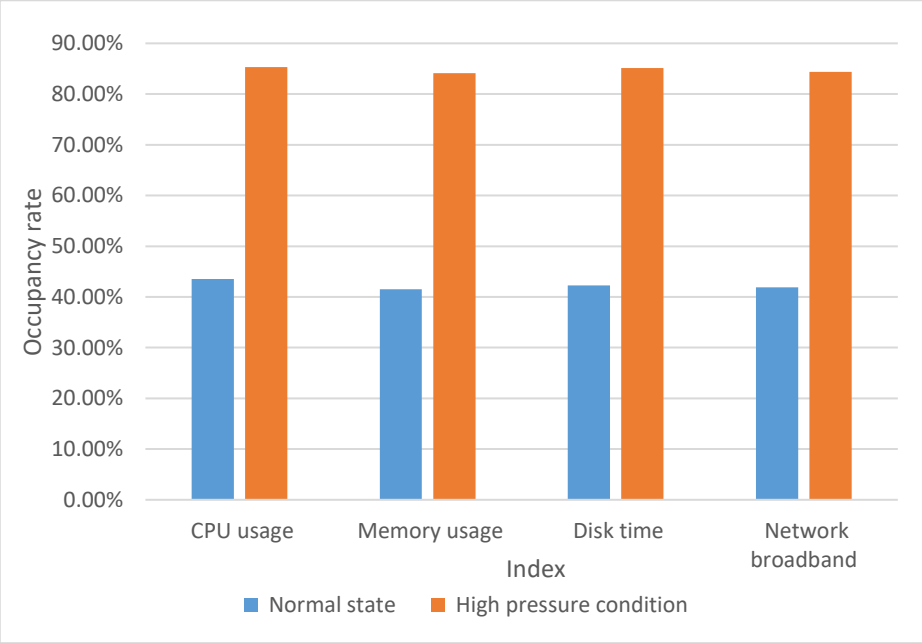

Fig.5 Indicator data chart

From Figure 5, it could be seen that under the testing environment designed in this article, the average occupancy rates of various indicators in normal and high voltage states were 42.3% and 84.725%, respectively. It could be seen that the student information management system designed based on Springboot in this article had excellent performance and could efficiently manage student information.

6.4 Experimental Summary

For the system designed and implemented using Springboot in this article, four indicators were designed to reflect the performance of the system, namely CPU usage, memory usage, Disk time, and network bandwidth. These four indicators were used to reflect the system's load capacity, pressure resistance, operational stability, and so on. By designing and configuring a testing environment, and continuously applying pressure to the running system, the system's indicators during runtime were constantly monitored and recorded. The recorded data included two types: normal system operation and high voltage operation. The experimental results showed that the average data of various indicators under normal conditions was 42.3%, indicating that the overall performance of the system was relatively excellent. The average

operating indicators under high pressure conditions were around 85%, indicating that the system's pressure resistance and stability were very objective.

7 Conclusions

In response to the design and implementation of a student information management system, this article analyzed the problems encountered in developing a student information management system by studying Springboot development technology. Based on the analysis, the system's database, functional modules, and operation process were designed, and finally a student information management system was implemented. It had three modules, namely the login module, which implemented the functions of login, logout, and deregistration; the teacher module implemented the function of viewing student information; the administrator module implemented functions such as expelling students and repeating students. By designing and configuring a testing environment, four detection indicators were designed to conduct experiments on system operation, constantly monitoring indicators and recording data during the continuous increase and operation of the system. According to experimental records, the average data of various indicators under normal operating conditions was 42.3%, and the average operating indicators under high voltage conditions were around 85%. The analysis of the recorded data and configured testing environment confirmed that the system designed in this article had very impressive performance.

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