Research Article

Design of Online Learning System of College Sports Gymnastics Based on BP Neural Network

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With the rapid development of artificial intelligence technology and big data analysis technology, the use of online learning has become more technical premises. It has the advantages of convenient data update, simple real-time communication, and high stability and flexibility. These have laid a good technical cornerstone for the development of online learning platforms. In order to solve the problems such as the lack of teaching materials for physical gymnastics in colleges and the lack of technical support for teaching, this study aims to study the design of college sports gymnastics online learning system based on BP neural network. On the basis of analyzing the introduction of BP neural network, the status quo of gymnastics teaching in Chinese colleges and universities and the principles of system design and adopting the principles of reliability, stability, and maintainability as the method of system design, the gymnastics online learning system based on BP neural network is carried out. Finally, the performance of the constructed system is tested. The test results show that, as the number of concurrent users continues to increase, the response time is gradually increasing. When the number of concurrent users is 3000, the maximum response time is 1.832 s, the minimum response time is 1.473 s, and the average response time is 1.512 s, which can meet the needs of users when the amount of concurrency is large.

1. Introduction

With the vigorous development of modern information technology, the application of computer technology and Internet information technology in college sports has become more and more in-depth and detailed, especially the integration of the Internet and campus networks, which has brought a lot of sports teaching to major colleges and universities. The resources of the Internet make online sports gymnastics teaching through the Internet a reality [1, 2]. It is an inevitable trend of gymnastics teaching and management work in modern colleges to establish a modern physical education network teaching system to cultivate the effect of gymnastics learning of students [3, 4].

Online education has flourished overseas for a long time. Since the 1990s, my country has also begun to conduct online education. At present, the development of online education overseas has formed a considerable scale. Although the upward momentum has declined in recent years, the scale is still expanding [5, 6]. In recent years, the slogan of the new education model "Online Education Model" also shows the development trend of China's online education. In the computer environment, students' enthusiasm for autonomous learning can be maximized, which can not only highlight the advantages of individual learning but also overcome the shortcomings of collaborative learning. This type of educational learning model focuses more on the individual needs of students' learning. In recent years, some online course platforms and online course management systems have emerged [7, 8]. These network platforms all provide a rich resource curriculum system and diverse information structures, thereby providing an interactive learning online platform with a good user experience [9, 10]. In recent years, with China's construction of Internet infrastructure and broadband speeds for major network service providers, the server access speed of each platform has always been maintained at a high level, and the navigation performance of web pages is also very clear. For scholars, the

human-computer interaction interface is very good and can adapt to learners at different stages [11, 12]. However, due to the imbalance in the degree of Internet informatization in various places, the theoretical structure of online education in schools is not perfect, and the special funds are not enough. There are also many problems in the interactivity of the platform, the stability of the operating system, and the interaction with teachers, and the content is mixed.

On the basis of consulting a large number of related references, this study combines the introduction of BP neural network, the status quo of gymnastics teaching in colleges and universities in my country and the principles of system design to design the online learning system of gymnastics in colleges and universities. The system mainly includes three functional modules, namely, the system login module, teaching information management module, and score management module. Finally, the performance of the system is tested to verify whether it meets the requirements of this study.

2. Design of Online Learning System of College Sports Gymnastics Based on BP Neural Network

2.1. Introduction to BP Neural Network.

The BP neural network algorithm can be trained using a multilayer network. The structure of the BP neural network is shown in Figure 1.

BP neural network architecture is divided into input layer, output layer, and hidden layer. Suppose a neural network with a layer number of m, the training input sample is X, and the output of the network is x_i^k; then, the weight difference between the input layer and the output layer is w_{ij}, and the function corresponding to the number of neurons is f, and relationship of BP neural network is (1) and (2):

$$X_i^k = f\left(U_i^k\right), \tag{1}$$

$$U_i^k = \sum_i W_{ij} X_j^{k-1}. \tag{2}$$

The BP algorithm is divided into 2 stages.

In the forward pass, the input sample vector first reaches the hidden layer through the input layer, then passes through the hidden layer, and finally reaches the output layer. In the stepwise process of each level, the previous level of each level is equivalent to a single-layer input layer, and the next level of the current layer is regarded as the output layer of that level. In the output stage transmission, the actual transmission is compared with the ideal signal. As long as the results are consistent, the transmission is completed, and there is no need to wait any longer or directly perform the reverse transmission process. Then, the reverse transmission process returns to the layer-by-layer error calculated according to the actual network output and the expected signal and gradually adjusts the neuron weights between layers until the convergence condition is met.
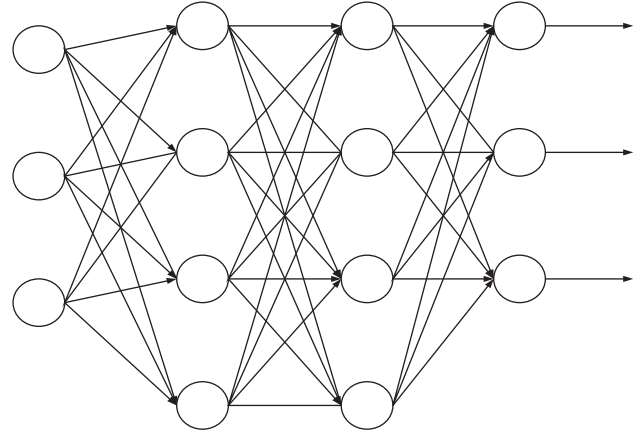

Figure 1: BP network structure.

2.2. The Status Quo of Gymnastics Teaching in Colleges.

Physical education is different from basic courses such as Chinese and mathematics in basic education. Because sports teaching is not for training people with a lot of basic sports knowledge, the main purpose is to cultivate a strong body and a spirit of striving for improvement because sportsmanship is a very crucial aspect for a person. Modern primary and middle school students have become more and more lazy, slow to do things, and unwilling to go out, let alone regular sports. Therefore, the current physical education teaching must carry out some deeper teaching reforms. The Internet seems to be only some problems that have nothing to do with sports, but they are actually closely related. The Internet can change the traditional sports teaching methods. In terms of sports courses, it can use the Internet. The reform of gymnastics teaching driven by network information technology has made gymnastics teaching students vigorous. However, teaching gymnastics at a university in China still faces certain problems.

2.2.1. Less Gymnastics Teaching Materials: Simple and Boring Movements.

At present, in the gymnastics courses of Chinese colleges and universities, there are still relatively few gymnastics courses offered by instructors, which are basically gymnastics defined for students. Due to the lack of professional knowledge and detailed materials by teachers, the various gymnastics taught to students are basically similar. The form of the exercises is relatively simple, and there are too many repetitions. Too many students are boring to practice, and exercise time is relatively lazy, and many gymnastics have no love for gymnastics because of irregularities. As the saying goes, "Interest is the best teacher," once learners have no interest in gymnastics at all, they will not be able to form an excellent learning attitude.

2.2.2. The Lack of Technical Support for Gymnastics Teaching.

In colleges and universities, many course directors do not pay much attention to gymnastics courses, and even think that traditional performance is the most important indicator of the student level. College teachers often lack rich video education resources when teaching gymnastics. Teachers

cannot guide students better without teaching resources. Teachers do not have technical equipment support such as video websites when they are in class, and some schools do not even have audio equipment, let alone teachers use network technology to carry out gymnastics teaching, so technical equipment support is also an important aspect.

2.3. System Design Principles

2.3.1. Reliability. The system must fully consider the performance problem when the number of visitors is increasing, and it is necessary to ensure that the system can operate without failure under the visit of a certain number of students. It is also necessary to ensure the reliable and stable operation of the system for a long period of time to ensure that the system can provide continuous and reliable services.

2.3.2. Stability. Since the system is up and running, the amount of access to the system will change over time. Therefore, the system can provide consistent services to users with different traffic and realize the same uptime as system load balancing. In the event of a temporary or power outage, effective measures can be taken to ensure that access to the system will not be compromised. Therefore, a backup server should be provided during system development to handle downtime.

2.3.3. Openness. The system involves a large number of functions such as the input and export of physical fitness tests and gymnastics learning data, so a standardized external access interface is required to ensure the openness and safety of the system.

2.3.4. High Efficiency. The system fully takes into account the ability of different users to quickly access and process data when using the operating system at the same time so that the operating system can quickly reflect the use of related features and access a large number of system resources. You need to dynamically adjust your system resources based on this to balance load system to ensure the highest cost performance of the system.

2.3.5. Advancement. The system formulates students' study plans based on their physical fitness data and guides students to study that includes a large amount of statistical data analysis. Completing these functions requires computer algorithms. The implementation of the selected algorithm should be efficient, mature, and stable, reflecting the advanced nature of the system.

2.3.6. Maintainability. After the system is developed, it is used to teach gymnastics knowledge to students, which can effectively improve the performance of the system. Since the system has a lot of room for performance and performance improvement after implementing various functions, it is easy to expand the system. Two tasks are required to

continuously improve the system functions in the future, and it must be able to run. The undeveloped existing platform saves growth time and development costs.

3. Experiment

3.1. System Login Function Module. The online gymnastics learning system includes three types of users: system administrators, teachers, and students. According to different user rights, each type of user has a different interface. The connection interface provides a variety of user options to facilitate the connection of different users of the system.

When a system user enters the login interface of the education learning system, select the user type and log in to the entire system with a user name and password. Due to the limited number of teacher users, the teacher account is issued internally by the system administrator. Freshmen can register and apply from the login interface. The user can only take effect after the system administrator checks the application.

When a system user uses the login interface to log in to the system, the system will make a decision based on the user type and account information, allowing multiple users to access the corresponding system interface. The operating system of the system is shown as in Figure 2.

When a specific type of system user chooses to log in to the system, the internal program of the system matches the account information and user type with the information in the system database to retrieve data with the same login information among the three types of users. Teachers and system administrators, based on the search results, present the user with the final response system interface. The most important user of the system is the student. After the system is connected, the student users in the system will be asked first. If no corresponding user is found, the teacher user is matched, and the system administrator account is finally matched. After the system is successful, it will enter the corresponding system interface, such as student interface, teacher interface, or system administrator interface.

3.2. Teaching Information Management Module. The main function of the education information management module is divided into two parts: user information management and education information management. User information mainly refers to basic student information, and educational information mainly refers to teacher resource information and course video information. If the login is a normal user, normal user, or student, the user can view and manage his user information, but he does not have the right to manage other users. If the login person is a teacher, the teacher can add, delete, and modify materials (such as videos and tutorials). If the login person is an administrator, you can not only manage all user information but also perform various management functions such as adding, deleting, and changing teacher information. This means that, after logging in, clicking the "Manage Teachers" tab will display a list of teacher details as shown below. If you want to make changes, select the information bar and click Edit. If you want to add
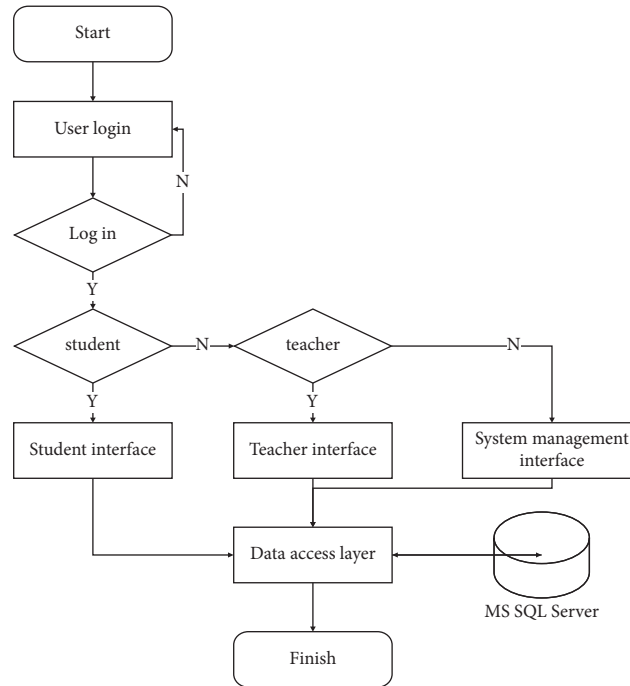
FIGURE 2: The internal operation flow of the system login module function.

new teacher information, you can add a new teacher information column by clicking the Add Teacher button on the web page.

3.3. Performance Management Function Module.
Performance management mainly refers to student performance management. Teachers are responsible for introducing and changing student grades. Students can only see their own grades. When the teacher logs in to the website and clicks on the score management tab, a list of student scores will be displayed. If you want to change, please select the information bar and then click "Edit" on the back to make changes. If you need to add student grades, you can add a new set of student grades by clicking the enter grade button on the web page. When a student logs on to the website, click the "Manage Scores" tab, enter the student ID on the page that appears, and click "Query" to view the scores.

4. Discussion

The system needs to achieve high efficiency, high stability, high fluency, and other indicators, so the nonfunctional requirements of the system need to be controlled. High efficiency mainly refers to high synchronization and load capacity testing to determine whether the system can operate stably. Stability is mainly to ensure the long-term and reliable operation of the system and provide users with uninterrupted services. Flexibility only requires one system to ensure high response efficiency. The performance test of the system is mainly to test the response time and pressure load of the system operation to determine whether the relevant

performance index conditions can meet the expected goals and to optimize and tune the system.

In this study, we will use analysis tools to perform system performance testing. The performance of each module was tested. First, test the performance indicators of the login function, and the test results are shown in Table 1 and Figure 3.

As the number of concurrent users gradually increases, the response time will gradually increase. For example, when the number of concurrent users reaches 3000, the maximum response time reaches 1.724 s, the minimum response time reaches 0.967 s, and the average response time is 1.156 s, but from the data, it can be seen that the number of users is within a certain range, and the response time can meet the requirements.

The test process and test results of the performance of the teaching information management module are shown in Table 2 and Figure 4, respectively. As the number of concurrent users increases, the response time is constantly changing. The query performance test can be found, but when there are enough query requests, a relatively fast response speed is still achieved, and the query results are quickly presented to the user.

The test results show that, as the number of users gradually increases, the response time increases accordingly. If there are 3000 concurrent users, the maximum response time of the system is 1.785 s, the minimum response time is 1.526 s, and the average response time is 1.672 s, which can meet the performance requirements of the teaching information management module.

The test situation of the performance of the performance management function module is shown in Table 3 and Figure 5. Different numbers of concurrent users were

TABLE 1: System login test performance result table.

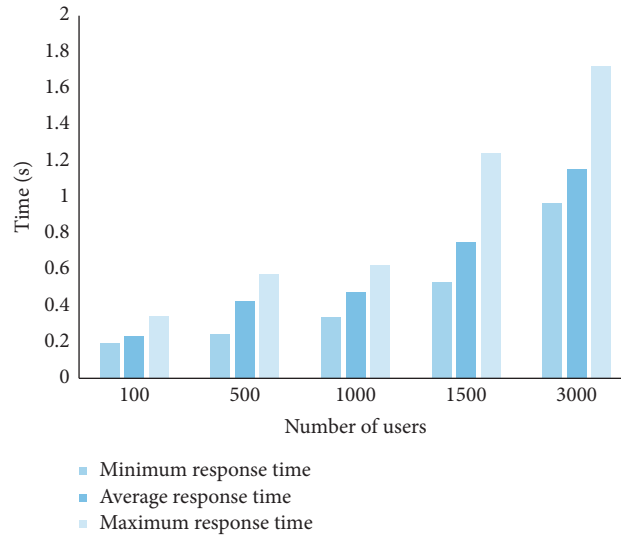| Number of concurrent users	Number of failed logins	Minimum response time	Average response time	Maximum response time
100	0	0.194	0.233	0.341
500	0	0.245	0.426	0.574
1000	0	0.338	0.474	0.623
1500	0	0.531	0.754	1.245
3000	0	0.967	1.156	1.724

FIGURE 3: System login test performance result graph.

TABLE 2: Performance test results of teaching information management module.

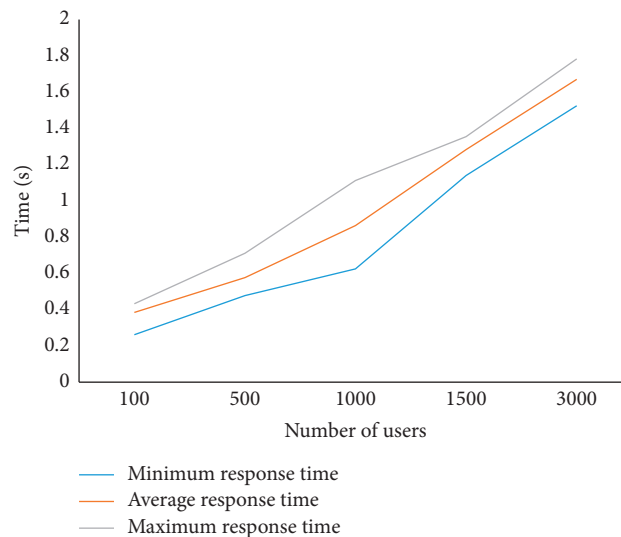| Number of concurrent users	Number of failed logins	Minimum response time	Average response time	Maximum response time
100	0	0.262	0.385	0.433
500	0	0.478	0.577	0.712
1000	0	0.625	0.864	1.113
1500	0	1.141	1.284	1.356
3000	0	1.526	1.672	1.785

FIGURE 4: Performance test results of the teaching information management module.

TABLE 3: Performance test of score management function module.

Number of concurrent users	Number of failed logins	Minimum response time	Average response time	Maximum response time
100	0	0.333	0.492	0.622
500	0	0.472	0.633	0.812
1000	0	0.654	0.845	0.926
1500	0	0.821	1.246	1.369
3000	0	1.473	1.512	1.832

■ Maximum response time
■ Average response time
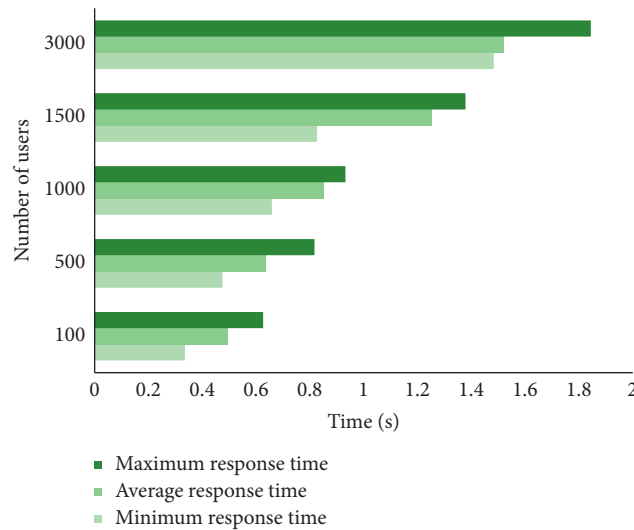■ Minimum response time

FIGURE 5: Performance test of score management function module.

selected for testing, and the final notification viewing performance was analyzed.

This test shows that this function has a strong amount of concurrency. As the number of concurrent users continues to increase, its response time gradually increases. When the number of concurrent users is 3000, the maximum response time is 1.832 s, the minimum response time is 1.473 s, and the average response time is 1.512 s, which can meet the needs of users when there is a large amount of concurrency.

5. Conclusions

Based on the design principles of the online learning system of physical gymnastics in colleges, this paper designs and realizes the framework and structure of the system, which not only improves the overall performance and security of the system but also meets the teaching needs of physical gymnastics in colleges and exerts good social benefits. It is of great value to improve the quality of gymnastics teaching.

Data Availability

The data underlying the results presented in the study are available within the article.

Disclosure

The author confirms that the content of the manuscript has not been published or submitted for publication elsewhere.

Conflicts of Interest

The author declares no potential conflicts of interest.

Authors' Contributions

The author has seen the manuscript and approved to submit to the journal.

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