Design of Human Resource Distance Education System Based on Internet of Things Technology

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Abstract. When the traditional distance education system deals with parallel tasks, there are too many network packets running in the system, which leads to the slow running of the system. This paper designs a human resource distance education system based on the Internet of things technology. In the hardware part, the structure of teaching processor is designed to form the circuit structure of human resource data acquisition and balance the data acquisition. In the software part, the Internet of things technology is used to build the system architecture, control the actual number of network packets, construct the function logic, and finally realize the function of human resources remote teaching. In order to prepare the software and hardware environment of the teaching system, two kinds of traditional teaching systems and the designed teaching system are applied to carry out experiments. The results show that the designed distance teaching system has the least number of network packets and the fastest running speed.

Keywords: Internet of Things technology · Human resources · Distance education system · Network package

1 Introduction

With the sustained and rapid development of the social economy, today's world has entered the era of rapid progress of information technology. The strong impact of information technology on traditional education has made great changes in the current education work in terms of teaching methods and teaching compositions. To do a good job of education modernization and improve the quality of teaching work, we need to enhance the informatization of teaching process. According to the relevant investigation, the focus of distance education supported by physical network technology is to deal with the interaction among teaching work, resource reserve and quality management. With the strong innovation of the current computer network technology, especially the realization of the personalized interaction function led by the physical network technology, the operation efficiency and service quality of the emerging system which provides various technical services for education work have been rapidly improved, and the effect

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of teaching interaction between teachers and students in the network situation is more significant, These are in line with people's expectations of the development of modern education [1, 2].

In related research, reference [3] proposed a problem-solving path with different difficulty levels in various disciplines by supplementing the existing learning tracking algorithm. The data set obtained by solving the path of the learner problem, and the optimal problem solving path through the recurrent neural network is suggested through the path data set. Reference [4] proposed a method of dynamically combining adaptive online learning courses based on learner activities, learning goals and instructional design strategies using Q-learning algorithm. The latter is based on the learner's behavior, and based on the learner's positive or negative feedback, it provides the necessary course content to achieve the learning goal.

Considering that experiments play an important role in the realization of the overall education goal, traditional education is restricted by the limitations of the region and experimental conditions, and it fails to show the teaching effect of the experiment effectively [5]. Therefore, it is necessary to construct a virtual teaching system with outstanding interactive effect, timely feedback and diverse display effects. Therefore, this paper designs a human resources distance education system based on the Internet of Things technology. In order to improve the operating efficiency of the system, the hardware part of the teaching processor structure is designed to form the human resources data acquisition circuit structure, which can balance the data acquisition. The software part uses the Internet of Things technology to build the system architecture and controls the actual number of network packets in operation to increase the operating speed of the system.

2 Hardware Design of Human Resources Distance Teaching System

2.1 Structure Design of Teaching Processor

The load-bearing device of the distance teaching system is mainly computer. So when designing the hardware of the distance teaching system, it is mainly designed for the computer carrying the teaching system [6]. Firstly, the processor required by the system is designed. The processor adopts S3C2410 as ARM processor, DSP processor selects processor of TMS320C6713B, and connects corresponding memory to form processor structure, as shown in Fig. 1.

According to the processor structure shown in Fig. 1, an FPGA is used to connect the interface between the arm processor and the external memory of the DSP processor, and to connect with the interface processor in the crossbar network. The HPI interface of the DSP processor is connected with the general interface of the arm, which helps to load the internal program of the processor.

In order to reduce the design difficulty of the simulation teaching system, cy7c1041dv33-iobgi static memory is selected. The SDRAM is used to control its storage capacity of 128MB, storage depth of 6 m and bit width of 32bit. Set the working voltage of the processor to ±3.3 V. The maximum clock rate of the chip is 142 MHz,

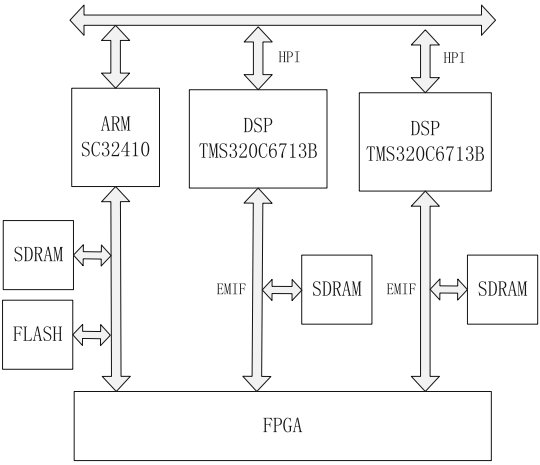

Fig. 1. Processor architecture

the data reading cycle is 5, and the reading time is 6 ns. The processor uses two FLASH memories, S29GL032M 10TAIR10 and no structure. Set the storage capacity to 2 m × 8 bit, control its working voltage to +3 V, debug the memory interface, and form the interface structure as shown in Fig. 2.

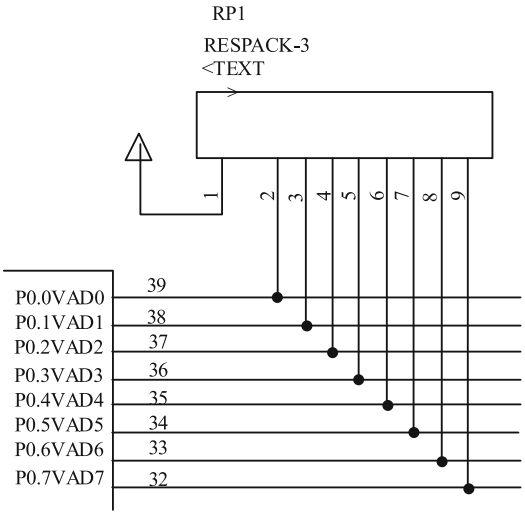

Fig. 2. Shows the interface structure

In the interface structure shown in Fig. 2, the working current for controlling read operation is 15 mA, and that for erasing and writing is 30 ma. Two FLASH memories with the above parameters are used, and one is used to store the code of distance teaching practice simulation teaching in the processor [7]. The other is used to store the

compensation calibration parameters of the setting processor. A storage capacity of 256 K is adopted × Two 8-bit SRAM control the data exchange inside the processor. All the above memory parts are connected to FPGA, and the control of memory is realized finally.

Fiber optic gyroscope (FOG) and flexible accelerometer (FAA) are used as the inertial components of the hardware. Rs-421 serial interface is used to realize the digital output of the processor and receive the data of FAA. I/F conversion circuit is used to convert the electrical signal in the processor into frequency signal. FPGA adopts EP3SL200F1152I3N with 65 nm process, and uses ALMs of 60 K in its internal to connect 4 GPIO in serial. One DC/DC power converter LTM4616 is used in power supply to provide two channels of current for processor [8]. Because the current requirement of the power supply in the processor is not high, the LDO conversion chip LTC1584-3.3 is selected to provide voltage and current for the hardware.

The teaching system takes the single-chip microcomputer as the core processing unit, combines with resistance and capacitance and other devices, and takes the single-chip microcomputer as the smallest processing unit. The final control core circuit composition block diagram is shown in Fig. 3

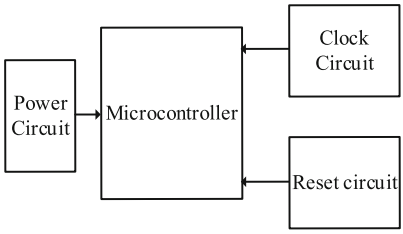

Fig. 3. Minimum system composition block diagram of STC89C52 single chip microcomputer

As shown in Fig. 3, the left side of MCU is mainly connected with power supply circuit, and the right side is connected with clock circuit and reset circuit. In the actual work of MCU, the time of accessing the memory from ROM is defined as a machine cycle, and the internal oscillator of MCU is used to store the access data of a machine cycle [9]. The XTAL1 and XTAL2 ports of the oscillator are used as the input/output

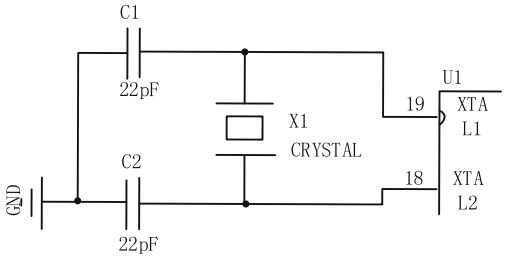

Fig. 4. Clock circuit diagram of single chip microcomputer

ports of the oscillator. The XTAL1 port of the oscillator is connected with a quartz crystal by internal and external clock mode. Then a capacitor is carried on the outside to form a parallel resonant circuit, which makes the internal oscillation circuit produce self-excited oscillation [10]. Finally, the connection diagram of the clock circuit is drawn. As shown in Fig. 4.

In order to prevent the single-chip microcomputer from being disturbed by the environment when it is running, the teaching system will fail. The reset circuit of the single chip microcomputer system is adjusted to the level switch reset mode, so that the teaching system is in the short circuit state when the power is turned on, and the reset pin is connected to the high level [11]. When the power supply is stable, the reset pin is grounded through resistance, so that the capacitor can isolate the DC level. The reset circuit of MCU is designed as shown in Fig. 5.

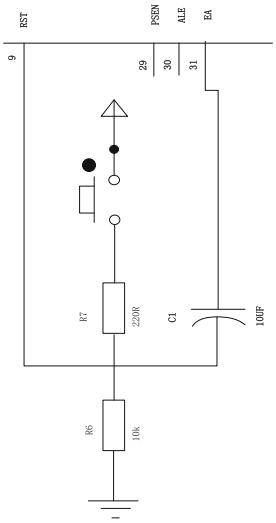

Fig. 5. Single chip reset circuit diagram

The power circuit uses USB to directly provide 20 V DC, in order to ensure that the program reading starts from the internal storage [12]. Connect the EA pin in the figure above to the high level to complete the design of the system processor.

2.2 Structure Design of Human Resource Data Acquisition Circuit

In order to ensure the smooth operation of the virtual scene simulated by human resources, a driving circuit is designed, which adopts the single power circuit structure, as shown in Fig. 6.

According to the structure shown in Fig. 6, when the power switch in the circuit is on, the supply voltage VCC helps the current of winding inductance L rise. When the current rises to the threshold, the system will be limited by the resistance R and control the current in a safe range [13]. In order to ensure the control of the controller by a single

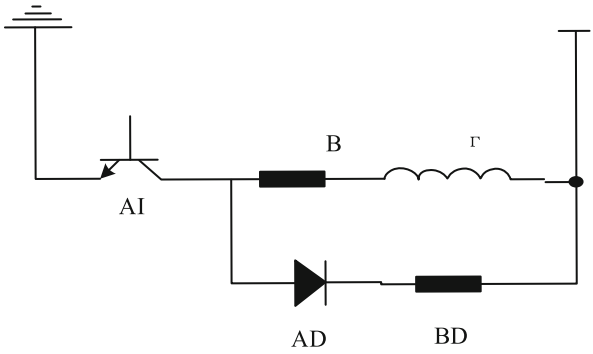

Fig. 6. Single power supply circuit

circuit, a power amplifier chip is connected to the circuit in Fig. 6. The chip selects ULN2003 as the driving amplifier, configures its pins, and sets pins 1–6 as the input pins to control the instruction of the teaching system. Pin 9–16 is output pin, external processor and power supply part [14]. Pin 7 is COM pin and control pin 8 is grounded. After the pin function is configured, a freewheeling diode is built into the chip, and the internal structure of the chip is shown in Fig. 7.

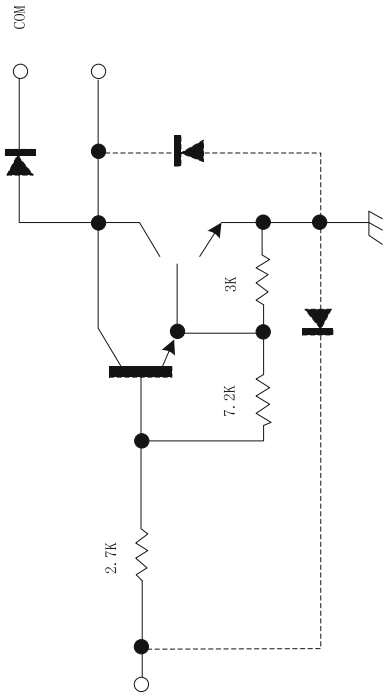

Fig. 7. Schematic diagram of internal structure of chip

As shown in the internal structure shown in Fig. 7, when the freewheeling diode chip output pin output low level. When the diode is not conducting, the output chip pin outputs high level. The high-level output value is too large, leading to the teaching system rate [15]. The hardware design of human resource simulation teaching system is completed.

3 Software Design of Human Resource Distance Education System

3.1 Using Internet of Things Technology to Build System Architecture

In the use of Internet of things technology to build a distance learning system, using B/S mode, using browser on direct access mode, in the front-end using htmlcss. JavaScript and other technologies to build a platform, in which HTML. CSS to achieve the display of the page, JavaScript to achieve the front-end business logic, including front-end data verification [16]. At the same time, we use Node. j s as our server-side language to quickly realize the construction of network services and application platform. The main function module on the server side directly supports the Internet of things browser and realizes the two-way communication with the client and the server side. WebRTC realizes the real-time transmission function of audio and video, and uses Express as the development framework of Node js [17] to ensure the smooth development of the server side. According to the needs of different users, the attributes of information-based teaching resources are demarcated. After contacting the entities of teaching resources with E-R diagram, they are converted to the selected DBMS record type. The sub pattern is used as the interface between the application and the resource database, and the data at the interface is collected and integrated into a data set A. A data transfer function is constructed

$$A(s) = \frac{\omega^2}{s^2 + Q} \tag{1}$$

In formula (1), s represents the data transmission time, Q represents the data transmission amount, and ω represents the buffer parameter. According to the above transmission process [18], it is assumed that the hardware structure has the same sensitivity to each incoming data, so an attribute parameter r is set, and the quantitative relationship of the parameters can be expressed as follows:

$$r^2 = (1 - e_{11})\left(1 + \frac{e_{11}(a_{11} + e_{21})}{2}\right) \tag{2}$$

In formula (2), e_{11} and e_{21} represent the data transmission amount at different times, and a_{11} represents the sensitivity parameter. Under the control of the attribute parameter, a shared signal delay parameter is set to form an attribute mode

$$\begin{pmatrix} u_{k+1} \\ v_{k+1} \end{pmatrix} = P\begin{pmatrix} u_k \\ v_k \end{pmatrix} + E_2\begin{pmatrix} 1 & j \\ 0 & \kappa \end{pmatrix} \tag{3}$$

In formula (3), u_k represents data stability parameter, v_k represents data transmission speed, j represents delay parameter, κ represents hardware structure sensitivity to

data, k represents signal transmission time, and P represents teaching resource attribute parameter. Under the control of different signal transmission time, in order to unify the data format of teaching resource data, the above processing sensitivity parameters and delay parameters are normalized

$$G = f\frac{T}{\kappa j} \tag{4}$$

In formula (4), f represents the working frequency of the hardware element and T represents the working period. According to the change of the above calculation formula, the normalized frequency of attribute parameters changes as shown in Fig. 8

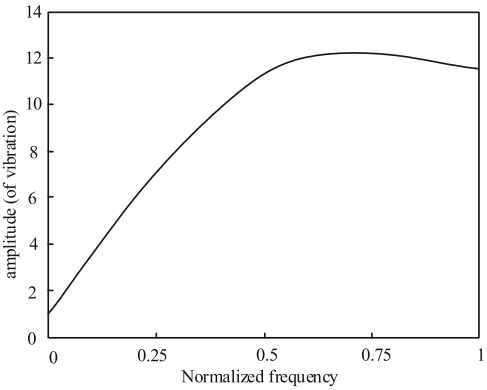

Fig. 8. Normalized change of attribute parameters

Under the normalized change of attribute parameters as shown in Fig. 8, the minimum amplitude frequency at different time points is controlled as the attribute division point, and the final system architecture is built.

3.2 Realizing the Function of Human Resource Distance Teaching

The front desk part focuses on the function composition of the students and teachers platform, registration module and login module. The front desk part is responsible for the teacher platform, student platform, registration function and login function. Among them, the function of the student platform is to effectively process the personal information, resource display, recent courses and other contents related to students [19]. Especially, given the student classroom, it can make students realize the existence of online video viewing, course browsing, group interaction discussion, etc., which is the key point of students to complete efficient learning. The teacher platform can handle the introduction and maintenance of each course, provide students with the necessary resources for effective teaching, enrich the knowledge reserve of the whole system, and the realization logic formed is shown in Fig. 9

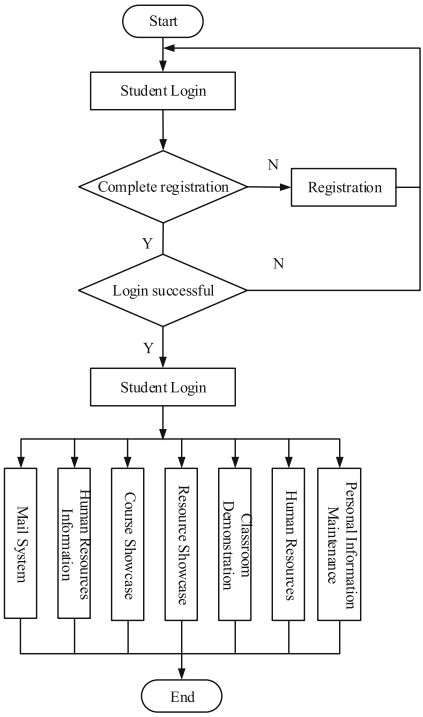

Fig. 9. The logical structure of the construction

Under the logic structure shown in Fig. 9, referring to the above logic situation, it can be made clear that students can perform the following operations in the platform when they formally log in to the system. First, the mail system in the station. This part can complete the mail receiving and sending, as well as the announcement and address book display operation. Students can use email to achieve daily mail delivery and other work. In the announcement, students can see the important announcement notes recently given. The address book is the email record between students and related personnel, which makes it easier to find the contact person. Second, the introduction of human resources, where students can refer to the details of their intended teachers [19]. Third, the latest course is displayed. There are recently introduced curriculum materials collected here, and students can check them in real time to determine the contents of the courses that are interested in in-depth study. Fourth, the latest resources display. Here, we collect the latest information, and students can check them in real time to determine the content that they are interested in in in-depth study. Fifth, students' classroom display. This will allow students to better complete the relevant work. Learning class can let students use it to realize online video access, course browsing, group interaction discussion and other operations.

4 System Test

4.1 Test Preparation

The main function of the system is online teaching management, the main function is teaching resource management, teaching program management, curriculum and training program management, curriculum learning and other functions. In addition, the online teaching system needs to meet the user access of multiple teaching bases, so the system test should ensure the correct operation of the system in terms of function and performance. Functional testing is mainly about requirement verification, which aims to ensure whether the final system implementation is consistent with the initial requirement analysis, whether it can meet the needs of users, and whether the requirement implementation is correct. The purpose of performance test is to verify whether the performance of the system can meet the requirements of multiple users accessing the system at the same time and whether the system runs normally. The test environment is as follows:

Table 1. Test environment parameters prepared

Composition of testing machine	Parameter name	Parameter details
Operator	CPU	Intel(R)Xeon(R)CPU ES-2430 0@2.20 GHz
	Memory capacity	64 G
	Hard disk capacity	1000 G
	Operating system	CentOS release 6.2 (Final)
	Web server	Node.js v0.10.26
	Database	MySQL5.6
Service machine	CPU	AMD A8-3870 APU with Radeon(tm) HD Graphics 3.00 GHz
	Memory capacity	18G
	Hard disk capacity	500G
	Operating system	Windows 7 旗舰版Service Pack 1
	Browser version	IE9, IE10, IE11, Firefox, Chrome, 360 browser

Under the parameters of operation machine and service machine prepared in Table 1, function test needs to cover the requirements analysis, so the design of requirement point and function test case is very complicated. Each requirement needs a large number of test cases to verify. As an essential part, testing accounts for more than 70% of a software life cycle. It shows that testing is very important in the whole process of software development, and software testing fully reflects the reliability of software. Through the testing process, we find out the neglected errors in the process of software development. In the process of software development, every link of the system should be tested periodically, and the problems should be found and repaired immediately. First of all, unit test is needed to test whether the components of the system are complete. This step is the test of the most basic module, which is usually completed by the programmer independently of the tester in the process of system development. The complete testing process needs to be completed by checking the syntax of the original code, finding data exceptions and detecting the basic algorithm of the program. Here, we need to build a test case and import it into the module under test to test the correctness of the module in the running state. The test environment is shown in Fig. 10.

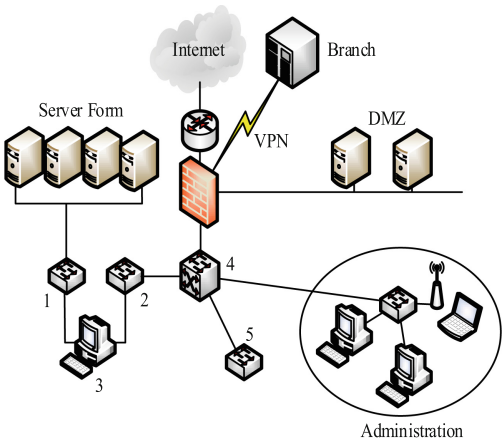

Fig. 10. System test environment

In the test environment shown in Fig. 10, software testers need to use the software as a user, test the input of the software through various situations, and check whether the output of the software is normal. The problems found in the process of trial operation are continuously corrected and improved, which are divided into the following three stages. First of all, test the software source code, according to the expected effect of online teaching system components, run the program code and feedback. At the same time, check the software source code, find the errors in the system module and correct them in time. Then, test the function of the system module. Use a variety of accounts of people with different identities to log in to the system, and perform the functions of reading, searching, adjusting, deleting, etc. to verify whether the software can achieve the expected effect, and whether the input information is correctly processed and applied. The third is to carry out open trial operation of the platform, collect and summarize

the problems encountered by teachers and students in the trial process, and make corrections and improvements. Delimit the use case number of human resource distance education system, and correspond to different operation processes in the number. The corresponding code and operation process are shown in Table 2.

Table 2. Set operation process and code

Operation name	Operation steps	Process description
CZMC-01	Fill in the account	Jump to page after correct input
CZMC-02	Fill in the password	If the password is filled in incorrectly, the corresponding prompt will be given
CZMC-03	Select login	Display management information
CZMC-04	Click on the question type	Navigate to the optional module
CZMC-05	Entry title	Jump to submit page
CZMC-06	Set the correct answer	Mark the score and give the score
CZMC-07	Input analysis	Jump after correct submission
CZMC-08	Select submit	Jump to the next interface
CZMC-09	Show add title content	Module classification
CZMC-10	Right key	Constructing the evaluation process
CZMC-11	Scoring criteria	Show the end after completing the selection

In the set operation process and compilation, prepare two traditional teaching systems and the designed teaching system for testing, and compare the performance of three teaching systems. The knowledge base used in the experiment in this article is based on a limited field. Here, the relevant courses such as "Comprehensive Experiment of Human Resource Management" in university undergraduate teaching are selected as the source of the knowledge base, and there are more than a thousand questions in the question bank.

4.2 Results and Analysis

Based on the above experimental preparation, the operation of the three kinds of teaching system is controlled, and the online number of the three kinds of distance teaching system is 50–1000. Taking 50 people as a functional test group, corresponding to different test items. The response time of the system is taken as the experimental index. The shorter the response time, the greater the throughput per unit time of the system and the more stable the operation. The response time of online teaching system is shown in Table 3.

Table 3. Response time of three distance education systems

Number of people online at the same time/person	Response time/S		
	Traditional online education system 1	Traditional online education system 2	The design of online education system
50	8.25	5.01	2.12
100	8.57	5.49	2.12
150	8.59	5.41	2.13
200	8.57	5.59	2.97
250	8.84	5.44	2.95
300	8.92	5.39	2.81
350	8.46	4.84	2.51
400	8.31	5.23	2.08
450	8.72	4.72	2.66
500	8.03	5.46	2.53
550	8.36	4.25	2.05
600	8.99	4.02	2.59
650	8.28	5.77	2.54
700	8.85	4.85	2.15
750	8.48	5.16	2.62
800	8.23	4.47	2.89
850	8.84	4.65	2.85
900	8.81	4.27	2.67
950	8.37	5.72	2.43
1000	8.92	5.15	2.53

According to the experimental results shown in the table above, the response time of traditional distance education system 1 is about 8.5 s, and the actual response time of the system is the longest. The response time of traditional distance education system 2 is about 5 s, but the actual response time of the system is longer. The response time of the designed teaching system is about 2.4 s. Compared with the two traditional teaching systems, the response time of the designed teaching system is the shortest.

Keep the above-mentioned experimental environment unchanged, the number of control system interface debugging is 20 times, call the task manager of the hosting system hosting server, calculate and count the call success rate of the three teaching systems, the higher the success rate of interface call, the system interface connection effect The better, the experimental results are shown in Table 4:

Table 4. Call success rate of three teaching systems

Debugging times	Call success rate/%		
	Traditional teaching system 1	Traditional teaching system 2	The designed teaching system
1	28.3	60.7	84.5
2	25.3	40.9	82.7
3	27.2	57.4	81.9
4	28.2	43.7	87.4
5	29.6	53.8	82.8
6	27.4	41.7	80.9
7	20.9	47.5	80.7
8	27.6	53.1	89.4
9	27.7	58.9	85.1
10	25.9	41.1	80.9
11	24.7	50.7	87.2
12	26.1	48.8	80.9
13	23.9	55.3	86.6
14	26.9	55.2	84.6
15	21.3	54.4	83.9
16	21.8	55.3	88.3
17	21.5	60.2	81.5
18	24.3	43.1	83.5
19	28.2	52.5	85.5
20	25.4	43.4	89.7

According to the debugging results shown in Table 4, the call success rate of traditional teaching system 1 is about 25%, and the actual debugging success rate of serial port is low. The success rate of traditional teaching system 2 serial port debugging is about 50%, but the actual success rate of debugging serial port is high. Compared with the two traditional teaching systems, the success rate of the designed teaching system is the highest.

In the above experimental environment, the test number of 500 people used in the three teaching systems is controlled, and the concurrent test number of distance teaching is set to be 10–200 groups. According to the set concurrent test group, the network packets used by the teaching system are counted and calculated. The experimental results are shown in Table 5.

Control three kinds of teaching system to deal with the teaching system with 500 people online at the same time, after setting different number of concurrent tests. According to the experimental results shown in Table 5, the average number of network packets

Table 5. The number of network packets used by the three teaching systems

Number of concurrent tests	Number of network packets		
	Traditional teaching system 1	Traditional teaching system 2	The designed teaching system
10	301	182	71
20	253	181	82
30	264	166	88
40	273	180	90
50	266	193	94
60	266	173	98
70	315	170	102
80	225	152	106
90	337	189	113
100	263	196	116
110	237	197	124
120	299	167	125
130	280	191	128
140	243	162	134
150	378	160	137
160	225	164	142
170	215	188	150
180	331	152	150
190	379	178	151
200	388	194	151

required for the normal operation of the traditional teaching system 1 is about 300, and the actual operation of the teaching system uses a large number of network packets, which is prone to network congestion. The average number of network packets required for the normal operation of traditional teaching system 2 is about 160, while the number of network packets required for the actual operation is less. Compared with the two traditional teaching systems, the designed teaching system uses the most network packets in processing.

5 Conclusion

The progress of network information technology accelerates the information circulation and improves the efficiency of online teaching circulation. In the past, the traditional teaching method was to teach through the topic, resulting in a waste of human resources. However, with the gradual popularization of online teaching, the whole teaching process

is electronized to reduce the waste of resources, improve the teaching quality and efficiency, and promote the accumulation and sharing of academic achievements. Based on the consideration of users, using physical network technology as the basis, the design of human resources distance teaching system can improve the shortcomings of traditional teaching system, and provide theoretical support for the design of teaching system in the future.

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