

A Case Study of a University Distance Education System Based on Multimedia Technology

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ABSTRACT

Distance education learning support service system is a two-way information exchange platform for teachers and students to communicate and learn, and it is based on modern multimedia information technology. With the construction of a learning society, people's distance learning service system is more widely used for reasons such as occupation or hobby. How to improve the learning service system of distance education is an important subject. We must have a full understanding of the learning service system of distance education and find ways to further improve it through case analysis and reference. Using the methods of field investigation, mathematical analysis, and experimental research, this paper focuses on the methods and means of evaluating distance education by using information technology and puts them into practice and designs and develops a model-based modern distance education quality evaluation system.

KEYWORDS

Distance Education, Education Learning System, Multimedia Technology, Service System

INTRODUCTION

With the development of the times and the continuous advancement of the network construction level in colleges and universities, the traditional teacher-centered classroom-teaching methods have become outdated (Aslam et al., 2020). To promote quality education and cultivate the innovative thinking of college students, it is necessary to use modern information technology to create an excellent environment for independent learning, and fundamentally reform the traditional ways of teaching and learning (Biziuk et al., 2021). At present, multimedia-teaching methods are gradually becoming one of the core contents of modern education and training technology (Cheng et al., 2022). It promotes the reform of training concepts, training content, training methods, and creates a new teaching method for the field of education and training technology-distance education (Daraghmeh, 2021). China's distance education began with correspondence education in the 1950s. From the beginning

DOI: 10.4018/IJWLTT.330021

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until today, China's distance education has experienced three different transformation processes: the correspondence education mode (mainly printed materials), the radio and television education mode (with audio and video recording), and the modern distance education mode (mainly network and computer multimedia) (Dekusar & Davydova, 2020). With the development of modern information technology, modern distance education has become a new form of education. It is the main means to build a lifelong learning system in the era of knowledge economy. It focuses on modern distance education, integrates face-to-face teaching, correspondence teaching, self-study, and other teaching forms, uses a variety of media to contact teachers and students, and carries curriculum content.

With the development of computer networks, the current distance education, based on its flexibility, simplicity, reliability, compatibility, and other advantages, has become an important way of distance education (Grigoryan et al., 2020). Is distance education as efficient as traditional face-to-face education? Research shows that successful distance education is no less effective than traditional education (Grytsenko et al., 2021). It breaks the time and space boundaries of traditional teaching and enables people to realize the joy of free access to knowledge (Gribkova et al., 2020). It can use network technology to share educational resources, improve the learning mode, enhance communication between students and between students and teachers, open, a long-distance, large-area interactive teaching system, and through interactive teaching, allow students to gain an in-depth understanding of the difficulties in a course, as well as improve the ability of image thinking and creativity (He, 2020).

Summarizing the existing network education forms, it is evident that the network-based distance education systems are all based on or structured so that the educational resources are located on a central server, and students learn through a client or a browser (Jurayev, 2023.). If students want to communicate with one another, the message must be forwarded by the server (Nikou & Maslov, 2023). The advantage of this form is that functions such as user management and security control can be easily realized, and the system maintains well; thus it is able to take advantage of the convenience of communication and the abundance of resources brought by the Internet (Kuleshova et al., 2020). There are also some auxiliary teaching systems that appear in the form of general websites, such as forums, and their software structure design is mainly based on the idea of modularization (Li., 2020). The system with this structure has the problems of difficult deployment, poor cross-platform, poor adaptability, and high management, maintenance, and upgrade costs (Lee & Tan, 2020). In order to change this situation, many studies have been carried out on the software architecture of the visual distance education system at home and abroad, such as introducing streaming media technology and component technology, exploring the use of framework models, etc., but the results are not very obvious (Mohd Nor, 2021).

Modern distance education is mainly based on network and computer multimedia, combining individual autonomous learning and interactive collective collaborative learning (Tang et al., 2023). Its network information resources are significantly different from traditional information resources in terms of quantity, structure, connotation, type, distribution, communication scope, communication means, etc. (Pogulyaeva, 2020). The learning progress can be arranged at will, and there are many advantages such as excellent teacher resource sharing (Peng, 2020). However, the current distance education system in China is still in the stage of exploration and improvement. Looking at the general distance education systems on the market today, most of them have shortcomings, such as the inability of course students to ask questions, a weak dynamic interaction function, the inability to teach students according to their aptitude, video buffering time being too long, and the lack of vividness (Teregulov et al., 2021). At the same time, there are other problems in the system, such as network school bandwidth limitation, software and hardware compatibility, data security, service overload, and so on (Shukhratovna & Shukhratovna, 2023). Aiming at the above shortcomings, the authors designed a multimedia distance teaching system with relatively complete functions (Schultheis & Rizzo, 2001).

Although the development trend of online distance education in China is slow, the number of websites registered with EDU domain names is still rising at the rate of hundreds every six months.

From this obvious point of view, as early as 1998, the Ministry of Education issued the Action Plan for Revitalizing Education in the 21st Century, which pointed out that China's should vigorously develop online distance education, and at the same time, to speed up the pace, social forces and foreign investors to allowed to join this field. Focusing on the future Internet field, distance education is a very promising investment direction.

This paper designs a multimedia distance teaching system with relatively perfect functions. By discussing the application of Agent technology and peer-to-peer (P2P) streaming media technology in a distance education system, a multimedia distance education system with perfect functions and strong practicability was constructed, which provides a good sharing teaching method for teachers and students. The system can not only greatly improve the quality of mutual cooperation and trust exchange between teachers and students in the process of completing teaching tasks, but also enables teachers and students to flexibly and independently arrange teaching time, improve teaching efficiency, and it has strong practicality.

METHODS

System Software and Hardware Platform Composition

The material foundation supporting the proposed network distance-education system is an actual computer network, which is similar to the structure of network centers in schools at all levels (Wang et al., 2013). The material foundation supporting the network distance learning system generally consists of the following components:

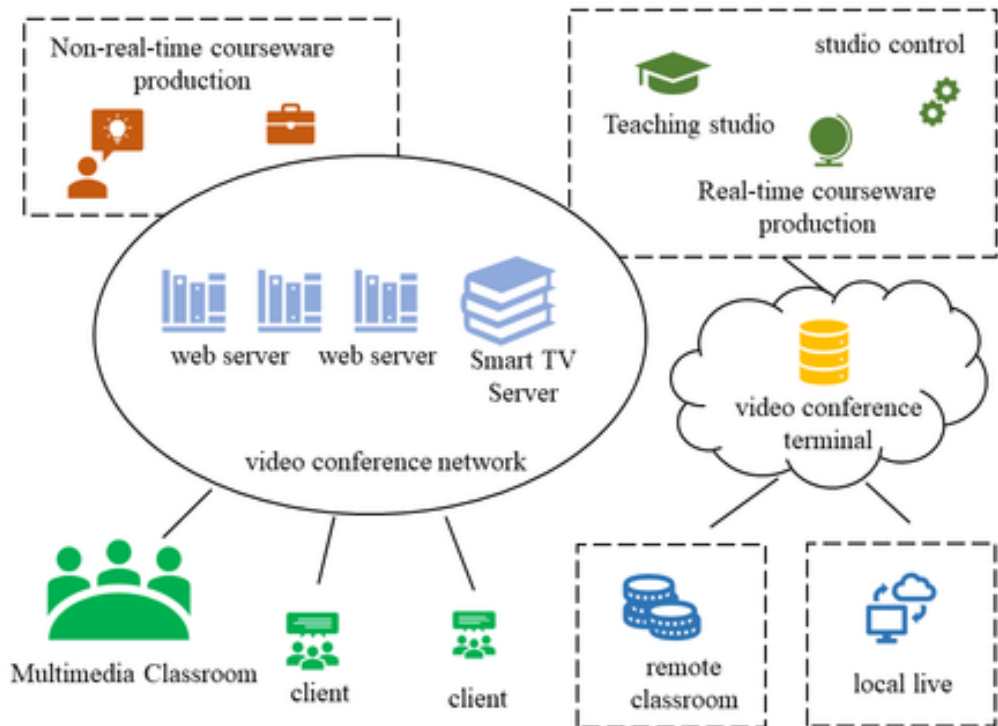
1. **Access Part:** The main equipment is a router, which is mainly used to connect the entire network to the Internet through the network dedicated line, so that users of the network can access Internet resources, while other network users can access network information.
2. **Switching Module:** This is the core of the whole network connection and transmission. The main equipment includes backbone switches, branch hubs, and network cables connecting modules, which form the whole backbone network.
3. **Server:** It is mainly responsible for the collection, storage, and release of information. They are the main entities providing external teaching and information services, generally including Web server, FTP server, E-mail server, DNS server, database server, etc.
4. **Network Management:** It mainly monitors the whole network, monitors the operation performance, alerts and diagnoses faults, etc.

Additionally, as a general distance education system, its hardware structure needs to be considered according to many factors, such as the number of students supported, the scope, and the way students access the network (Wilson & Wineburg, 1988). As the cost of hardware has fluctuated in recent years, and the configuration has become higher and higher, many servers costing about 10,000 Yuan can meet the needs of the system. For example, CPU: xeon3.0*2, memory: 4 GB, hard disk: 500 GB, and a RAID card is added to form a disk array (Wineburg & Wilson, 1998). The software structure of this system adopts the three-tier structure of Browser/Web Server/Database Server, the code is developed under the Windows XP operating system, the server adopts IIS6 under Windows 2003, the database adopts the SQL 2000 database system, and the development tool used is Visual Studio 2005. This system plans to use Agent technology and P2P technology to research and improve it (Zaborova & Markova, 2021).

Based on the campus network, the authors built a general interactive network distance-education system. The main functional modules of the system are shown in Figure 1.

The user management module mainly includes four roles: system administrator, information entry officer, student, and assessment administrator. System administrators primarily maintain the

Figure 1. The functional module structure of the multimedia distance education system



functional modules of the system, mainly system maintenance personnel; information entry personnel and assessment administrators are typically responsible for entering learning materials, and managing assessment questions, grade records, and other information; these are mainly college teachers.

The learning system module mainly includes a learning system, a courseware management system, and other modules. It generally supports students in course study and teachers' management of courses. The two-way real-time classroom system enables two-way video and audio interactive teaching, and document and screen sharing between teachers and students. In this way, a network-based virtual reality space is constructed, and the most advanced communication method in the network era can meet the needs of users for cross-space real-time interactive Q&A's, such as distance training and distance teaching. The current distance education virtual reality space is mainly the synchronization and sharing of multi-source data. The future direction of the distance education virtual reality space is to identify and dynamically capture through the sense of direction, indication, and operation habit of body behavior. Using the motion capture technology, one can simulate the actions of teachers and students in the remote classroom, and create a more real learning atmosphere than online remote teaching.

The test system module includes: a test question-creation system, an online test system, and a score query system, providing services for test results.

This module mainly includes system configuration, authority setting, data statistics, and other columns, which are used to manage and maintain the system.

Modern Distance Education in Colleges and Universities

"Modern distance education" refers to the third generation of distance education among the three generations recognized by the distance education industry. It is a new type of education and teaching

system. “Modern distance education” does not exclude the use of the first and second generation of distance-education communication media, such as text, print, radio, television, and video, but combines these communication methods in the best form, mainly using digital technology, to achieve the transmission of educational information.

The important feature of modern distance education is that teachers and students use modern educational technology to carry out real-time or non-real-time interactive teaching across space in a separate state. Compared with the traditional teaching form, it emphasizes the revolutionary teaching means and students’ individual independent learning. Its teaching mode requires openness, including the teaching concept, teaching objects, teaching resources, teaching methods, and teaching processes. This requires teachers to change from traditional face-to-face teaching to guided learning, and to design the overall teaching plan and courseware to facilitate students’ self-study. Their roles have changed from lecturers to participants and collaborators.

In China, “modern distance education” also has its special meaning or significance. First of all, the “Century-Oriented Education Revitalization Action Plan” formulated by the Ministry of Education of the People’s Republic of China formally proposed the implementation of modern distance education projects. China’s modern distance education project is mainly composed of hardware construction and software construction. Among them, software construction includes modern distance-education pilot activities, a distance teaching resources construction, distance-education support-environment research, distance education worker training activities, distance education strategy, laws, and regulations, and theoretical research. Among them, the modern distance-education pilot activity is the key point. Due to the large influence of the modern distance-education pilot activity, it has also attracted extensive attention in society. The image of the pilot program represents the image of China’s modern distance education project to a certain extent. Another meaning is that, according to the relevant documents of the Ministry of Education, all network colleges that implement the modern distance-education pilot project have a series of preferential policies, such as the right to enroll students independently and determine their majors independently. Therefore, the quality of modern distance education in colleges and universities is affected. Evaluation is more special.

In view of the extensive orientation of modern distance education in China—distance higher education using information technology, this paper only conducts quality-assessment research work on modern distance education in ordinary colleges and universities participating in China’s modern distance education project. It is called “modern distance education in colleges and universities” and is referred to as “modern distance education” hereinafter.

The Composition of the Modern Distance Education System

The sum of the components of the modern distance education system and the forms of connection between them is the structure of the modern distance education system. The components of a system are usually divided into element and subsystem levels. The important content of analyzing the structure of the modern distance education system is to divide subsystems, analyze the structural elements and relevant ways of each subsystem, and clarify the relevant ways between different subsystems.

Any system is generated in a specific environment, and then runs, continues, and develops in a specific environment. There is no system without environment. A group of things related to it outside the system is called the “system environment.” Therefore, the environment of the modern distance education system includes everything except the related system.

The modern distance education system is an open social system. The internal components of the system are interconnected, constrained, and interact with each other to jointly achieve the overall functions and objectives of the system. At the same time, as a social unit, the system interacts with other modern distance education systems and the external social environment, and exchanges personnel, resources, and information with the host society. Its main functions are as follows:

- **For Learners:** To overcome the relative separation of teachers and students in time and space, so that teaching and learning can achieve effective two-way interaction. Network distance education has flexible and diverse learning methods (autonomous learning): online learning can be carried out through the Internet in the form of courseware, video, online tutoring, etc., and the learning content can be sent to students through the Internet or satellite transmission system in the form of e-mail. Online discussion can also be conducted through BBS forums. Other ways can also be used for autonomous learning.
- **For Society:** Helping people who cannot attend traditional campus studies for various reasons receive higher education and train talents on a large scale with less investment and in a way similar to industrial production.

More importantly, the interconnection and interaction between the modern distance education system and the environment is realized by exchanging materials, energy, and information. The modern distance education system can survive and develop only if it is open to the environment, interacts with the environment, and exchanges material, energy, and information with the outside world (Asadullah et al., 2023).

RESULTS AND DISCUSSION

Agent Technology

Agent is a technology to study the behavior of virtual agents in the network virtual world. It is a new software architecture and system with the characteristics of autonomy, sociality, collaboration, interaction, mobility, and adaptability that serves the interests of human beings. Agent technology, especially the development of multi-Agent technology, enables software to not only be used as a tool for human beings, but also to become an active virtual agent representing human autonomous activities in the network world, and can form an organized group to serve its “master.”

Using Agent technology to research and improve the system, the system can automatically arrange the learning plan and progress according to the students’ cognitive level and ability, and realize personalized teaching. Teachers can also continuously adjust the teaching content according to the students’ acceptance ability, thus overcoming the existing system to realize the intelligent teaching of teachers (Figure 2).

The entire task is represented in Figure 2, and small arcs represent the dependencies. Through Figure 2, one can obtain the relationship between cloud computing tasks.

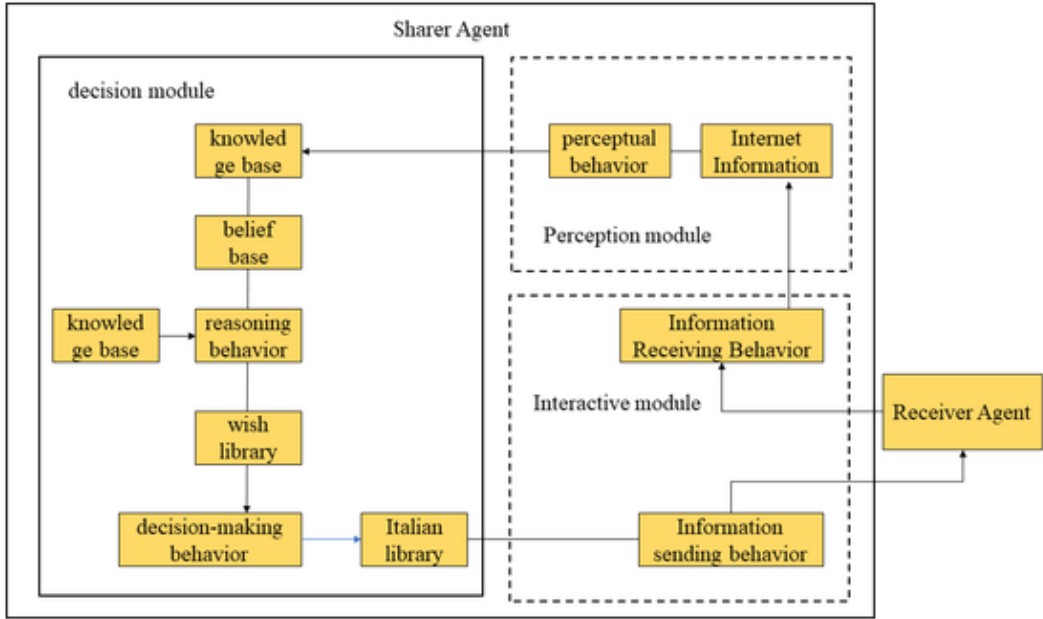
On this basis, the cloud computing task decomposition method, based on multi-Agent technology, adopts the fuzzy clustering method to cluster cloud-computing tasks. The specific steps are as follows:

1. Establish an initialization sample matrix according to the dependency W_i of cloud-computing tasks in the cloud environment.
2. In order to eliminate the dimension existing in the initialization sample matrix, standardize the initialization sample matrix.

In the formula: $i = 1, 2, \dots, N$, $w_k = \sum_{i=1}^N W_{ik} / N$ represents the mean value corresponding to the original data of the k -th dependency; d_k represents the standard deviation of the original data:

$$d_k = \sqrt{\left[\sum_{i=1}^N (W_{ik} - \bar{w}_k)^2 \right] / N} \quad (1)$$

Figure 2. Internal structure model of information sharing behavior based on agent



The compressed data is processed by standardization and controlled within the interval [0, 1].

- Use t_{ij} to represent the similarity of different cloud computing tasks, and its calculation formula is as follows:

$$t_{ij} = \left\{ \sum_{k=1}^m \exp \left[-3 \left(W''_{ik} - W'_{jk} \right) / 4d_k^2 \right] \right\} / m \quad (2)$$

A fuzzy similarity matrix T is established according to the calculation result of similarity t_{ij} .

- In order to ensure that t'_{ij} does not change, the fuzzy similarity matrix T is iteratively calculated to construct the fuzzy equivalence matrix T^* :

$$t'_{ij} = t_{ij} = \max_{1 \leq k \leq N} (t_{ik} \wedge t_{jk}) \quad (3)$$

- Set the threshold β . When the threshold is within the interval [0, 1], it means that the cloud-computing task has completed the clustering.

Using multi-Agent technology to decompose cloud-computing tasks, analyze the characteristics of agent capabilities; obtain the main tasks in the process of cloud computing-task decomposition, and complete cloud-computing tasks based on the hierarchical specification decomposition method. The multi-Agent system is one of the problems that people are generally concerned about in recent years.

As an important branch of distributed artificial intelligence, the multi-Agent system has autonomy, distribution, coordination, self-learning ability, organizational ability, and reasoning ability, providing a new solution for complex practical problems. Multi-Agent can help to complete certain work in some situations instead of human beings.

Decomposition of tasks: use D_{ij} to represent user j 's satisfaction with cloud-computing tasks, and use fuzzy notation to quantify user satisfaction and convert it into $\{0, 0.25, 0.5, 0.75, 1\}$, where 1 represents users who are very satisfied with cloud computing tasks, and 0 represents users who are very dissatisfied with cloud computing tasks. The average satisfaction of users is represented by $\bar{D}_i$, and its calculation formula is as follows:

$$\bar{D}_i = \frac{\sum_{j=1}^m D_{ij}}{m} \quad (4)$$

Decompose the task according to its structure and function to obtain multiple subtasks. When the subtask cannot be decomposed further, obtain the smallest task of cloud computing, and stop decomposing the task at this time. If the subtask can continue to be decomposed, evaluate the user's perception of the cloud-computing subtask. When user satisfaction reaches the threshold μ , task decomposition is stopped. Finally, it can effectively improve the network load efficiency and reduce the difficulty of task allocation, realize the reasonable allocation of resources, optimize the configuration, reduce the system overhead, improve the operation efficiency of the distance education system, and have good stability, which can meet the needs of online teaching services under the online teaching environment.

P2P Streaming Media Technology

Streaming media refers to continuous time-based media using streaming transmission technology in Internet/Intranet, such as audio, video, or multimedia files. The streaming media does not download the entire file before playing, but only stores the beginning of the content in the memory. The data stream of the streaming media is transmitted at any time and played at any time, with only some delay at the beginning. The key technology of streaming media is streaming transmission. The streaming media technology based on P2P is based on the idea of the P2P network to distribute and disseminate streaming media content. The system design is to make full use of the idle resources of many clients to build a streaming media distribution and dissemination system with low cost and good scalability. The application of technology can also more effectively prevent the impact of network jitter on the continuity of video playback.

Based on the analysis and description of the problem of a data distribution algorithm, in order to solve the data distribution problem within the distribution time interval, this section models this problem as a distributed data distribution model with optimal local delay. The so-called local delay optimal model refers to minimizing the transmission time of the distributed data block as a dynamic programming problem under the premise of ensuring a high quality of video playback. This problem is expressed by the following formula:

$$\left(\min \left\{ \max \left\{ T_1, T_2, \dots, T_{N-1}, T_N \right\} \right\} - delay \right) \quad (5)$$

The dynamic programming problem of formula (5) has N solutions and is NP-hard. Considering the network delay of the scheduling node sending the data block request message, the network delay of the data block spreading from the neighbor node to the scheduling node, and the sending time of

the neighbor node sending the data block, the priority formula for the neighbor node to transmit the requested data block is proposed as:

$$T_j = d_{ir} + d_{ri} + XNum_j / W \quad (6)$$

Here d_{ir} is the network delay from the scheduling node r to the neighbor node. The neighbor node: the network delay to the scheduling node r $d_{ri} + d_{ir}$ is exactly the round-trip delay time between the scheduling node r and the neighbor node; this time can be scheduled by scheduling. It is obtained by periodic message interaction between nodes and neighbor nodes. X is the size of a single data block, and the size of each data block is equal. The number of data blocks allocated by scheduling node r to neighbor nodes:

$$Num_i = \sum_{l=1}^N \sum_{k=1}^N \theta_{r/k} \quad (7)$$

In this algorithm, the time required to schedule each data block is related to the priority of the data block and the sending rate of neighbor nodes. Next, the historical information algorithm network is used to determine the sending rate of neighbor nodes. The specific solution idea is: after this scheduling is performed, the scheduling is completed within the cycle time T , and before the next scheduling is performed, the current neighbor node is estimated by using the data blocks transmitted during the execution of this scheduling. The rate at which data blocks can be sent: let q_{km} be: at. The number of data blocks missing from the requesting node received by the requesting node from its responding neighbor node k within a cycle, then the sending rate of the neighbor node k in $m + 1$ cycles is:

$$R^{(m+1)}(k) = \mu g \left(\sum_{l=m-M+1}^m q_k^{(l)} \right) / M \tau R^{(m+1)}(k) \quad (8)$$

where the expansion coefficient μ is a constant. μ is the return rate of each responding neighbor node requesting a block of data in the last scheduling period. If all the requested data blocks from the neighbor node are returned successfully, it means that the neighbor node can provide the next schedule at least at this rate.

Then, the matrix subsequence is completely parenthesized, and finally the result is parenthesized to obtain a complete parenthesis method of the original matrix sequence. From this, the recursive formula for gas can be obtained as follows:

$$P_{(n)} = \begin{cases} 1 & n = 1 \\ \sum_{k=1}^n P_{(k)} P_{(n-k)} & n > 1 \end{cases} \quad (9)$$

Based on the above analysis of the distribution process, this paper proposes that the basic idea of dynamic programming to allocate data blocks is that the requesting scheduling node selects and allocates the responding neighbors for the data blocks according to the data block priority sequence that has been obtained by the data block priority method. In the process of selecting neighbor nodes for the data block, the selected neighbor nodes transmit the data block, and these selected neighbor nodes satisfy the following formula, that is, select the neighbor node that can transmit the data block with the smallest time required:

$$\min \{t_{ri}\} = \min \left\{ \sum_{l_r=1}^J \sum_{s=1}^N (d_{ir} + d_{ri} + Xl_r / W) \theta_{sl_r,j} \right\} \quad (10)$$

where T satisfies the following formula:

$$T_i = -\ln(1 - \mu) / \lambda \quad (11)$$

Using formula (11), it can be obtained that relatively more neighbor nodes provide the most data blocks to the new node, so that the start-up delay of the node is small.

The results obtained by copying the dynamic equations in the above process are not necessarily evolutionary stable strategies (ESS) of the game process. Therefore, on this basis, it is necessary to further verify the system stability strategy. First, the Jacobi matrix of the game system (denoted as J) is calculated, and the stability of the system equilibrium point is verified by the calculation of J. The following are the partial derivatives of F(p) and F(q) with respect to p and q to obtain the Jacobi matrix, which is calculated as follows:

$$J = \begin{pmatrix} \frac{\partial F(p)}{\partial p} & \frac{\partial F(p)}{\partial q} \\ \frac{\partial F(q)}{\partial p} & \frac{\partial F(q)}{\partial q} \end{pmatrix} = \begin{pmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{pmatrix} \quad (12)$$

If the following conditions are met:

$$\begin{cases} tr(J) = a_{11} + a_{22} < 0 \\ |J| = \begin{vmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{vmatrix} > 0 \end{cases} \quad (13)$$

At this time, there are five points that meet the requirements of the equilibrium state of the system. Based on the Jacobi matrix obtained above:

$$a_{11} = (1 - 2p) \left[q \cdot t_j \delta_i - (t_i r_i + c_i) \right] \quad (14)$$

EXPERIMENTAL RESULTS AND ANALYSIS

Verifying the Effectiveness of Agent Technology

In order to verify the overall effectiveness of the cloud-computing task decomposition method, based on multi-Agent technology, this paper takes the cloud-computing platform as the experimental object. The environment is the network simulator 2.0 (Network simulator 2.0, NS2.0) simulation software, Microsoft Windows XP operating system, Intel(R) Celeron(R) 2.6 GHz processor, 16 GB memory, one simulation experiment test. The experimental parameters are set as Windows 10 operating system, 20-minute operation time, 150 Hz working frequency, and JAVA programming language. Taking the network load, task decomposition times, task decomposition time, and task execution time as

indicators, the cloud-computing task decomposition method based on multi-Agent technology is used to compare and test with the methods of literature.

The five cloud computing tasks are analyzed by the method in this paper, the method in the literature and the decomposition times used by different methods are compared. The test results are shown in Figure 3.

Analysis of Figure 3 shows that when the five cloud-computing tasks are decomposed, the number of decompositions used by the method is controlled within five times. When the task is decomposed, the number of decompositions used is less, which verifies the effectiveness of the method in this paper.

The network load is affected by the task decomposition situation; the better the task decomposition effect, the lower the network load.

Analysis of Figure 4 shows that in multiple cloud-computing task decomposition tests, the network load of the method in this paper is below 104 bytes, and the network load of the method in [3] and [4] is higher than 1.5×10^4 bytes. By comparing the test results for the methods shown in Figure 4, it can be seen that the network load of the method in this paper, after the decomposition of cloud-computing tasks, is low, indicating the method can complete the decomposition of cloud-computing tasks with high quality. The method in this paper analyzes the relationship between cloud-computing tasks before decomposing the tasks, and decomposing cloud-computing tasks based on the analysis results, reducing the network load.

In this paper, 30 initial sharing individuals and 30 recipients are set. This paper mainly simulates the sharing status between different individuals, and the rest of the sharing process repeats the simulation process, as shown in Figure 5.

Figure 5 shows the status of some sharer Agents during the sharing process. It can be seen from the figure that the sharer Agent has partially participated in the sharing process and shared information, and the receiver Agent has also made corresponding behaviors of receiving information and rejecting information; the monitor value on the left side of the figure has also changed. This also verifies that the risks, benefits, and costs in the sharing process all affect the process of behavior, and the more factors that individual users consider, the lower the possibility of information sharing, which is not consistent with real life experience.

Figure 3. Bar graph of task decomposition times for different methods

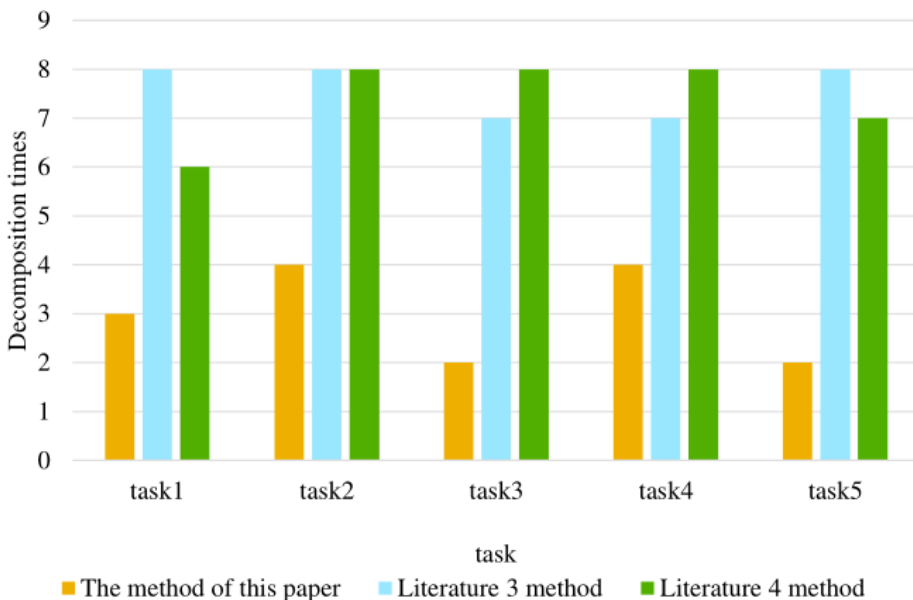


Figure 4. Network load situation diagram

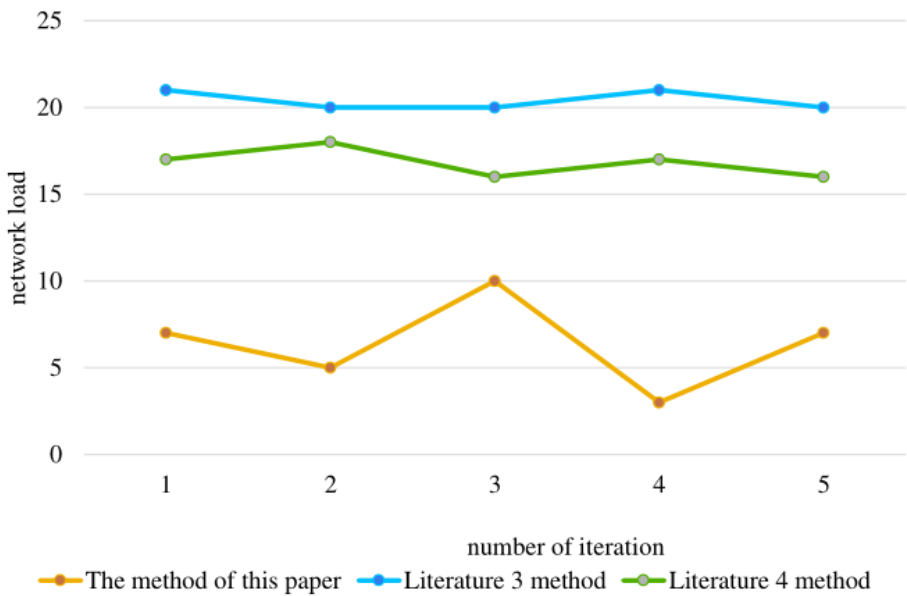
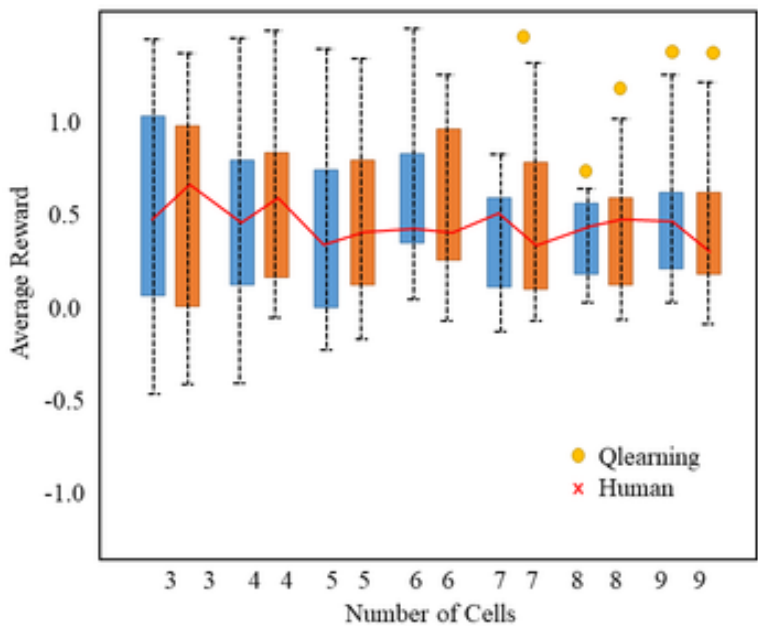


Figure 5. Sharing process simulation results



Analysis of P2P Streaming Media Simulation Experiment Results

The experiment is the simulation of the proximity-based cache data-selection algorithm in the video-on-demand of P2P streaming media proposed in this paper. The second type of experiment analyzes the adopted strategy of “first random download with the least number of slices first,” the network

topology remains unchanged, but the relationship between the proximity values between nodes is cancelled, and then the simulation is carried out according to the above experimental settings. The data results of the simulation experiments are shown in Figure 6.

It can be clearly seen from Figure 6 that when the data selection algorithm based on proximity is used, the data block arrival rates of the three groups of nodes are basically the same according to the time series, and all remain above 87%. Moreover, with the delay of time, the data block on-time arrival rate has improved. This shows that during the downloading process, the nodes in the P2P network adaptively adjust their own downloading order to make the downloading performance better. Since the authors measured the smoothness of the video playback by the successful arrival rate of the data blocks in time series, they could ascertain that the smoothness of the video playback was also stable at over 87%.

Two groups of experiments were designed to analyze the effect of the improved algorithm on flow control. The authors investigated the service and service network throughput, respectively, in order to show the effect of the experiment in the two aspects of file sharing application flow control and improving the smoothness of streaming media. The results of the two sets of simulation laboratory data are shown in Figure 7.

As can be seen from Figure 7, after the BT node in the network ran the improved TCP Reno algorithm, the throughput of the UDP-based CBR service was greatly improved, reaching 85% or even over 90% of the constant rate, which showed that the flow control of the transport layer TCP effectively improved the network bandwidth share of UDP applications. Since the simulation of P2P streaming media is represented by CBR packets, it can be considered that P2P streaming media has obtained larger network bandwidth resources, which can effectively play the video smoothly.

CONCLUSION

As an emerging learning system, the modern distance education learning system caters to the continuous needs of society, and prompts distance education institutions to continuously improve the distance learning service system to make it better serve the learners. This paper discusses the application of Agent technology and P2P streaming media technology in the distance education system, and provides a good shared teaching method for teachers and students by constructing a

Figure 6. Streaming media data arrival rate at 0s, 10s, and 20s

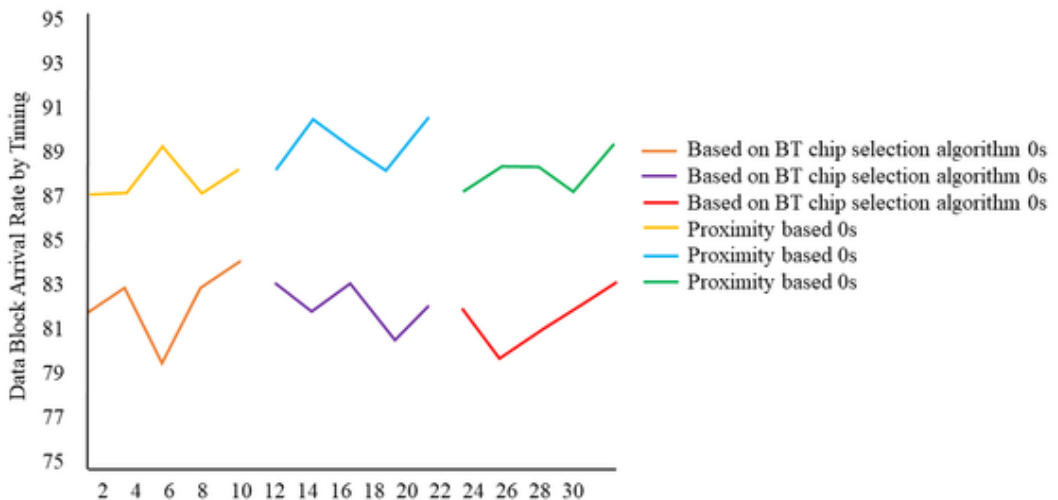
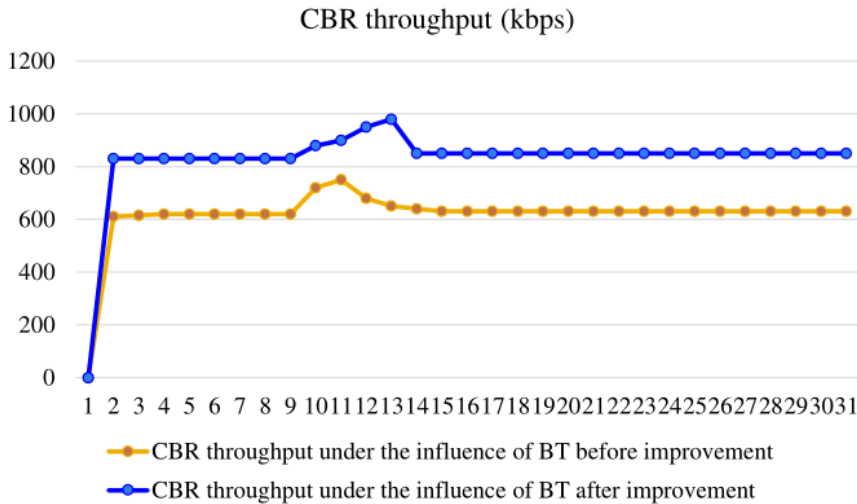


Figure 7. CBR throughput before and after reno improvement



multimedia distance education system with perfect functions and strong practicability. The model is learner-centered and realizes personalized information service through reasonable organization and management of knowledge, tasks, and related resources. In the traditional distance teaching process, there is a certain degree of space-time separation between teachers and students, and P2P streaming media can effectively solve this problem. Compared with the traditional streaming media playback technology, the playback technology adopted by the system greatly reduces the load pressure of the server, and greatly reduces the time complexity of search in the processing of new nodes and failed nodes. The distributed structure of the Agent can well solve the heterogeneous problem of each node. The system can not only greatly improve the quality of mutual cooperation and confidence exchange between teachers and students in the process of completing teaching tasks, but also enable teachers and students to arrange teaching time flexibly and independently to improve teaching efficiency, and the system has strong practicability. The impact of the system on classroom teaching includes: after the introduction of Agent technology, the distance education system can help students choose learning materials and test topics independently, and can effectively remind students of problems in the learning process. This model combines traditional teaching methods with modern educational technology, which makes it more adaptable to the changes in the requirements of social development on the quality of talents, and can give full play to the subjectivity and creativity of students, thus improving the teaching quality.

The future distance education is gradually developing interactive distance education in the direction of interactive intelligence, which is an inevitable trend of the development of distance education and also a problem being solved at present. Generally speaking, the interactivity of distance education using multimedia technology is poor, and it is difficult to meet the learning needs of students, which is also where it is inferior to traditional education. However, with the development of network technology, the development of various real-time teaching systems, online question answering, and testing systems, it is possible to have good interactivity. Due to limited time, the designed system still has some shortcomings. For example, the analysis of some potential unreasonable conditions is not enough. This is also the next work plan in the future.

AUTHOR NOTE

The authors declare that they have no conflicts of interest.

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The figures used to support the findings of this study are included in the article.

This work was supported by “the construction and research of ‘New Medicine’ curriculum system under the background of artificial intelligence” (No. 202101040001).

The authors would like to show sincere thanks to those who have contributed to this research.

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