Online Examination System of Distance Open Education Based on BP Neural Network

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Abstract—Remote examination system (ES) has become possible and has achieved certain results. There are many problems in school management and information exchange between teachers and students. We need to develop a new efficient, convenient, safe and reliable online ES. In this paper, BP network algorithm is studied. This paper mainly uses the experimental method and the comparative method to test the ability of the online ES. The experimental results show that the packet loss rate of the system designed in this paper is smaller than 0.1 within the controllable number of people. However, when the number of people exceeds 600, the packet loss rate increases. Therefore, the system designed in this paper is feasible within a certain range.

Keywords- BP Neural Network, Distance Education, Online Examination, System Design

1 INTRODUCTION

The online ES of distance open education (DOE) is based on the network, integrating the examination information of the school and other departments, and establishing an efficient, convenient and safe online ES among the subsystems. Based on BP neural network (BPNN), this paper designs an online examination (OE) platform for DOE under Internet environment. The system adopts advanced technology and concept, and realizes the function modules such as OE, score query and course arrangement.

There are many achievements in the research of BPNN and DOE and online ES. For example, some scholars have shown that the use of BPNN algorithm can use data in the OE process for mining and analysis to assess the impact of students' autonomous learning [1-2]. Some scholars have studied the architecture and modeling of online formative audit system and online audit system [3-4]. Others believe that online assessment is a common form of assessment in online and distance learning based on network and multimedia technology [5-6]. Therefore, the design of online ES based on BPNN has theoretical basis, and can have a positive impact on the system.

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In this paper, the key technologies of online ES for DOE are studied and analyzed. Secondly, the development status and existing problems of the online ES are discussed in depth, and the improvement direction of the ES is proposed. Then the overall design of the ES. Finally, through the system test of online ES, the relevant conclusions are drawn.

2 ONLINE EXAMINATION SYSTEM OF DISTANCE OPEN EDUCATION BASED ON BP NEURAL NETWORK

2.1 Key Technologies

The distance network education system is built with B/S architecture. J2EE platform is a standard development standard. Its system deployment and application development environment are designed according to this standard. The integration architecture of the middle tier is based on the actual requirements of the enterprise in the design, development, application and deployment process when developing application software. The design and implementation of the remote network teaching system is to analyze and design the system after the requirements of the system are clarified. In the whole system development process, the application and logic in the system network teaching and the design of related information services are mainly considered [7-8].

By mandatorily separating the input, processing and output, MVC framework mode works together according to the logical relationship, which avoids the possibility of cross cutting in business processing, thus simplifying the maintenance of the system. In addition, each part is connected with the outside through the standard interface, and the details of the internal specific implementation are hidden, which greatly reduces the code coupling between them. For Web applications with MVC architecture, the request and response loop of HTTP protocol is usually used to implement the MVC design pattern. The MVC architecture is the foundation of the distance network education system based on the MVC architecture model, which runs through the design and implementation. An important feature of XML is the separation of data and presentation. At this stage, XML documents mainly have two presentation methods: XSL (XML Stylesheet Language) and CSS (Cascading Stylesheet) [9-10].

The essential meaning of the computer's logical thinking training mode is to convert information into neurons, distribute and store them on the computer or network, and then realize the decentralized neurons through dynamic expressions. The performance of neurons in the system is handed over to the computer for tracking and learning, and finally the entire process is carried out. BP network can learn and store a large number of input-output pattern mapping relationships. Its learning rule is to constantly adjust the weights and thresholds of the network through back propagation. The activation function of BPNN is usually sigmoid function or linear function [11-12]. The linear function g (a) is expressed as:

$$g(a) = a \tag{1}$$

The Tan Sigmaid function expression is:

$$g(a)=\frac{2}{1+f^{-a}}-1 \quad (-1\prec g(a)\prec 1) \tag{2}$$

The value range of the function is $-1\prec g(a)\prec 1$.

In the ES, in order to make the designed ES more similar to the traditional examination environment, the system introduces timer technology. Online students enter the ES through identity verification, and need to select the corresponding examination subjects to take the examination. Once the students enter the answer page, the system will start counting down. The OE module is the most important module of the ES. The online ES provides examination papers with the same number and content for all the students who participate in the examination at the same time. However, in order to avoid mutual comparison during the examination, the order of the test papers used by each student is inconsistent, and the test papers can be arranged through random functions. For a good ES, it should be able to organize a set of test papers according to the requirements of the user. Currently, many ESs adopt the method of randomly selecting test questions to generate test papers. In order to ensure that students' answer information will not be lost due to re entering the ES, the system introduces real-time information storage technology [13-14].

2.2 Development Status and Existing Problems of Online Examination System

The online ES is based on the network. Users only need to download the client program to install and set it. It is not limited by the operating system and the region, and the operation is relatively simple, expanding the scope of distance education. A perfect online ES can not only realize OE, but also enable students to detect the learning effect through this system to improve the learning effect. At the same time, teachers can draw up test questions, produce test papers, mark and analyze test papers through this system. The current online ES has a wide range of types, and the content of the developed system is also relatively complex, but generally lacks individuality and pertinence. Most of them are general-purpose examination management systems, and lack of management of the examination process. Even some commercial software, although with relatively complete functions, basically has common content and lacks personalized design [15-16].

The existing ES has many drawbacks, which can not realize the sharing of the question bank between courses, and the separation of the storage and performance of the questions, which can not solve the problem of failure under the B/S structure. The existing system is unscientific for the storage of test questions. The change of test question type will cause changes in the system and structure, which is not conducive to the expansion and repeated use of the system, and is not conducive to the related subsequent development and third-party expansion [17-18].

2.3 Overall Design of the System

The design orientation of this system is to face many types of examination management processes. The system aims at comprehensive functions, simple operation and rapid response. The design goal is to achieve the system task and meet the user needs. The main design idea of this system is to introduce the examination workflow and processed data into this system,

which facilitates the work of examination management staff, improves work efficiency, reduces the workload, and has a free and flexible way to select topics.

The database of this system must ensure the integrity and security, so as to ensure the authority of the online ES information. After the analysis and summary of the functional requirements, the main information is classified into background comprehensive management subsystem information and OE subsystem information.

Because of the B/S mode adopted in the system design, the system classes and methods are mainly designed in the early stage of the design, which is convenient to understand the main functions of the system, and greatly reduces the development difficulty and workload. The background management module is a core module of comprehensive management in the online ES. This is also the basic module of the whole system, including two sub function modules: system setting and examination management. The examination management module is an important part of the online ES. When the ES is running, the open examination parameters in the system need to be set, and the system parameters need to be maintained during the operation of the system. The OE subsystem connects the background database and the background processing program. The background processing program provides the examination interface for the examination user. All operations except the login interface can be completed with the mouse. The operation is as simple as possible and the interface is beautiful. online examination includes: self test and OE.

The system has two types of users: students and administrators, so the system can be divided into student subsystem and administrator subsystem. The main functions realized by students are random exercise, user-defined exercise, OE, information management, score query, exit, etc. See Figure 1 for details:

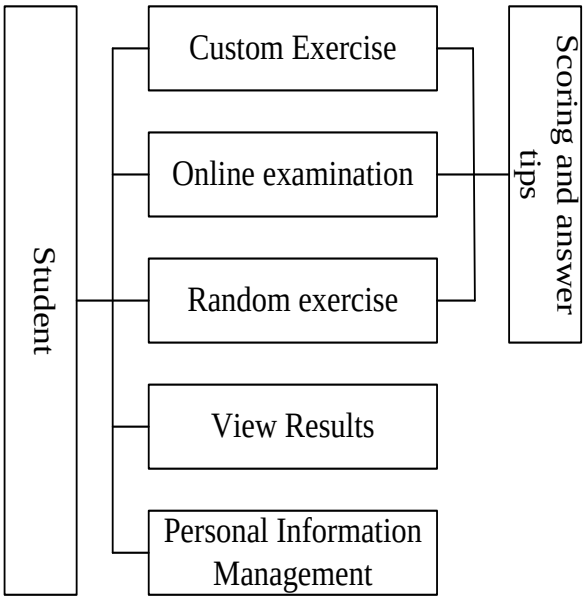

Figure 1. Student Online Test Practice System

The main functions of the administrator are: user management, question bank management, score management, administrator management, etc. On the home page of the system, you can first see the system introduction, through which you can have a preliminary understanding of the purpose and operation process of the system. To log in to the system, the user must first perform authentication. Only users in the system can perform the next operation. Otherwise, log in again. The system uses the student ID number as the user name, which can effectively ensure the authenticity and uniqueness of the system's student users. The administrator can manage the question bank, generate test papers, manage scores, etc., while students can conduct OEs, random exercises, user-defined exercises, etc. After this random exercise or custom exercise ends the exam, students can also perform the next exam again.

3 SYSTEM TEST OF ONLINE EXAMINATION SYSTEM

3.1 Test Environment

In order to better test the online ES, the server side test environment is as follows:

CPU: Intel Core i9 5780, Intel Xeon L5810

Memory: Kingston: 12G, Samsung: 12G

Hard disk: Seagate 2TB

Operating system: Windows 2013 Server

Database: MS Access 2013

In order to test the stability of the online ES from the perspective of the client, the client test environment needs to be designed:

CPU: Intel Core i4 3450, Intel Celeron G1720, AMD A20-5800K, Intel Core i5 3670

Memory: Weigang 8G, Memory Digital 8G, Weigang 6G, Kingston 6G

Hard disk: Seagate 500G, Seagate 500G, Seagate 250G, Western Data 2T

Operating system: Windows 10, Windows XP, Windows XP, Windows 11

3.2 Performance Test

This article uses the server of IBM x6 system, and this option is reasonable. The system parameters are measured and tested with the professional software testing tool Mercury loadrunner 13.0. Record relevant data of the system at this time, system response delay, packet loss, etc.

3.3 Safety Test

In the security testing phase, the system mainly completes user authentication, network security testing and database security testing. During the test, the permissions of different users shall be clarified. Simulating unauthorized attacks shows that the protection system is robust. During

the test, the confidentiality, integrity, data backup and recovery capabilities of the system were tested.

4 ANALYSIS OF ONLINE EXAMINATION SYSTEM TEST RESULTS

4.1 System Performance Analysis

This paper mainly evaluates the system performance from two aspects: system delay and packet loss rate. It can be seen from the relevant detection data in Table 1 that when the system transmits information at the rate of no more than 400, the system delay is relatively small, basically less than 0.5s. In addition, the packet loss rate of the system is 0, that is, the system performance is excellent at this time.

Table 1. Test Results of the Online Examination System Performance

	System delay	**Packet loss probability**
100	0.4	0
200	0.45	0
300	0.48	0
400	0.5	0
500	0.6	0.03
600	0.8	0.18
700	1.5	0.18
800	2	0.2

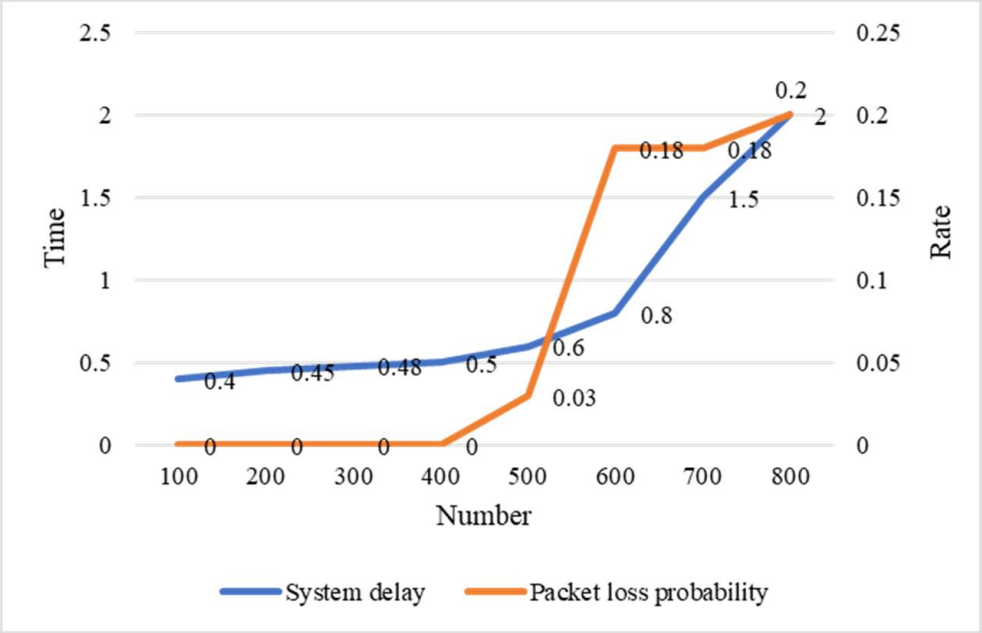

Figure 2. Test Results of the Online Examination System Performance

As shown in Figure 2, we can see that when the number of users exceeds 400, packet loss begins to occur to a certain extent. That is to say, the carrying capacity of the system is not strong enough at this time, and the network environment is crowded. In the case of concurrent processing above 500, not only the packet loss rate of the system increases rapidly, but also the system latency increases a lot.

5 CONCLUSION

The online ES of distance and open education is a new teaching mode. Through the network environment, teachers in the traditional classroom are centralized and students learn independently before class. It breaks the limitation of time and space. Based on the theory of BPNN, this paper makes a deep research on the online ES of DOE. The online ES of DOE is an important and rapid way to promote the reform and innovation of higher education and provide students with a more convenient and efficient learning environment. This paper expounds the demand analysis and overall planning of the online ES for DOE in detail, and puts forward the key technologies used to develop the system on this basis.

REFERENCES

[1] Abha Maru, Arpita Dutta, Vinod Kumar Kulamala, Durga Prasad Mohapatra: Software Fault Localization Using BP Neural Network Based on Function and Branch Coverage. Evol. Intell. 14(1): 87-104 (2021).

[2] Yoonhyung Kim: Learning to Adapt to Label-Scarce Image Domain via Angular Distance-Based Feature Alignment. IEEE Access 10: 104783-104792 (2022).

[3] Hazwani Nordin, Dalbir Singh, Zulkefli Mansor, Elaheh Yadegaridehkordi: Impact of Power Distance Cultural Dimension in E-Learning Interface Design Among Malaysian Generation Z Students. IEEE Access 10: 64199-64208 (2022).

[4] Asanka G. Perera, Brijesh K. Verma: Road Severity Distance Calculation Technique Using Deep Learning Predictions in 3-D Space. IEEE Access 10: 68000-68008 (2022).

[5] Birol Çelik, Hüseyin Uzunboylu: Developing an Attitude Scale towards Distance Learning. Behav. Inf. Technol. 41(4): 731-739 (2022).

[6] Hibah Khalid Aladsani: The Perceptions of Female Breadwinner Parents Regarding Their Children's Distance Learning during the Covid-19 pandemic. Educ. Inf. Technol. 27(4): 4817-4839 (2022).

[7] Mahmoud Hawamdeh, Zehra Altinay, Fahriye Altinay, Ahmet Arnavut, Kezban Ozansoy, Idris Adamu: Comparative Analysis of Students and Faculty Level of Awareness and Knowledge of Digital Citizenship Practices in a Distance Learning Environment: case study. Educ. Inf. Technol. 27(5): 6037-6068 (2022).

[8] Moh'd Khaled Yousef Shambour, Muhannad A. Abu-Hashem: Analysing lecturers' Perceptions on Traditional vs. Distance Learning: A Conceptual Study of Emergency Transferring to Distance Learning during COVID-19 Pandemic. Educ. Inf. Technol. 27(3): 3225-3245 (2022).

[9] Rozita Tsoni, Chris T. Panagiotakopoulos, Vassilios S. Verykios: Revealing Latent Traits in the Social Behavior of Distance Learning Students. Educ. Inf. Technol. 27(3): 3529-3565 (2022).

[10] Luciana Pereira de Assis, Ana Carolina Rodrigues, Alessandro Vivas, Cristiano Grijó Pitangui, Cristiano Maciel da Silva, Fabiano Azevedo Dorça: Relationship Between Learning Styles and Learning Objects: A Systematic Literature Review. Int. J. Distance Educ. Technol. 20(1): 1-18 (2022).

[11] Míria L. D. R. Bóbó, Fernanda Campos, Victor Ströele, José Maria N. David, Regina Braga, Tiago Timponi Torrent: Using Sentiment Analysis to Identify Student Emotional State to Avoid Dropout in E-Learning. Int. J. Distance Educ. Technol. 20(1): 1-24 (2022).

[12] Mohammad Khair Mahmoud Alsalamat, Hamad H. Alsowat, Rashed M. Alroqi: The Effectiveness of Distance Learning (BlackBoard) in Pursuing the Educational Process at Taif University During the COVID-19 Pandemic. Int. J. Inf. Commun. Technol. Educ. 18(1): 1-13 (2022).

[13] Hakan Altinpulluk, Hakan Kilinç: The Opinions of Field Experts on the Usability of Internet-of-Things Technology in Open and Distance Learning Environments. Int. J. Inf. Commun. Technol. Educ. 18(1): 1-17 (2022).

[14] Renatus Michael Mushi, Deogratius Mathew Lashayo: E-Learning Readiness Assessment on Distance Learning: A Case of Tanzanian Higher Education Institutions. Int. J. Inf. Commun. Technol. Hum. Dev. 14(1): 1-10 (2022).

[15] Safia Bendjebar, Yacine Lafifi, Hassina Seridi-Bouchelaghem: An improvement of a data mining technique for early detection of at-risk learners in distance learning environments. Int. J. Knowl. Learn. 15(2): 185-202 (2022).

[16] Murat Sümer, Cengiz Hakan Aydin: Design Principles for Integrating Gamification into Distance Learning Programs in Higher Education: A Mixed Method Study. Int. J. Serious Games 9(2): 79-91 (2022).
[17] Amira Sghari, Fatma Bouaziz: The Moodle Distance Learning Platform Usage by Tunisian University Teachers Under the COVID-19 Context. Int. J. Technol. Hum. Interact. 18(1): 1-19 (2022).
[18] Khosro Rezaee, Seyed Jalaleddin Mousavirad, Mohammad Reza Khosravi, Mohammad Kazem Moghimi, Mohsen Heidari: An Autonomous UAV-Assisted Distance-Aware Crowd Sensing Platform Using Deep ShuffleNet Transfer Learning. IEEE Trans. Intell. Transp. Syst. 23(7): 9404-9413 (2022).