Design of Computer Professional Training Teaching System Based on Big Data Under the Background of "Three Integration"

Jie-lan Zhang(✉)

Jiangxi Teachers College, Yingtan 335000, China

Abstract. In order to meet the needs of the society for the application-oriented computer talents, define the professional orientation and training goal of the application-oriented computer talents, according to the requirements of companies and enterprises for the computer talents, and based on the current big data information, a computer professional training and teaching system is designed. The hardware unit includes controller configuration unit, audio control chip selection unit and wireless communication unit, and the software module includes training teaching content module, wireless node configuration module and database building module. Through the design of the hardware unit and software module, the operation of the computer professional training teaching system is realized. Set up computer professional training teaching environment, set up the software module configuration program, carry out simulation experiments. Experimental results show that the server utilization rate of the design system is lower than 70% compared with the existing system, which indicates that the design system is effective and feasible.

Keywords: Three financing background · Big data · Computer specialty · Practice teaching

1 Introduction

The computer speciality is a key construction speciality of the state. In the course of demonstration construction, this speciality actively adapts to the needs of regional economic and social development, adheres to the principle of service-oriented and employment- oriented, and takes the road of industry-university-research-integrated development; and in the demand of social electronic enterprises for highly-skilled talents, actively probes into the talent cultivation mode of "combination of three types of talents and integration of three aspects of work and study", obtains obvious achievements in reconstructing the curriculum system of the speciality, creating excellent teaching teams, and jointly constructing practical training bases inside and outside the school, etc., and the quality of talent cultivation keeps improving. The "three combinations" refers to the combination of industry, enterprise and school, and the "three financing" means the accommodation of courses, posts and vocational qualification certificates.

W. Fu et al. (Eds.): eLEOT 2021, LNICST 389, pp. 430–441, 2021.
https://doi.org/10.1007/978-3-030-84383-0_37

Through the establishment of electronic information "School-enterprise" cooperative education work committee, to achieve "School-enterprise" close combination, trinity common development. Through the "three combinations", highlight the guiding role of electronic associations, electrotechnical associations and other industrial institutions in talent training, new technology training and other aspects; highlight the guidance and enthusiasm of enterprises in the process of deep cooperation in talent training [1].

Under the background of "three integrations", the computer specialty is a highly practical engineering specialty, and the practical teaching is an important part of the talent training program and teaching plan. With the rapid development of informationization in our country, the information technology with computer technology as the core will play a key role in promoting the rapid development of national informationization and economy. At present, the country's information and economic development of computer professionals in growing demand. However, in the supply and demand of computer talents, there are two contradictory situations. On the one hand, companies and enterprises cannot recruit the computer talent they need; on the other hand, there are difficulties in finding jobs for graduates majoring in computer science [2]. The reason is that the school does not understand the requirements of computer talents' knowledge structure, professional ability and professional quality in the corresponding positions of companies and enterprises. In the formulation and implementation of the talent training program, the emphasis is laid on theory rather than practice, and students' practical and hands-on abilities are generally not high. Therefore, we have carried on the reform to the university applied undergraduate computer specialized personnel training plan, and made clear the specialized localization and the training goal of training computer applied talents.

2 Design of Hardware Unit of Training and Teaching System for Computer Specialty

Hardware unit is the precondition and foundation of system operation and application. The hardware unit of the system, including controller configuration unit, audio control chip selection unit and wireless communication unit, shall be designed based on the needs of practical training and teaching of computer specialty. The specific design process is as follows:

2.1 Controller Hive

The controller is also called sandbox in the design system. The controller is an important condition to ensure that the students can be trained. In the process of configuring the controller, there are two methods:

(1) Configuration using the Console port of the controller (sandbox)
On each controller of the system, there is a Console interface that configures the system. Once properly connected to the human console, the controller's associated communication interface can be configured on the command line, with basic configuration such as the IP address of the CFG interface to complete the associated configuration [3]. The specific configuration method is as follows:

Set smc 192.168.1.253:9600.
Set intcfg eth0 192.168.1.1
Set DNS 255.255.255.0
Such configuration is a necessary configuration, and then set up the communication configuration of the design system, you can carry out normal communication. After configuration, the controller (sandbox) device uses the eth0 interface to register the data of the system with the system server. After configuration is completed, the configuration of the system server SMC can be viewed through the show efg command, or the ethnic 0 command can be used to view the interface configuration area of the system and other relevant situations.

(2) Configure by using the controller's configuration network port (CFG)
Typically, there is a CFG interface in the controller's device that has a default configuration address of 1.1.1.1, which is built-in to the system and is not allowed to be changed. However, in the system, port 212 can adopt 1.1.1.2 address for remote connection, which means that the IP address of the student or teacher machine is set to 1.1.1.2 for data communication, and the communication within the system can be realized by connecting the CFG interface of the controller device with cross wires [4].

2.2 Audio Control Chip Selection Unit

Computer professional training teaching system needs teachers to carry out certain teaching through audio, so we need to choose the appropriate audio control chip [5].

At present, multimedia equipment is favored by people because of its intuitive sense of vision and the enjoyment of hearing. In audio, many audio systems to CD, digital TV audio, digital audio processors and digital audio tapes, in the market deeply attracted a large number of consumers. S3C2440 core microprocessor internal integrated with IIS bus interface, can be external 8/16 bit stereo audio decoder integrated chip connected to the development of audio applications. S3C2440's IIS bus interface supports two data formats: MSB-aligned data formats and IIS bus data formats. Its interface uses DMA mode instead of interrupt mode to access FIFO, so that the core processor can receive and send data simultaneously at the same time. With the core processor interface support, in order to achieve the overall design goal of the audio module design, but also need to add audio control processor to assist. Here, the type of audio processing chip for the UDA1341TS is selected.

UDA1341TS is a DAC signal processing chip based on Bit Stream Converter. Its fully integrated analog front-end includes digital AGC and programmable gain amplifier. The UDA1341TS audio processing chip can support a variety of data formats, including 20-bit IIS bus data format, 20-bit highest significant bit alignment format, 16–18/20-bit lowest significant bit alignment serial data format, and complex data format combining the highest significant bit output with 16-or 18-or 20-bit lowest significant bit alignment data input. In playback mode, the UDA1341TS has digital sound processing features such as volume, treble, bass, stress removal, and soft mute, all of which can be controlled through the L3 - interface of the microcontroller. The UDA1341TS has digital sound processing capabilities that make it a great choice for home stereo mini drives and other

applications. It is also ideal for portable applications such as laptops, MD/CD stereos and digital video cameras because of its low power consumption and low voltage.

2.3 Wireless Communication Unit

Now the design system is developing towards the direction of network interconnection, so the training platform as a teaching device, Ethernet interface has become an indispensable module. In general, Ethernet communication is more complex, in addition to the core microprocessor to provide some necessary pins for use, usually need a more powerful, pin-complicated control chip to assist, so that it is easier to achieve the full function of Ethernet interface. At present, there are many kinds of Ethernet control chips on the market, and the quality of chips varies, and different types of chips can be used in different environments. Considering that the training platform needs to support the Linux 2.6 kernel operating system, that is, its network communication function should be the same as that of the PC used in our daily life. Therefore, the Ethernet control chip required to be selected has higher processing capacity and better functions. Based on these factors, the DM9000, which is widely used in the industry and developed by DAVICOM, is chosen as the control chip of the Ethernet module of the training platform [6].

The DM9000 control chip is a fast Ethernet control processor integrated with MAC, PHY and MMU. It is also known as the DM9000 network card. Its internal configuration has a 4 KB double-word SDRAM buffer space, as well as 10/100 Mbps adaptive transceivers. The DM9000 offers four general-purpose, versatile GP10 pins that allow the core microprocessor to read and write data and manipulation commands from its internal memory at a byte/byte/double Word length to support different processors. The DM9000 supports both half-duplex and full-duplex modes and provides a media-independent interface that can be effectively connected to all transceivers or network devices that support media-independent interface functionality. In addition, the DM9000 also has a power failure handling capacity, ultra- low power consumption, compatible 5 V and 3.3 V input and output voltage, easy to use, easy to port and so on.

The above process realizes the selection and design of the hardware unit of the design system, but it is still unable to carry out the training and teaching of computer specialty.

3 Design of Software Module of Training and Teaching System for Computer Specialty

The software module of the design system includes the training content module, wireless node configuration module and database building module. The specific design process is as follows:

3.1 Content Module of Practical Training

Starting with the analysis of professional demand, the professional post quality, ability and key post skills of computer major are decomposed and the core professional ability is cultivated. According to the quality and key professional ability requirements

corresponding to the job positions, design the talent training program for the specialty according to the production process of typical electronic products, and really implement the work-study talent training mode with real (enterprise) work tasks as the carrier [7].

Computer professional training teaching is divided into three stages.

(I) Stage of cultural quality cultivation. Students first learn English, computers, advanced mathematics, two courses and other cultural quality courses at school. Then they choose a certain social work post to carry out social practice for one month during winter vacation to understand the quality requirements of society for highly skilled talents and accumulate certain social work experience. Teaching time is 1 semester.

(II) Stage of basic skills training. Students in the school to professional basic ability training as the center, as the carrier of the item to complete the multimeter, radio, television and other electronic products installation and commissioning and electronic measurement technology learning. During the second and third semesters of study, students shall take turns to take such posts as the assembly and debugging of electronic products and electronic measurement technology in the typical training bases within and outside the school, participate in the production training and labor for two months, and complete certain work tasks under the joint guidance of the training teachers and the enterprise masters. Through practical training, practice, learning by doing, learning by doing, integration of "teaching, learning, doing" in one, so that students master professional knowledge at the same time with the professional skills required for the post. Teaching time is 3 semesters.

(III) Stage of post comprehensive ability training. Students can complete the design, installation and debugging of SCM control system, innovative design, installation and debugging of multi-function digital clock, electronic display and other typical electronic products. In the sixth semester, students in the cooperative enterprise off-campus internship base selection and application of electronic technology professional related posts, post comprehensive ability training, complete the 6 months internship. Through innovative design and production, on-the-job practice and other practical teaching links to carry out comprehensive training of professional skills, cultivate students' knowledge application ability, independent learning ability and coordination and cooperation ability. Teaching time is 2 semesters [8].

Under the background of "three finances", the main characteristics of computer professional training teaching are: First, to achieve three years of uninterrupted integration of the whole process. In the process of learning, students alternate skills training and on-the-job practice in classroom, society and practice bases both at home and abroad for three years without interruption, which is conducive to the cultivation of professional quality and practical ability. In the training of basic professional skills and comprehensive abilities for posts, students shall be assessed in accordance with the standards for the assessment of abilities for posts and vocational standards, and the certification of professional qualifications such as "Assembly and Deployment of Electronic Instruments and Meters i}", "Certificate of Technician for Electronic Products" and "Certificate of Debugger for Electronic Products" shall be completed, so as to realize the integration

of diploma and diploma and vocational qualification certificate; and thirdly, the training of professional qualities in the whole process. Attention shall be paid to the cultivation of students' professional ethics, technical knowledge, operational skills and basic professional quality, and the cultivation of professional quality shall run through the whole teaching process. At the same time, actively help students with career planning.

3.2 Wireless Node Configuration Module

The wireless node module in the design system includes fixed node and mobile node, and all modules are integrated with two parts: CC2530 controller and functional equipment. The functional equipment is all kinds of sensors, and the CC2530 controller is the core of the whole module. This design completes the design and implementation of the whole wireless node on CC2530 chip. This design uses the Z-Stack protocol stack issued by TI Company, which has been widely used as the specification of software in wireless networking industry [9].

The Z-Stack protocol stack hierarchy is shown in Table 1.

Table 1. Z-stack protocol stack hierarchy table

Arrangement	Name	Describe
APP	Application layer	Functions created by developers based on requirements
HAL	Hardware layer	Contains hardware related driver configuration and functions
MAC	Mac layer	Contains configuration parameters and lib library
MT	Monitoring and debugging layer	Control other layers through serial port to realize interaction
NWK	Network layer	Contains network configuration and interface library
PROFILE	Af layer	Including af layer interface
SECURITY	Security layer	Include security processing interface
SERVICES	Address processing layer	Contains interfaces that define address patterns and processes
TOOLS	Engineering configuration layer	Including space partition and z-stack configuration
ZDO	ZigBee device layer	Contains service objects used by developers
ZMAC	ZMac layer	It includes the interface of mac layer and network layer in z-stack

(*continued*)

Table 1. (*continued*)

Arrangement	Name	Describe
ZMAIN	Main function layer	Contains related hardware configuration and entry function
OUTPUT	Output layer	Automatically generated information

As shown in Table 1, the Z-Stack protocol stack is a semi-open source software, and part of the code is provided to the developers as a function library. In the actual application development process, the developers do not need to change the underlying function implementation, but only need to provide the function interface to achieve the function they need, which greatly reduces the difficulty of development. The Z-Stack protocol stack realizes each level of software function according to ZigBee standard, and the developer realizes his own function in this level of software. It can be said that the Z-Stack protocol stack is a complete small operating system. The system mainly completes the running and task execution of the system by the way of round robin and event-driven.

This design mainly completes the system design and realization in the wireless node module through the IAR project. The whole system starts from the main () function of ZMain.c file under ZMain layer. This function mainly realizes two tasks: initializing system configuration and running operating system. In the task of initializing system configuration, the main task is to initialize hardware devices and some modules needed in the protocol stack, such as interrupt configuration and timer configuration. When the initialization is completed, the system is a dead loop, which processes events by querying the current task list. The implementation can be polling or event-driven, depending on the configuration. Query and process tasks in the current system are processed according to the level, the priority of different levels is different, in which the MAC layer is the highest priority and the application layer is the lowest priority. Once the entire Z-Stack stack has been configured, the next thing to do is to implement the functionality for each wireless node. User function is implemented in the application layer, through the specific functional requirements to complete the corresponding system configuration, functional programming, so as to achieve the corresponding implementation.

It should be noted that the platform uses a multi-hop approach to complete the entire wireless node networking implementation, as shown in Fig. 1.

Fig. 1. Effect of wireless networking

After the whole system starts up, the functions of each layer will be handled automatically according to the configuration, and after the processing is completed, the functions of the current nodes in the whole network will be set up according to the configuration of the current application layer: the coordination node, the routing node and the terminal node, among which the coordination node is also the root node, which mainly completes the selection of the whole network channel and the creation of the network; the routing node is the transit node, which mainly assists other nodes to join the network; the terminal node is the sensor node, which is mainly used to collect data and forward data. When the network is started up, both the routing node and the terminal node will automatically find and join in the created network, and the routing node can be used as a transit node to connect to the wireless network indirectly.

3.3 Database Creation Module

There are many subsystems in the system, such as the content inquiry subsystem, the result management subsystem, the computer room management subsystem, the flow management subsystem, the consumption management subsystem and the reading room management subsystem. Eclipse can also meet the needs of different vendor tools in the same integrated development environment, so that the tools among vendors can achieve interoperability, and then optimize the project workflow. Eclipse extension point mainly refers to the use of conventional expression filter to complete a simple string description of the Java class, the process can be done with Eclipse extensibility, effectively reducing the complexity of the program. And extension points defined by Eclipse plug-ins can meet the needs of other plug-in applications, and can also work in extension points defined by other plug-ins. Apart from having prior knowledge of the interfaces defined by the extension point, there is no way at the plug-in port to know how the services it provides from the extension point will be utilized. When operating with Eclipse, the system designer fulfills complementary requirements by combining high-level design with low-level development tools that are connected by Eclipse extension points. When the system developer checks with the debugger, the UML dialog box feeds the actual operation of the device back into the hands of the system designer and developer. Because Eclipse does not know the development language, either the Java language debugger, the C 10 debugger, or the assembly debugger is valid and can target different processes or nodes simultaneously within the same framework [10].

The algorithm for brushing professionalism is as follows:

Step 1: the program starts, transfer income function initialization serial port;
Step 2: Use SndCmdQuery to check the status of the professional machine, if no professional is found to continue;
Step 3: Use the SndCmdIdentifyCardType function to check the professional type, if there is no specific training professional content, then turn to step two; if you find the professional code, you need to return to the professional page. If it can not identify the professional, remind them of the relevant information after the second step;
Step 4: transfer the function to compare passwords, read and write professional processing;

Step 5: If the received message is wrong, it is necessary to send and retransmit the request message according to the degree, and wait for retransmission; If the professional machine does not appear due to noise after a certain time, it needs to reset the professional machine with the IcReset function;
Step 6: Operation process need to display, call can be mobilized when the corresponding function;
Step 7: When the professional reading and writing of the professional operations completed, ScdCardOver can be used to represent the end of the function;
Step 8: To continue processing, you need to go to Step 2.

Through the design of the hardware unit and software module, the operation of a computer professional training teaching system is realized, which provides some help for the education and training of computer majors.

4 Experiment and Result Analysis

The above process realizes the design of practical training and teaching system for computer specialty. In order to verify the performance difference between the design system and the existing system, a comparative simulation experiment is designed. The specific experimental process is as follows:

4.1 Construction of Practical Teaching Environment for Computer Specialty

In order to meet the requirements of large-scale student training, the cloud operating platform environment needs to set up 6 nodes. Specifically, by configuring 6 working virtual machines in the Vmware Workstation, the management of the system can be controlled in real time. Each virtual machine should be configured with 1 node and connected to the server. Among them, it is necessary to set up one node as the main node or name node (Nameno-deb) to connect with the main server of the system, and the remaining five nodes are the children of the system or data nodes (DateNode). In the specific configuration process, it is necessary to configure these nodes with corresponding IP address assignment and host, and the specific configuration is shown in Table 2.

Table 2. Configuration table of IP and host of design system node

Node type	IP Address	Host name
NameNode	192.168.1.110	Master
DateNode	192.168.1.111	Slaver1
DateNode	192.168.1.112	Slaver2

(*continued*)

Table 2. (*continued*)

Node type	IP Address	Host name
DateNode	192.168.1.113	Slaver3
DateNode	192.168.1.114	Slaver4
DateNode	192.168.1.115	Slaver5

It is a complicated process to set up a big data-based computer professional training platform. In this process, it is necessary to set up the SSH password-less login password of the system, and generate the key pair on each node of the system to manage the system.

4.2 Implementation of Design System Software Module

Students can submit their own training tasks by entering the management page, selecting and clicking the corresponding training task submission list option after completing the training operation. As for the results, if the submission status is displayed as complete, it means that the user's training project has been submitted and completed 9. After the submission information is completed, students can, on the one hand, generate test papers according to their own needs and measure their learning effects; on the other hand, they can browse the content of the test papers after clicking. If the submission status displays incomplete, the student is not likely to complete subsequent related operations.

According to the corresponding specifications for software system testing, this system mainly adopts the mixed mode of B/S and C/S of the computer practical training platform based on cloud computing in the actual testing link, sends the source program to the evaluation server through the browser at the client end of the system, analyzes the stability, security, fault-tolerance and other related performance tests of the server during the working process, and analyzes the relevant test data. Through testing the function of the system, such as the function of training, the function of generating test paper, the function of evaluation, the function of students and teachers, the function of broadcasting, the function of virtual experiment, the function of program debugging, the function of courseware uploading and downloading and so on, it is found that the system runs stably and can meet the requirements of the system.

4.3 Analysis of Experimental Results

Server utilization is used to show system performance. Experimental server utilization data is shown in Table 3. Server utilization is a measure of data utilization within a specified time. The formula is as follows.

$$\gamma = \frac{\alpha}{\beta} \times 100\% \tag{1}$$

Where, γ represents server utilization, α represents the amount of server data, and β represents the amount of data that the server can hold.

Table 3. Server utilization data table

Number of experiments	Existing systems	Design system
1	70.15%	56.42%
2	86.12%	60.12%
3	85.56%	60.00%
4	80.12%	58.75%
5	84.75%	54.45%
6	89.45%	54.12%
7	87.12%	50.13%
8	81.24%	54.78%
9	87.50%	59.58%
10	81.01%	50.14%

As shown in Table 3, compared with the existing system, the server utilization rate of the design system is lower, which is less than 70%, indicating that the design system has good operation effect, which fully proves the effectiveness and feasibility of the design system.

5 Conclusion

Under the background of "three financing", this paper designs a new computer professional training teaching system based on big data, which greatly reduces the server utilization rate, ensures the stable operation of the system, and provides help for computer teaching.

6 Fund Projects

Source: General Project of Jiangxi Provincial Department of Education Science and Technology.

Research Title: Research and Practice on the Construction of Maker Service Base for College Students Based on Mobile Internet of things.

Project Number: 171223.

References

1. Zhao, Y., Le, J., Zhu, L.F., et al.: Study on the effect of hypertensive treatment based on drug factor analysis model under the background of big data. J. Intell. Fuzzy Syst. **37**(11), 1–14 (2019)

2. Shim, J.P., et al.: Purchase-based analytics and big data for actionable insights. IT Prof. **21**(5), 48–56 (2019)
3. Song, W., Xu, M., Dolma, Y.: Design and implementation of beach sports big data analysis system based on computer technology. J. Coast. Res. **94**(1), 327 (2019)
4. Li, W., Zhu, J., Zhang, Y., et al.: Design and implementation of intelligent traffic and big data mining system based on internet of things. J. Intell. Fuzzy Syst. **38**(2), 1–9 (2020)
5. Tian, C., Tian, Z.: Optimization research of ship power system based on big data. J. Coast. Res. **94**(1), 137 (2019)
6. Hu, Z.M., Luo, L.L., Li, L., et al.: Indigenization of the median of markers for down syndrome screening based on statistical analysis of medical big data. Taiwan. J. Obstet. Gynecol. **59**(4), 556–564 (2020)
7. Wu, J., Jia, D., Wei, Z., et al.: Development trends and frontiers of ocean big data research based on citespace. Water **12**(6), 1560 (2020)
8. Liu, S., Bai, W., Zeng, N., et al.: A fast fractal based compression for MRI images. IEEE Access **7**, 62412–62420 (2019)
9. Breen, C., Zhu, T., Bond, R., et al.: The evaluation of an open source online training system for teaching 12 lead electrocardiographic interpretation. J. Electrocardiol. **02**(3), 454–461 (2016)
10. Jianqiu, L.: Construction of real-time interactive mode-based online course live broadcast teaching platform for physical training. Int. J. Emerg. Technol. Learn. **13**(06), 73 (2018)