Application of Big Data in the Design of Simulation Linux Teaching System

Xiuzhuo Wei, Suhua Wang, Bo Tang, and Hui Sun(✉)

Changchun Humanities and Sciences College, Changchun, China
278838061@qq.com

Abstract. In view of the problems existing in the current teaching platform, such as mutual independence, poor compatibility and openness, a teaching system based on Linux information processing is designed. The teaching platform takes imx6 as the core processor and is designed with multiple information processing hardware interfaces, which can access multiple images, voices and other signals at the same time. Based on the idea of Linux system architecture, the application layer software adopts layered architecture, which is convenient for function cutting and expansion, and the platform code is completely open source, which is convenient for teachers and students to write and add information processing codes. In addition, a teaching system based on the transmission, decoding and playing of video information is designed and applied to the teaching process. The teaching effect shows that it has good openness and compatibility.

Keywords: information processing · Openness · Embedded · Video · Teaching case

1 Introduction

With the rapid development of cloud computing and big data technology, great changes have taken place in people's social environment and working environment. Smart city, smart transportation, smart life and other unique products of the times are quietly changing people's lifestyles [1]. Even in the sacred field of education, the traditional teaching mode in the past is being replaced by the "smart teaching" mode that adapts to the development of the times with the widespread application of big data technology [2]. As the product of science and technology and the development of the times, the teaching mode of simulated Linux teaching system is very popular among students in teaching practice, and the teaching effect is also remarkable.

The teaching system aims to realize an intelligent teaching system based on the current advanced information technology, so that teachers and students can experience the fun of teaching and learning through information-based teaching, so that learners can master the key to developing a treasure house of knowledge, actively talk about knowledge, learn and develop independently, and make learning and teaching more efficient [3]. At present, as an important part of smart education, there is no detailed research and discussion in the current domestic smart campus construction scheme, so it is of great significance and meets the needs of future development to build a teaching system based on simulated Linux. The construction of simulated Linux teaching system

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has expanded the application and promotion of high-quality teaching resources, which can comprehensively improve teaching quality and promote educational reform.

The research on teaching system at home and abroad presents a wide range of research contents, such as multi-faceted and multi-angle, due to the differences in technological development in different countries.

In order to better consolidate and develop this model, this paper further discusses and studies the design and implementation of simulated Linux teaching system based on big data. The purpose of teaching system construction is to adopt Linux system and computer software technology to build a teaching system with interactive teaching as the core element, intelligent teaching as the technical support, and information, automation and interaction as the characteristics.

2 Design of an Open Teaching Platform for Information Processing

2.1 Hardware Design

In order to solve the compatibility problem of information processing, the hardware system architecture of the teaching platform is shown in Fig. 1. The core processor of the teaching platform based on embedded Linux system is imx6, and its main frequency can reach 1. 2 GHz. Imx6 integrates functional modules such as CAN and Gigabit network. The input module includes image signals, voice signals and simple signals (such as temperature, infrared, etc.). The output module includes WiFi signal, I/O signal and 4G/V2X signal output. The image signal input module communicates with the embedded Linux teaching platform through gigabit network port, which ensures the real-time performance of image data [4, 5]. The voice signal input module is connected through USB and embedded Linux teaching platform. According to different basic signal input modules, the embedded Linux teaching platform has a variety of communication data input interfaces, such as I/O, UART, CAN and V2X wireless communication interfaces. The output of WiFi signal is connected with embedded Linux teaching platform through UART, and the platform sends the result of information processing to the display terminal of tablet and PC through WiFi [6]. I/O signal output module outputs some high and low level control signals such as LED and relay control. The system also retains the 4G communication interface and V2X communication interface, which ensures the diversity of data output and can communicate with a variety of external devices, thus improving the compatibility of the teaching platform.

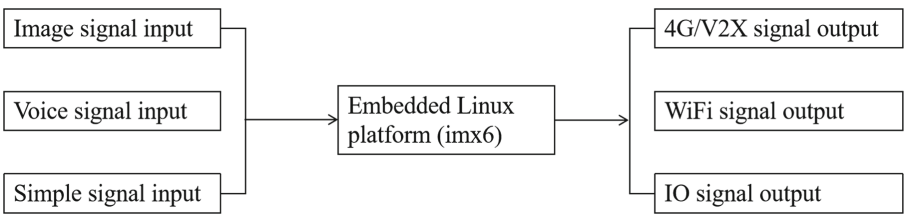

Fig. 1. Hardware system architecture

2.2 Software Design

This information processing open teaching platform adopts embedded Linux system architecture, including application layer, kernel layer and hardware layer. I/O layer is mainly responsible for communicating with external devices in the teaching system, realizing the input and output functions of devices, and providing data for the application of the upper-level teaching system at the same time, and the module can cut and expand the corresponding functions according to the connected device teaching system. This layer includes image information service, voice information service, I/O information service, teaching system WiFi information service and reserved interface service [7, 8]. The main function of these modular teaching systems is to obtain data from the corresponding external devices, and the teaching system carries out certain processing to provide data of different types of teaching systems for the upper application. The reserved interface service represents some extensible information processing interface services of the teaching system. Different teaching systems are programmed according to different interfaces, and each different interface service is an independent process of the teaching system. The application service layer of the teaching system mainly includes the input data processing module and the output information processing module of the teaching system, which is mainly responsible for integrating the input data into the teaching system, distributing the data to the application layer, and providing an interface for data transmission for the application layer of the teaching system [9, 10]. The functions of the teaching system module and I/O data processing module in the speech signal department are similar to the data processing logic of the image number teaching system. The application layer of the teaching system is mainly responsible for realizing different teaching applications, so that the teaching system can comprehensively use the image processing results uploaded by the application service layer, the teaching system processing results of the voice department and the I/O information processing results, and the teaching system sends the control results to the output information processing module [11]. The output information processing module of the teaching system sends different information to the I/O Layer module of the corresponding teaching system according to different messages and output devices existing in the current system teaching system, and outputs control results.

2.3 Overall Functional Design of the System

After entering the comprehensive learning platform, the platform software name, running time, user's current login and exit buttons will appear above the menu. The user must ask at any time for any operation, select the exit button, and exit the system without any other operation. Real-time monitoring and training system alarm real-time statistics field and on-site transmission data are on the right side of the main interface of the system. After generating an alert, update the entered data [12, 13]. When an alarm is generated, the displayed number will turn red. You can navigate related tools by clicking the corresponding number or symbol. On the left side of the main interface of the system, users can find the equipment list, knowledge management, training management, examination management, question type statistics, learning space, and security management. Video monitoring, attendance management, environment, security system, monitoring and audio system are all in the option list.

3 Teaching System Test

The stable operation of the learning system has higher requirements. All system files must be stored for a long time, and flash is not allowed. When the data is lost or the system is paralyzed, the loss to the school is immeasurable. If a fault occurs, the fault can be sent to the backup server through the work module. In addition, the database adopts distributed server cluster, which reduces the burden of processing large files [14, 15]. The main functions of the system are tested in the software and hardware test environment of the learning system, and the security, reliability and user interface of the system are checked, and the performance evaluation data and optimization strategies are formulated.

3.1 Performance Test Data

When the most users are online, the average exchange time should be less than 5 s, the maximum response time should be less than 10 s, the response rate should be greater than 98%, the CPU utilization rate should be less than 80%, and the memory utilization rate should be less than 80%. See Table 1 for specific test data.

Other performance test data of the teaching system are shown in Table 2.

Description of system performance test items:

Table 1. User Load Test Data Sheet

CPU (%)	Memory (%)	Average response time (s)	Maximum response time (s)	Transaction response success rate (%)
16	9	0.79	1.21	100%
27	17	2.16	2.64	100%
39	28	2.71	3.91	100%
48	39	3.08	4.49	100%
65	41	3.84	5.01	100%

Table 2. Other performance test data of the system

System performance test items	Test
State quantity acquisition and transmission time	<1 s
Response time of information data query	<20 s
Call screen response time	<3 s
Switching time between the main and standby computers	<30 s
System clock accuracy	<10 ms
System software failure, restart recovery time	<1 min
Correct rate of fault alarm response	>99.9%

Collection and transmission time of state variables: refers to the collection and transmission time of switch state variables of equipment such as infrared correlation alarm, smoke sensor, infrared dual-detector and so on [16, 17].

Information data query response time: refers to the response time for querying the data stored in the system database.

Call screen response time: refers to the response time of system call screen for interface display.

Switching time of active and standby computers: refers to the response time of system switching between host computer and backup computer.

System clock accuracy: refers to the clock accuracy of the system.

Recovery time for system software failure and restart: refers to the recovery time required for system restart after system failure [18, 19].

Correct response rate of fault alarm: refers to the correct response rate of various alarm signals on the system.

The results of the above performance test data of the teaching system show that the performance index of the system meets the application requirements of school teaching [20].

4 Conclusion

The software design of the teaching system is based on big data and other technologies. The core element of the software architecture is to meet cross-platform requirements. The data sharing among the modules of the system adopts the standard protocol of data and message bus to communicate, thus forming a loosely coupled distributed system with scalable scale, and users do not need to rebuild the system for the growth of network and demand. Because the teaching system is provided for multi-level users of teachers and students in the school, optimizing the response time, success rate and CPU and memory occupancy rate of the system has become the key to ensure the load balance and fault takeover of the teaching system under the condition of multi-user login. By constructing "Linux-Nginx-tomcat" distributed cluster server and using lvs for load balancing and dual-machine hot standby, the response time and success rate of system transactions are improved, and the occupancy rate of CPU and memory is reduced.

Linux operating system can establish a virtual simulation laboratory environment on the computer, and provide a virtual simulation experiment teaching system of Linux operating system, so that students can complete relevant experiment content through browser client on the Internet, improve their practical skills and achieve teaching goals. However, there are still many shortcomings, such as the lack of score statistics, online discussion and other modules in the management platform, and some detailed functional operations of Linux operating system are not perfect now, which will be improved in future research.

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