Design and Development of C Language Teaching System Based on Vue

Xia Gao[a], Dongdong Zhang[b], Xin Zhao[c*]

School of information engineering, Shanghai Zhongqiao Vocational and Technical University, Shanghai, China

[a]493473225@qq.com, [b]zddqrs@163.com
[c*]Corresponding author: zhaoxin203@126.com

Abstract. With the rapid construction of experimental computer rooms in universities, more and more courses have entered the field of intelligence from traditional classrooms. Compared with the improvement of hardware, how to use computer means to promote the quality of teaching in college education is the key research topic. In order to break the conventional office software teaching mode, this study is based on the programming course C language, through the design and development of a set of programming learning system, so as to improve the teaching efficiency of real-time grasp the students' learning progress, the introduction of a new teaching means to subdue the boring characteristics of traditional programming courses. The first point is to break the teaching limitations of programming courses through the introduction of the teaching system. Secondly, the main feature of the teaching system is the interaction between teachers and students. The 11 supporting cases integrate the basic knowledge units, and the effective combination of point to point. The development of the whole teaching system is divided into front-end and back-end. The front-end is mainly developed based on Vue framework, and then divided into teacher end and student end according to the function. The back-end is deployed and developed through Spring Boot and Netty network framework, and finally uses WebSocket protocol for communication. Finally, the real C language teaching scene was simulated for students to simulate training.

Keywords: Vue framework; Spring Boot; C language.

1 Introduction

The development of programming course believes that C language teaching is a topic that cannot be avoided. In Shanghai, for example, more than 95 percent of computer majors have opened C language courses [1]. Every year, college students apply for the Shanghai Application Technology Level examination of C language level two certificate of about 9000 people. According to the data of TIOBE programming community, the share of C language is still as high as 12.08% in 2023, ranking second. Especially

Y. Feng et al. (eds.), *Proceedings of the 4th International Conference on Internet, Education and Information Technology (IEIT 2024)*, Atlantis Highlights in Social Sciences, Education and Humanities 26,
https://doi.org/10.2991/978-94-6463-574-4_33

in programming situations such as operating system and calling hardware, C language is significantly better than other high-level languages, and most large system software is also written in C language. The above data is enough to prove that C language is still hot after many years on the top list, but for university teaching, the development of the course has entered a bottleneck period. After many years of teaching reform, there has been no major breakthrough. The reason is that the design of the course is boring, and the teaching mode is monotonous, which cannot adapt to the needs of the new generation of children, resulting in students unable to apply what they have learned [2]. Although there are all kinds of new laboratory construction popularization, but more just the improvement of traditional hardware parameters, there is no customized development for the course, so this subject will research and develop a set of teaching system based on C language based on this demand, through the simulation of C language teaching scene to help students directly exercise the application ability of programming language [3].

2 Key Technologies

2.1 Vue

Vue is a JavaScript framework for building user interfaces. It was created by Evan You in 2014 by taking some features of AngularJS and adopting the MVVM architecture to make it a more lightweight framework. The whole framework is built based on standard HTML, CSS, and JavaScript, with a complete core library of graphics, the composition of the progressive framework can help users develop front-end pages more efficiently. This system chooses Vue2.0 as the development version, and node.js is installed before installation. Because npm and other management tools have been integrated into node.js, there is no need to install it repeatedly. Figure 1 shows the Vue service startup interface. After starting, you can enter the local IP address and port number for verification. The Vue framework mainly solves the functions of data transmission and refresh in the whole front-end system, and feeds data back to the front-end interface in real time to improve the operating efficiency of the system. Especially in the teacher end interface, a large number of log information needs to be called to help teachers grasp the programming situation of students in real time.

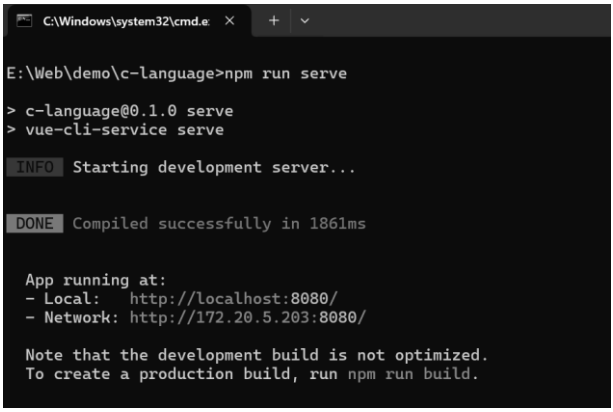

Fig. 1. Starting the server

2.2 SpringBoot and Netty

For back-end development, a combination of SpringBoot and Netty was chosen, with SpringBoot taking care of one-off network requests and the Netty networking framework integrated into it for real-time data transfer via the socket service protocol. SpringBoot is designed based on Spring4.0, which not only inherits the original advantages of the Spring framework, but also further simplifies the construction and development of the whole link. Then the integration of Netty is equivalent to simplifying the programming and development process of network applications. It can be divided into three parts: automatic configuration, dependency management and configuration management. The auto-configuration is mainly responsible for the various parameters and Settings of Netty, and the dependency management solves the relationship conflict, which can be managed in the configuration file Gradle, and the configuration management completes the parsing of the operation. Since Netty is an event-driven network framework, as shown in Equation 1, E denotes the total number of events, n denotes the number of events, and e_i denotes the ith event.

$$E = \sum_{i=1}^{n} e_i \tag{1}$$

MySQL is used as the back-end database management system, which is accessed through MyBatis, a Java-based persistence layer framework that includes SQL Maps and DAOs. In addition to supporting SQL queries, stored procedures and advanced mappings, MyBatis removes the complexity of JDBC code and uses simple XML to handle configuration and raw mapping, and finally maps interfaces and Java objects into database records. MappedStatement is the core class, which is mainly used to store all kinds of SQL configuration information.

Data communication and synchronization is the biggest difficulty of the whole system development, here the data communication is divided into two parts, one is the

front-end and back-end communication, mainly through the Http protocol and Web-socket protocol to complete, the second is the C language program and back-end analysis feedback, is completed through the socket. The back-end communication between the teacher and the student is also based on socket to complete the transmission.

2.3 Tomcat Server

Since the system is designed by modular division, the front-end and back-end will be installed and deployed on each computer. In this way, the coupling of the system operation is reduced, and it is more secure and stable. For the convenience of later maintenance, this side chooses to use the virtual machine to create image files, the front-end program and the back-end program are installed and run in the Tomcat server respectively, and the socket protocol is convenient to call and find the IP address. Tomcat is a free open source Web server, belongs to lightweight application server, suitable for some small and medium-sized project development, the design architecture can be understood as two containers, respectively store the front-end and back-end, to ensure that the operation is more stable, independent of each other.

3 Development and Research

3.1 System Functions

The system functions are divided into student end and teacher end, as shown in Figure 2, which is the login interface of students. Only students who have entered data in the database can log in to this system for learning, and the student's account information can also be synchronized in the teacher's end to facilitate the teacher's daily teaching management.

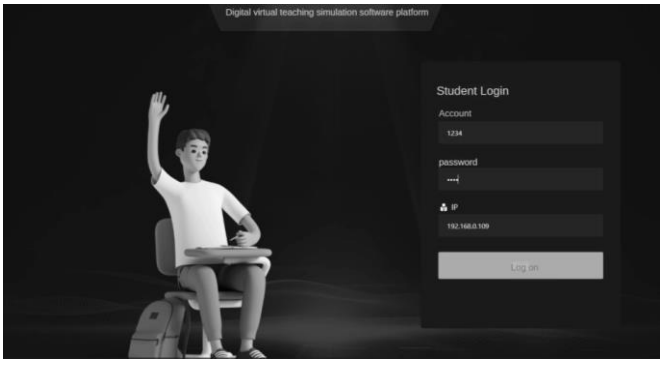

Fig. 2. Student Login interface

After successful login, you will enter the home page as shown in Figure 3, where the system simulates a variety of training scenarios and hardware sensors, including human body infrared sensor, LCD display, illumination sensor, temperature and hu-

midity sensor, DC fan, red, yellow and green light, buzzer and expansion IO and other resources. Students can use any C language editor to interact with them to control the simulated sensors. At present, 11 kinds of teaching case scenarios have been created according to the system functions, and the knowledge points of C language are combined with them to really help students to synchronize with the classroom and practice while learning. All the running results of the front-end will also be displayed through the log management tool, so that students can understand their programming results at a glance.

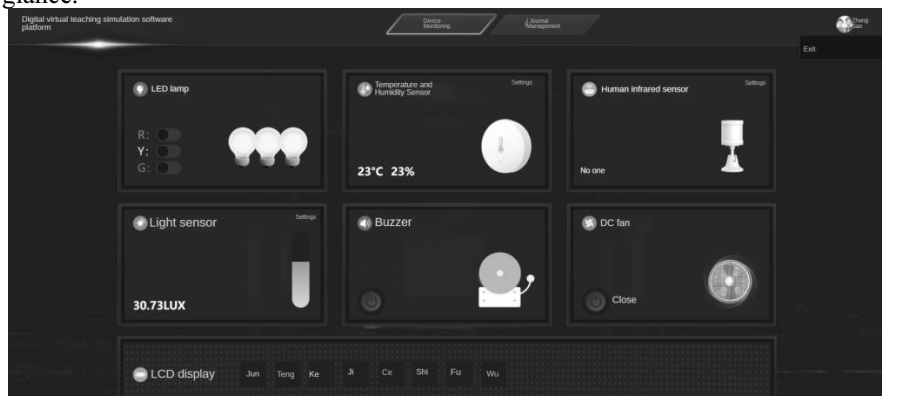

Fig. 3. Student home page

The interface style of the teacher side is similar to that of the student side, but user management and screen display are added on this basis. After successful login on the teacher side, you can select any student interface to display and master the current running results of student programming. As shown in Figure 4, the teacher terminal interface. When you click the log management tool, you will enter the log menu effect interface, where you can view the student's experimental information and whether the equipment in the simulation scene has been successfully debugged and run.

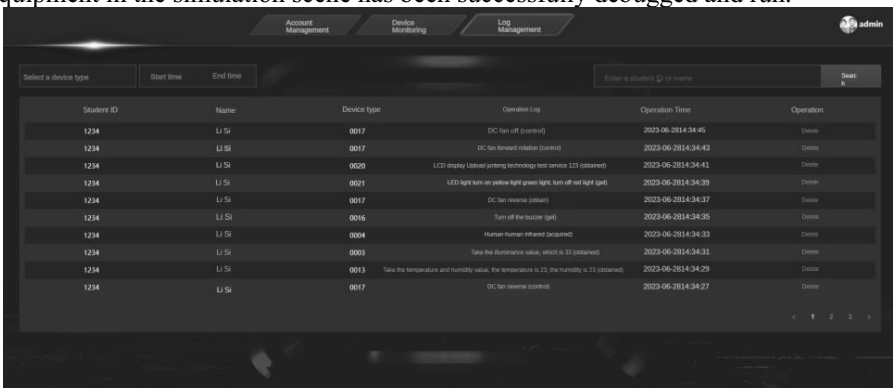

Fig. 4. Teacher home page

3.2 Case Study

At present, 11 teaching scene cases have been set up according to the teaching content, covering the knowledge points of input and output, sequential structure, selection structure, loop structure, array, function, structure and pointer in C language. In the future, it can also be expanded according to the content of the course. Let's share a case scenario of choosing a structure. As shown in Figure 5, three smart room modes are created and defined under the editor codeblocks, which are room temperature mode, light mode and leave mode. When the user switches the mode, the switch statement is used to judge the condition value, and the case clause under different conditions will enter the corresponding code block. The SocketSend function is responsible for controlling the sending of instructions. In the room temperature mode, when the temperature is greater than 25, the fan will be turned on. Such a smart home teaching example not only exercises students' code example writing, but also intuitively debug the interface to make students' programming more vivid.

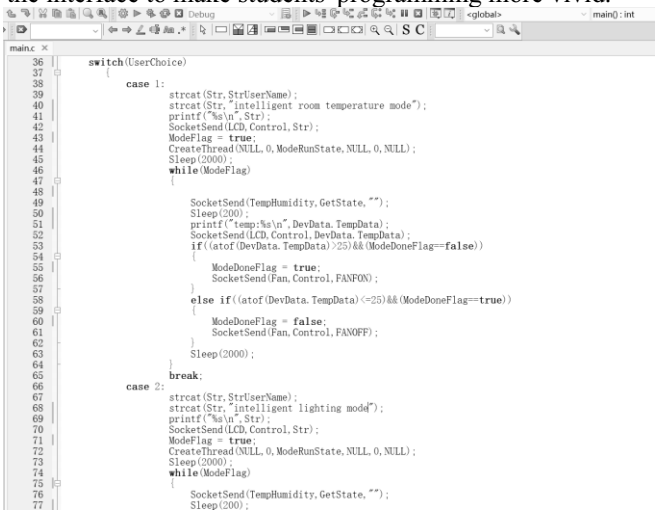

Fig. 5. Select structural statements

3.3 Data Synchronization Technology

The difficulty of the whole system lies in the data transmission and synchronization, because the different objects and clients involved need to be handled separately [4]. The first is the communication between the front end and the back end of the student side, using Http protocol and Websocket protocol to achieve and the C language client call parsing is completed through the socket protocol. As shown in Figure 5, the back end first opens a port for the front end to call, and first does a shunt analysis. The http protocol is mainly responsible for the login and registration module, and the Websocket protocol is responsible for the data of the front end. The Websocket data is uniformly converted into json format, and then the data is pushed to the C language

client. The reverse is the same, C language client through the socket protocol transmission to the back-end, converted into json format and then pushed to the front end for display, here all the parsing and judgment operations are completed in the dealMsg function.

Then the communication between the teacher and the student side, in the front C language and back-end communication at the same time, the data is pushed to the background of the teacher side, which is equivalent to a new socket thread to deal with this section of transmission. The teacher end will first store the database after receiving the data, and reserve the data source for the later display of the student interface.

4 Comparison of Implementation Effects

The teaching effect of using case teaching has significant advantages compared to traditional teaching methods. Case teaching simulates real-life scenarios and problems, enabling students to exercise their thinking and practical abilities while solving problems. Students need to analyze the causes of problems, propose solutions, and evaluate their feasibility. This process can cultivate their ability to analyze and solve problems. However, traditional teaching methods often focus on imparting and memorizing knowledge, while neglecting the cultivation of students' thinking and practical abilities [5].

Before implementing case teaching, the teaching order may be relatively single and fixed, mainly based on teacher lectures, with students passively receiving knowledge. However, after the introduction of case teaching, the teaching order has undergone significant changes. Students begin to participate more actively in learning, and they need to express their opinions in groups and collaborate with others to solve problems. This interaction and cooperation make the teaching order more active and interesting. At the same time, teachers also need to pay more attention to guiding and stimulating students' thinking and discussion, so that the teaching order is more in line with the needs and development of students.

Through case teaching comparison, students have strengthened their interest in learning, improved their understanding and mastery of knowledge points, and improved the quality of teaching. By comparing the teaching order before and after, the situation is shown in Table 1.

Table 1. Comparison of Implementation Effects of Case Teaching in Classroom

	Before implementation	**After implementation**	**Comparison**
learning interest	45%	70%	25%↑
Case completion rate	40%	75%	35%↑
Mastery of knowledge points	65%	80%	15%↑

The implementation of case teaching has significantly improved the quality of teaching. Firstly, the increased interest in learning among students makes them more willing to invest time and energy in learning, thereby improving learning outcomes. Secondly, students have a deeper and more solid understanding and mastery of the knowledge points, enabling them to better cope with various exams and practical application scenarios. Finally, case teaching focuses on cultivating students' comprehensive qualities and innovative abilities, making them competitive and high-quality talents. Therefore, more and more academic fields are adopting case teaching as an important teaching method.

5 Summary

The C language teaching system mainly simulates the teaching hardware scene through the front-end and back-end deployment, so that students can use the C language to call it and improve their practical ability. At the same time, 11 case scenarios are set up to help students deepen their understanding of language knowledge points. Each scene is closely connected with the chapters of the C language course, step by step, and the knowledge points are truly integrated with the teaching system to improve the teaching efficiency. The difficulty of the whole teaching system is the synchronization and transmission of data. First of all, each computer needs to be deployed separately, and two containers are set up by Tomcat to store them respectively. The system has a rigorous logical structure in the design, and all these should be reflected in the underlying code to achieve. The completed work is highly practical and suitable for the daily teaching of contemporary college students. In the subsequent development, more simulation equipment can be added to build a more perfect teaching scene. At the same time, the management function is more subdivided and the score statistics function is added.

References

1. Fangqin Xu, Xia G. and Wanying F, "Research on the Application of Virtual Simulation Technology in the IoT programming class, " Proc. SPIE 12640, (2023).
2. Shchemeleva Y B; Sokolov A A; Labazanova S H, "Development of hardware and a system for analyzing energy parameters based on simulation in SimInTech," Journal of Physics: Conference Series 2176,(2022).
3. Demidova L A; Mordakin B Yu, "Intelligent analysis of the list of technological operations for the problem of developing of functional simulators stowage and installation-mooring of the landing gear, " Journal of Physics: Conference Series 1902,1-13(2021).
4. Umran Samir M.; Lu SongFeng; Abduljabbar Zaid Ameen; Nyangaresi Vincent Omollo, "Multi-chain blockchain based secure data-sharing framework for industrial IoTs smart devices in petroleum industry, " Internet of Things 24,(2023).
5. Kelin Wang; Zhiyong L; Chengyi W;etc," Research and Design of a Chicken Wing Testing and Weight Grading Device," Electronics 13, 1-17(2024).