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Optimum design of distance education assistant system based on wireless network

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Abstract: In order to solve the problems of low operating efficiency, long response time and poor stability of distance education auxiliary system, a new distance education auxiliary system based on wireless network is designed. Design the hardware part of the system business process, optimise the subsystem functions. The subsystem includes course information query, teacher and face-to-face teaching process management, plan management and so on. In order to better realise related applications of hardware, audio and video signals are collected in software design by combining video and audio signal coding technology, and MMX technology is used for synchronous processing. The experimental results show that the designed system can effectively reduce the system response time and improve the system stability. *Conclusion:* This study lays a solid foundation for the stable operation of the distance education auxiliary system and realises the optimisation of one distance education auxiliary system.

Keywords: wireless network; distance education; assistant system; optimisation; system business process; subsystem functions; synchronous processing.

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Biographical notes: Zixiang Yan graduated from Xiamen University with a Master degree in Software Engineering in 2014, and he is recently an Associate Professor at Nanning University. His main research interest is in software engineering.

1 Introduction

With the rapid development of social economy and the emergence of various difficulties, such as the rapid development of Internet technology, the serious aging of the global population and so on, the educational threshold is facing a wider range of people and providing corresponding educational services to more people in society. How to effectively improve the important role of higher education in the social environment has become an important topic of research at this stage (Zhang et al., 2017; Cao and Mao, 2017). In recent years, China's distance education has developed rapidly, but there are

still many deficiencies in the present stage of distance education technology. One of the most important problems to be solved is the construction of resources, support services and other issues. China's existing resources are very scarce, and effective resources cannot be shared. The existing distance education services cannot meet the users' needs. In order to realise the real sense of distance education, there are still many problems that need to be studied in depth. At present, the management of distance education is a key factor for the sustainable development of distance education in China (Wang, 2018). Thus, the development of distance education has become a hot topic.

At present, some experts have given good research results. Deng and Zhang (2017) proposes the design of web-based distance education assistant system in colleges and universities. Firstly, from the development background, social needs and practical significance of the system, the distance video education system in university based on Web is summarised. Secondly, the development environment, development mode and operation environment of the system are described in detail by using object-oriented system analysis method and use case diagram. Then, starting with the analysis of the goal and requirement of the system, the overall design scheme of the system is put forward, and the function design and database design of the system are described in detail. Finally, the realisation method of each module in the system is introduced in detail by combining text with flow chart, and the testing process of the system is explained in detail by combining some test cases. However, the method is too complex and the practical application effect is not ideal. In Yu et al. (2018), based on SIP protocol, a distance education assistant system is designed. This paper analyses various network structures in the application of distance education, and proposes a hybrid network structure suitable for multi-area and multi-media transmission. The working principle of SIP distance education system based on hybrid network structure is also discussed, and the functions and specific implementation methods of each system component are expounded. It provides a new idea and method for the realisation of distance education system. But the teaching effect of this method is not good. In Cheng (2017), Wang Yong and others have studied an innovative quality education system. From the perspective of the latest educational system dimension, they reasonably define the connotation and classification of the educational system, analyse and study the educational mechanism, and set up an educational model through the corresponding feedback mechanism, which lays a solid theoretical foundation for educational research. In Li and Mo (2017), the research background and significance of distance education are analysed. Facing the key problems of "distance learning teaching assistant system", MVC design concept is adopted, Hibernate, Spring, Struts framework and relevant database technology are used, and a design scheme based on MVC model is proposed. But its application efficiency is low through practice. In Gupta et al. (2018), this paper puts forward a computer lab and hardo centralised remote control system solution. The system USES UDP broadcast mode to achieve the centralised control on all clients in the same subnet, using unicast and time delay technology, solved the problem of the certain system instantaneous bear ability is limited, the using window synchronisation technology, implements the client controlled window location and size of synchronisation, so as to realise the function of the mouse precise positioning, at the same time system also implements the function of each different client automatically input string. However, the response time of this scheme is long in practical application. In Price et al. (2017), a distance education system

based on web service is designed and implemented. B/S architecture, the use of Java EE, Flex, Red5 technology development and implementation. In this paper, we study the design of remote education system can well solve the traditional correlation between the larger question of education platform, students on its platform to register a account you can login, through friendly course choice, students can get their needs of course, at the same time inside the platform are independent of each other between different courses. But the stability of the system is poor.

The three methods mentioned above are related to the education system, but there is no research on educational assistance. The designed system in this paper will mainly focus on this aspect.

2 Optimum design of distance education assistant system based on wireless network

2.1 Hardware design of distance education assistant system

The traditional distance education auxiliary system cannot realise the management of teachers' face-to-face teaching process, and the course information is relatively chaotic. Therefore, on the basis of the traditional system, the business process of the system is sorted out, and the functions of each module in the system and the need for comprehensive analysis are analysed. Through the above analysis, we can find that the existing distance education assistant system has a large amount of business, and there are intersections and information exchanges between different departments. This paper comprehensively analyses the impact of different modules on the whole business of the administrative office, and improves the traditional system. The specific results are shown in Figure 1.

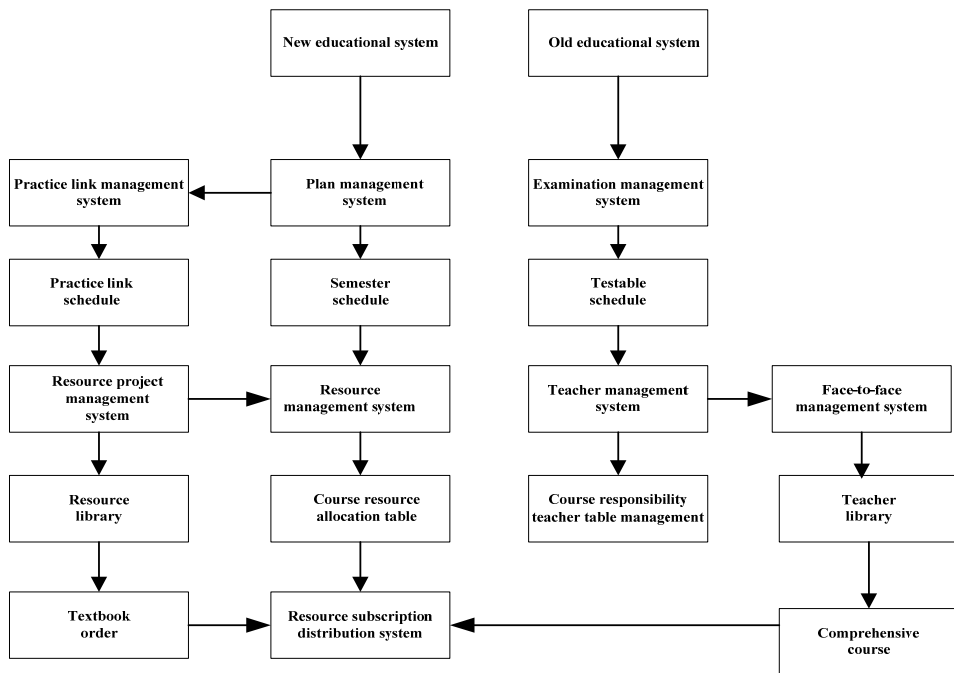
The above subsystems work mainly through the daily work of education management. The whole system contains most of the requirements of distance education management. The above requirements are not available in the existing system. Docking it with the data of the distance education management system can realise part of the education plan and make it find a certain balance point in the personalised development. The subsystems in the figure above constitute a new whole, which can be used as the main assistant of the designed system, and can work quickly and accurately to reduce human errors and human interference.

According to the special needs of the existing education, the operation process of the whole system needs to be strengthened. The designed system consists of eight subsystems. The following subsystems are briefly introduced:

(1) Course information query subsystem

This subsystem is mainly responsible for cooperating with the distance education management system, analysing the actual needs of the development of education, integrating and sorting out the teaching plan, curriculum rules and other data, and obtaining the relevant curriculum information of the new semester. All the information under the same course will be provided to the relevant managers to facilitate the query of teachers and students. The whole process is recorded and saved according to the real-time information exchange and dynamic update of each sub-module between the systems.

Figure 1 Hardware framework of distance education assistant system



The information obtained by course inquiry is mainly imported by distance education administrators through the system used. Other information can not be obtained directly in the distance education management system. Course information query can get all the information of the whole course from one site. As can be seen from Figure 1, the designed system is the basic system of the whole distance education assistant system and the only way to query courses.

(2) Teachers and face-to-face teaching process management subsystem

The subsystem mainly includes various sub-modules such as professional rule management and open course management. Different managers can make statistics by inquiring the basic situation of teachers in school, inquiring the opening situation of different majors and the teaching situation of each branch school.

The main purpose of the system is to monitor the whole process of face-to-face teaching between students and teachers, and to inquire about teachers' teaching situation at any time. It includes teachers' workload, teachers' attendance and so on. The authority of different users is different. The leaders of each branch school can inquire about teachers' teaching situation at any time.

(3) Planning management subsystem

This module is a supplement to the planning module of the whole distance education management system. In order to meet the personalised needs of the whole system, it is necessary to obtain the next work plan of the whole college, collate and process it, and obtain the whole course plan in line with the college, so as to provide a certain basis for practical arrangements.

(4) Resource management subsystem

The process of making, publishing and using different kinds of resources are saved, relevant feedback information is collected, and teaching resources are comprehensively managed. The whole process of resource utilisation is implemented and managed, to maintain and manage the resource database regularly, and provide appropriate data for system resource allocation.

(5) Resource project management subsystem

This subsystem is closely connected with the above subsystems, which can realise the mid-term review of teaching resources, and also need to maintain the normal operation of the whole system.

(6) Practice management subsystem

According to the teaching plan data of the above subsystems, the corresponding practices are arranged. The whole process needs to cooperate with the use of various subsystems. Firstly, the teaching resources project needs to be managed well through a series of operations. It is also the basis of the whole system.

(7) Examination management subsystem

According to the construction of distance education management system, different examination work is managed dynamically. Teachers in colleges are assessed in groups to realise real-time data sharing and ensure the correctness and unity of data. And through the machine core, real-time monitoring of the quality of teachers' work can be achieved, to keep abreast of the changing trend of related issues, real-time protection of possible problems found in the examination process, and ensure the smooth operation of the entire examination.

(8) Resource subscription and allocation subsystem

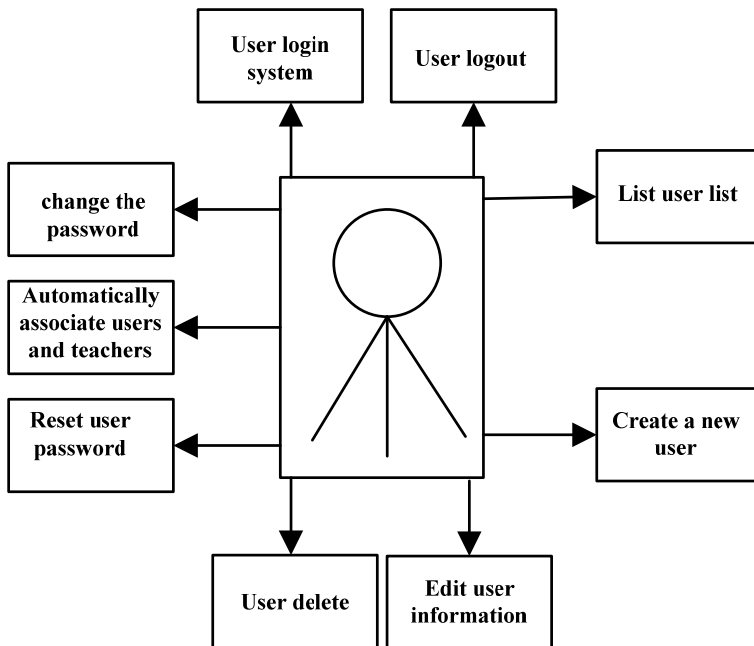
After resource allocation is determined, resource subscription and allocation can be completed. According to the characteristics of the relevant colleges, it is necessary to manage the related work. According to this subsystem, the resource subscription and allocation process can be monitored and managed comprehensively. And it can effectively improve the overall work efficiency and promote its overall work system. For the integrated teaching unit, it can effectively reduce the manpower and physical resources, and reduce the work cost by completing the resource subscription and allocation of the whole college through the design system (Diego et al., 2017).

Through the analysis of the basic needs mentioned above, and combined with the business needs collected by different departments of the college, the relevant project groups hold meetings and discuss, to get the following solutions.

User management module:

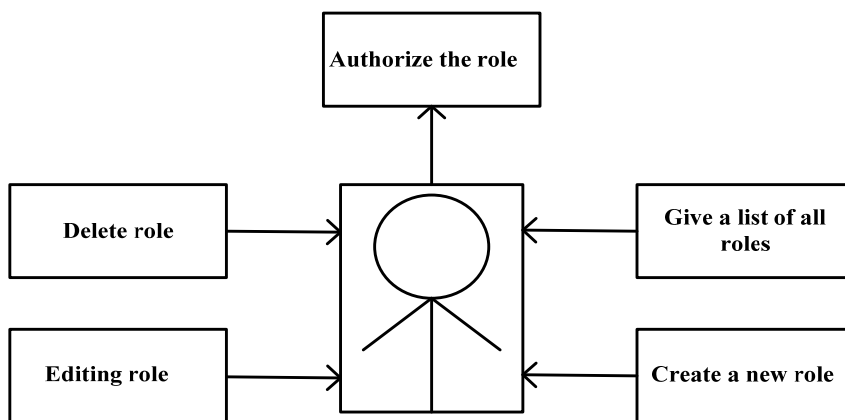
This module is mainly responsible for providing new user management functions for the system, and cannot provide the function of user self-registration. Users can only use the privileges of the system to create personnel. The diagram of user management module has been shown in Figure 2.

Figure 2 Diagram of user management module



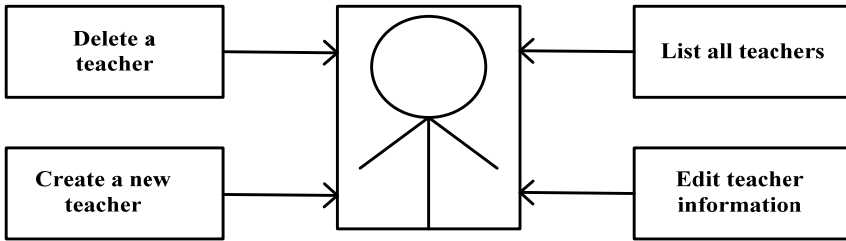
Role management module: The system provides various flexible role creation functions for modules, and sets corresponding functional permissions for adding new roles to the system. The diagram of role management module has been shown in Figure 3.

Figure 3 Diagram of role management module



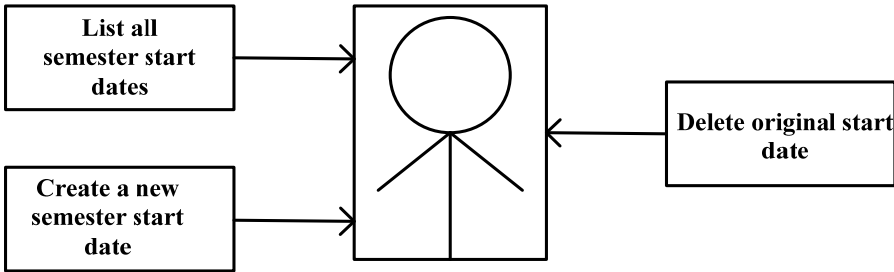
Teacher management module: This module is mainly used to maintain the related work of the teacher list, and the teacher team module in curriculum management is selected in the teacher list. The diagram of teacher management module has been shown in Figure 4.

Figure 4 Diagram of teacher management module



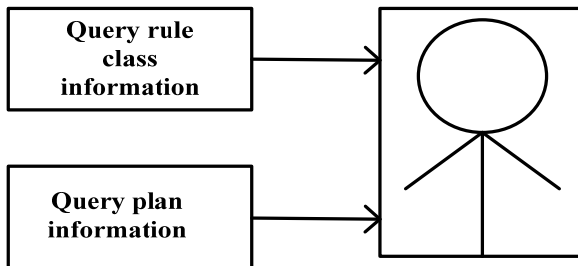
Semester setting management module: The system needs to maintain the opening semester of each semester regularly, so that the system can judge whether the students are currently in the school stage. The diagram of semester setting management module has been shown in Figure 5.

Figure 5 Diagram of semester setting management module



Course query module: The system can combine various conditions filled by users, construct query lists, and get the information needed by query lists. The diagram of course query module has been shown in Figure 6.

Figure 6 Diagram of course query module

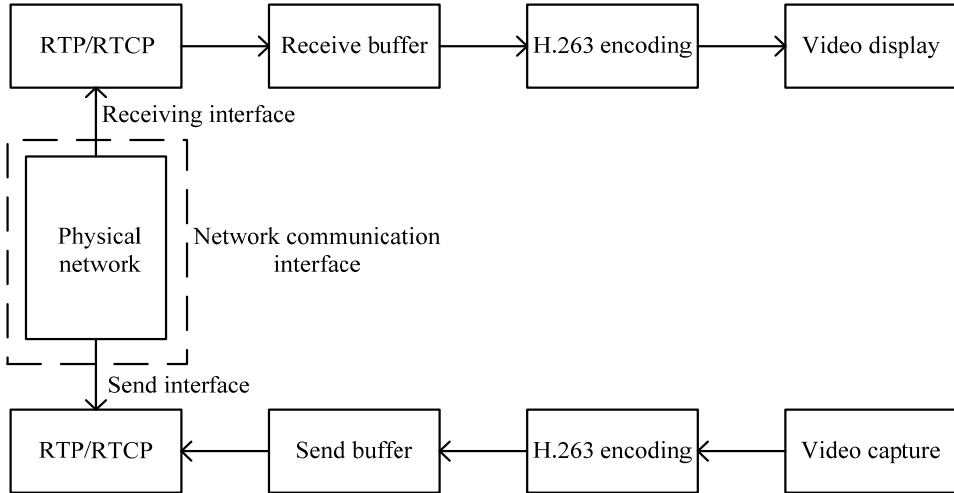


2.2 Software design and optimisation of distance education assistant system

As far as distance education assistant system is concerned, video and audio signals occupy the most important position in the software design of the system. The acquisition of video (Nazaroff, 2016; Royal, 2017) and audio signals is also an important module in the system. Real-time synchronisation of video and audio signals plays an important role in the system.

The software is divided into three different modules: video signal processing module, audio signal processing module and video and audio signal synchronisation module. It is described in detail in Figure 7.

Figure 7 Structure diagram of video signal acquisition



(1) Video signal acquisition:

As shown in Figure 1, video signal acquisition is mainly accomplished by the combination of camera and video acquisition card. The acquisition card is mainly responsible for the input of various videos (Loehfelm et al., 2016). It can output a variety of signals at the same time, and transmit the output signal to the encoding block for use.

There are two commonly used data formats, RGB and YUV. The above two formats can be converted arbitrarily. The following two space conversion formulas are given:

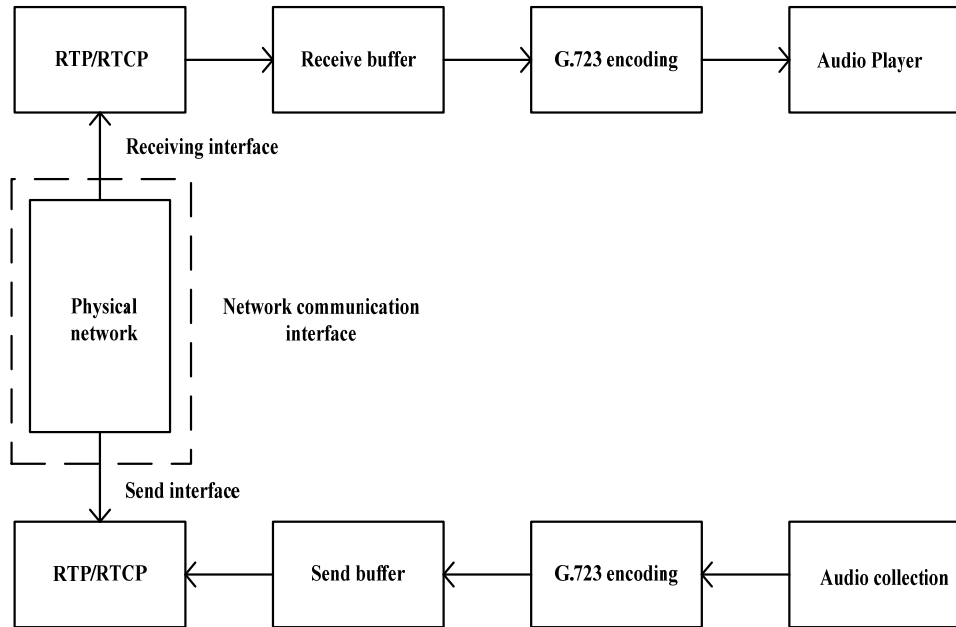
$$\begin{bmatrix} Y \\ U \\ V \end{bmatrix} = \begin{bmatrix} 0.299 & 0.587 & 0.114 \\ -0.1687 & -0.3313 & 0.5 \\ 0.5 & -0.4187 & -0.0813 \end{bmatrix} + \begin{bmatrix} 0 \\ 128 \\ 128 \end{bmatrix} \quad (1)$$

$$\begin{bmatrix} R \\ G \\ B \end{bmatrix} = \begin{bmatrix} 1 & 0 & 1.402 \\ 1 & -0.34414 & 0 \\ 1 & 1.772 & 0 \end{bmatrix} + \begin{bmatrix} -1.402 \\ 0.34414 \\ -1.772 \end{bmatrix} \times 128 \quad (2)$$

At this stage, in order to meet the development needs of real-time video transmission, experts at this stage mainly study how to reduce the complexity of the algorithm and computing time. The proposed method uses MMX technology to realise real-time transmission (Xu et al., 2016). MMX technology was adopted by Intel. To enhance the CPU for audio, graphics, and communications applications. MMX technology is the most important enhancement to the Intel architecture since the Intel386(TM) processor, which extended the architecture to 32 bits. The instructions of these technologies

can accelerate the processing of graphics, image, sound, etc. MMX enhances the lack of multimedia processing function. It can utilise its built-in multimedia instructions to simulate 3D graphics processing, MPEG compression/decompression, stereo sound, etc.

Figure 8 Structure diagram of audio signal acquisition



(2) Audio signal acquisition:

As shown in Figure 8, the audio signal acquisition equipment is mainly realised by sound card and microphone. The microphone is mainly responsible for capturing the analogue audio signal, and then sending the signal to the sound card. The sound card energy reduces the audio signal to digital signal, which is convenient for the system to process. MMX technology is also used to optimise the module, which can achieve real-time transmission of audio signals.

(3) Synchronisation of audio and video signals:

In the assistant system of distance education, the synchronisation of audio and video signals is an important index to measure the whole system. One of the most important points is to achieve lip synchronisation, so that users have a strong sense of reality.

In the network environment, the designed system needs to use the network to transmit to the receiving end for display. In the process of demonstrating the whole file, the receiver must keep in synchronisation with the media. In order to ensure the smooth progress of the whole process, it is necessary to introduce a strong synchronisation mechanism in the system to achieve real-time playback of teaching video and audio (Yang and Ma, 2017).

2.3 Implementation of distance education assistant system

When dealing with relatively complex systems, hierarchical systems are needed. The following advantages can be gained by applying the technology mentioned above to software writing:

- The level of the system, data access, business logic and so on are clearer. It is convenient to maintain the related business of the system and enhance the maintainability of the whole system.
- Setting up a special system level is responsible for the business logic of the processing system, so as to minimise the dependency and coupling among the levels.

In summary, by introducing layered technology, it can effectively enhance the maintenance and management of the system. At the same time, it facilitates the development of the system and improves the overall operational efficiency of the system.

The designed system applies hierarchical technology to education management and distance education.

Following is a detailed analysis of the scale and complexity of the software system using three-tier design.

(1) Business entity class:

This class mainly refers to the entity type of multiple services, which transfers between hierarchical data.

(2) Data access layer:

This class is mainly responsible for the maintenance of the data, the data will be transferred to the database in time, to achieve the operation of the database. All other databases operate in the same way. When the database is migrated or changed, it needs to be repaired simply.

(3) Business logic layer:

This class uses the method of DAL layer to verify the user name and password. After successful login, the system needs to maintain the browser's authentication status.

The remote teaching part of the designed system uses Flash to realise the client. Although some users' clients have strong expressiveness, due to security considerations, the above client can not achieve direct communication with the database.

From the functional point of view, on the premise of meeting their own conditions, no other system will provide standardised data information. The original system cannot be changed when the system function is extended.

3 Experimental results and analysis

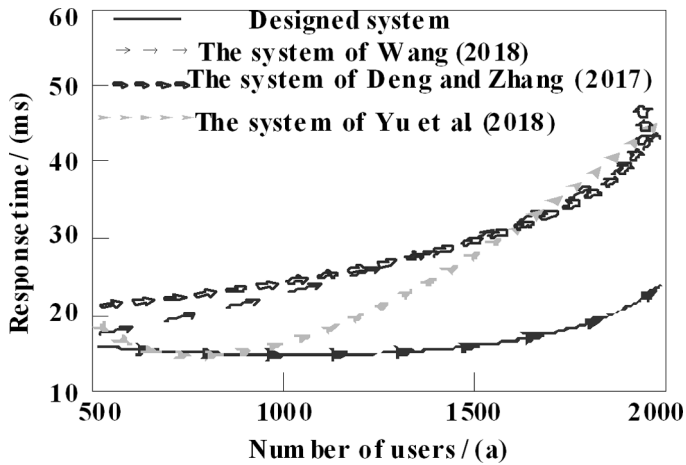
In order to verify the comprehensive effectiveness of the distance education assistant system based on wireless network, simulation experiments are needed. The experimental environment is DELL LATITUDE E6400 with InterCore i3M380 2.53GHz, 909MHz, and 4 GB memory. In order to verify the application effectiveness of the system designed in this paper, (Wang, 2018) system, (Deng and Zhang, 2017) system and (Yu et al., 2018)

system were selected as the control group, and the experimental results were compared with the test results of the system designed in this paper. The experimental indexes are the response time and system stability of the auxiliary system of distance education. The shorter the response time is, the higher the application efficiency is. The stability of the system is the key index of its applicability. The better the stability, the better the practical application performance of the system.

- The response time (ms) of different distance education assistant systems is compared, and the specific comparison results are shown in Figure 9.

Figure 9 shows that the system response time of the designed system is the lowest among the four systems. The main reason is that the design system uses the layered design method in the software part, which greatly reduces the response time of the system, improves the overall operation efficiency of the system, and also realises the optimisation of the designed system.

Figure 9 Comparison of response time of different methods



- Comparing the stability of different systems, the specific results are shown in Table 1.

Table 1 Stability comparison results for different systems

Number of experiments /(times)	Stability /(%)			
	The designed system	System in Wang (2018)	System in Deng and Zhang (2017)	System in Yu et al. (2018)
10	98	85	95	92
20	99	86	93	90
30	97	88	91	88
40	99	91	92	86
50	99	93	94	84

By comparing the results in Table 1, we can see that the stability of the designed system is the highest in the four systems, and the designed system has been in a relatively stable state, while the stability of the other three systems is relatively poor. Through the specific experimental data, the advantages and effectiveness of the designed system are fully verified.

4 Conclusions

The designed system has carried out in-depth research on different distance education assistant systems. By analysing the existing problems and shortcomings of the system, a new system, the distance education assistant system based on wireless network, has been designed. It introduces in detail the design and implementation of the course information query subsystem – the subsystem of the distance education management assistant system. Specific research work is given below:

- The current situation and development trend of distance education management system are analysed. The functions of different systems are compared, and the shortcomings of existing systems are analysed.
- By analysing the problems existing in the existing system, and improving it, a distance education assistant system based on wireless network is designed.
- Detailed demand analysis is carried out to realise the real-time query of course information, and the relevant characteristics of existing technology are analysed.

In the analysis process of the distance education assistant system, we can find that the management of distance education is very complex. Although a lot of efforts have been spent to improve it, the situation of each college is different. On the basis of the above, the distance education assistant system is very necessary. As an important supplement to the educational management system, the educational management assistant system needs to be designed by each college according to its own needs, which meets its own work needs and is compatible with the designed system.

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