Information Management System of Student Laboratory Based on BP Neural Network

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Abstract: The laboratory is an important part of cultivating students' practical ability and experimental skills. With the development of education, the teaching mode of experimental courses has changed from traditional experimental teaching to today's open experimental teaching. The purpose of this paper is to research student laboratory information management system based on BP neural network. The investigation and analysis of the student laboratory information management system based on BP neural network is carried out, and the key technologies involved in the construction of the system are discussed. Using the advantages of artificial neural network in data prediction, a three-layer feedforward network model based on BP algorithm is built, and a framework corresponding to this model is constructed in the system, and the predicted value of laboratory IGBT devices is verified by simulation results. The results show that the BP neural network can accurately predict the number of IGBT devices.

1 INTRODUCTION

Laboratory safety in colleges and universities has become an important part of scientific management and healthy development in colleges and universities. With the continuous improvement of the opening scale of colleges and universities and the increase of the mobility of examiners, new challenges have been brought to the informatization services of laboratories (Wines 2019). At present, there is a lack of comprehensive assessment standards for laboratory safety management in colleges and universities (Jenica 2019). Therefore, how to accurately and truly evaluate the safety level of the scientific organization and fair index system in colleges and universities is a problem that college administrators should think deeply about (Valencia 2018).

In order to further strengthen the management of the teaching open laboratory and improve the utilization rate of equipment, some scholars proposed a teaching open laboratory management information system based on video surveillance and fingerprint access control. The system uses the .NET programming environment and SQL Server database system to construct a The software structure mode combining B/S and C/S. On the basis of remote video surveillance and fingerprint access control system, the system realizes online examination appointment approval, experimental report submission and modification, online question and answer, remote video surveillance, fingerprint access control and other services through learning and opening the laboratory management website. It improves the teaching management efficiency of the open laboratory and provides a good environment for the cultivation of students' innovative ability (Johanyák 2019). SA Róański discussed and demonstrated the necessity of using computer-aided experiments in the teaching of physics. The benefits of using computer-aided measurement methods have been shown. The application of selecting a measurement console equipped with sensors and coupled to a computer during the execution and analysis of experimental results is demonstrated. The results of three computer-aided experiments are presented, in which the electromotive force and internal resistance of the battery, the hysteresis loop and the Dulong-Petit law are determined (Róański 2020). Therefore, in order to enhance the laboratory management of the school, it is very necessary to establish a university experimental learning platform based on scientific learning management and advanced information technology, and to establish a fully operational training laboratory network

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management platform (Ummu, Yildiz 2019).

This paper aims to develop a school-based resource laboratory information management system. The current situation of the school laboratory is analyzed. The method and design scheme of the development system are proposed and practiced. Make the work of the laboratory truly efficient, labor-saving and fast. It facilitates school management, facilitates the daily work and study arrangements of teachers and students, further improves the school's informatization management level, and indirectly supports the development of the school's new curriculum reform.

2 RESEARCH ON INFORMATION MANAGEMENT SYSTEM OF STUDENT LABORATORY BASED ON BP NEURAL NETWORK

2.1 System Design Goals

The laboratory information management system can integrate and intelligently manage the daily work of the school's physics, chemistry, biology, and computer laboratories (Mohammadi 2018). Make the work of the laboratory truly efficient, labor-saving and fast. It is convenient for school management, and also facilitates the daily work and study arrangements of teachers and students, and indirectly supports the reform of the new curriculum (Mcwatt 2018). The design of this system should achieve the following goals, as shown in Figure 1:

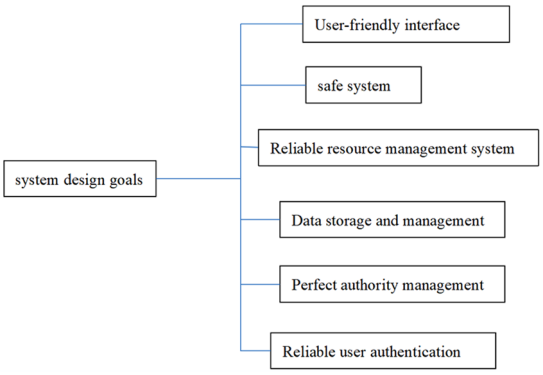

Figure 1. System Design Goals

(1) Friendly user interface: the teachers of this school are the direct users of the system, the overall beauty of the system and the ease of use of the system will directly affect the frequency of teachers' use of the system and the teachers' overall evaluation of the system;

(2) Safe system: There are a large number of school-based materials in the system, all of which are confidential documents, so the system should provide confidentiality measures as much as possible to prevent hacking and data leakage;

(3) Reliable resource management system: The system should have a laboratory management function module with complete functions and convenient operation, and the system administrator can perform a series of operations on the data through the module. The system should also have the function of batch processing, such as batch uploading files, downloading files, deleting files, etc.;

(4) Data storage and management: With the increase of system resources, in order not to bring too much burden to the system, the system should have a reasonable data storage scheme, that is, database storage;

(5) Perfect authority management: The users of the system include the following groups: system administrators, physics, chemistry, biology, computer laboratory administrators, teachers and students. In order to meet the needs of different users, different users should have different permissions;

(6) Reliable user authentication: The system provides built-in user management functions, which can be unified by the system administrator to add, modify, and delete teacher users. At the same time, it also provides students with online registration through school card information and birth date.

2.2 BP Neural Network

In this paper, the weight value is calculated by the questionnaire method to obtain a set of optimal weight values, and then the laboratory safety evaluation system model is evaluated. BP neural network learning includes four processes: feedforward, error propagation, memory training and consolidation training .

The learning process of BP neural network includes two stages of forward estimation and error propagation (Pitts 2020). First, take the two-layer BP network as an example, assuming that the input is p, the input layer has r neurons, the hidden layer has s1 neurons, and the activation function is F1. The output plane has a meridian element s2, the corresponding activation function is F2, the output is

A, and the target vector is T.

The network structure layer used in this paper is three layers, which are the input end, the hidden layer and the output layer. Since the number of hidden layers is too large, the training time will be too long. The number of hidden layers and the number of nodes is the key consideration. Normalize the initial value again. Because the initial weight is randomly given, it is easy to cause network bias. If the initial value is too large or too small, it will affect the performance of the algorithm. Therefore, data with variability is normal and limited to a certain range of values (Kornilov 2020).

Finally, determine the nonlinear correlation function, select the appropriate transfer function and training function, and call the newff command to create a BP neural network.

3 INVESTIGATION AND RESEARCH ON INFORMATION MANAGEMENT SYSTEM OF STUDENT LABORATORY BASED ON BP NEURAL NETWORK

3.1 System Structure

This article describes the contents of the three layers and the functions to be implemented:

The bottom layer is the laboratory resource layer. On the basis of the underlying hardware facilities and operating platforms, a laboratory resource library (including large-scale experimental instruments, small-scale experimental equipment, experimental drugs, and experimental materials) is established, which is the basis for constituting laboratory resources. It is actually necessary to create a resource library, and at the same time create the Web server and database server required by the system.

The management layer (functional layer) is the core of the entire laboratory information management system, which is divided into physical discipline management, chemical discipline management, biological discipline management and computer discipline management. On the one hand, it manages the resources of the bottom layer (data layer), and on the other hand, it provides a standard and simple service calling interface for the presentation layer. Shield the difference and distribution of the underlying (data layer) resources. On the basis of the bottom layer (data layer), basic setting management, fixed asset management, authority management, etc. are realized.

The presentation layer provides various services to many different types of users. The presentation layer provides users with basic setting management, item storage management, item procurement management, item requisition management, etc. on the basis of the management layer. Types such as laboratory administrators, teachers, students, and system administrators, users have different permissions, and provide different service permissions to meet the needs of maximizing the use of laboratory resources.

3.2 Realization of Demand Information Prediction for Experimental Devices

This section takes IGBT devices as an example for analysis. Other components are similar to this. The purchase volume of laboratory IGBT devices from 2018 to 2021 is shown in Table 1.

Table 1. Purchases of IGBT devices from 2018 to 2021

years	amount
2018	33
2019	51
2020	66
2021	71

In the model for predicting the purchase volume of IGBT devices in 2022, a three-layer BP neural network structure is adopted, and 3 training samples, 1 test sample, 2 input data, 1 output data, and 6 hidden layer nodes are selected. number.

4 ANALYSIS AND RESEARCH OF STUDENT LABORATORY INFORMATION MANAGEMENT SYSTEM BASED ON BP NEURAL NETWORK

4.1 System Architecture

The system is mainly composed of three parts: student system module, teacher system module and system administrator module. The business logic of

each module will be described in detail below.

(1) Student system module

Browsing the experimental information can better ensure the integrity of the experimental information during the experiment reservation process. If students want to make an appointment for an experiment, they can see the number of experiment appointments in time to judge whether the appointment is successful or if they have more control over the time.

Under special circumstances, students cannot participate in the experiment in time, and students can also cancel the experiment appointment. But it must be before the experiment starts, otherwise the system will not display the experiment information and cannot perform the undo function.

(2) Teacher system module

In the previous laboratory management mode, teachers can only browse students' experimental reports after class, but can browse the system application of the experimental center during the experiment.

Through the laboratory management system, teachers can timely feedback the experimental reports submitted by students. Statistics are based on the results and procedures of student experiments.

(2) System administrator module

System parameter settings.

data backup.

Experimental information management includes: experimental items, experimental equipment and materials, experimental personnel, experimental funding, and experimental data reporting.

4.2 2022 Procurement Forecast of Laboratory IGBT Devices Based on Matlab

This section uses the newff() function in NNbox to build the neural network model of the IGBT device, and uses this function to determine the transfer function, the number of network layers, and the number of neurons in each layer. The syntax of this function is:

$$net = newff(PR,[S1,S2,...,SN],\{TF1,TF2,...,TFN\},BTF,BLF,PF) \quad (1)$$

In the formula, BTF, BLF, and PF are string variables, which respectively refer to the name of the network training function, the name of the network learning function, and the name of the network performance function; The Si value represents the number of neurons in the i-th layer in the network. TFi represents the transfer function of layer i in the network. The implementation process of newff is as follows: after the network structure is built, the init function is called to initialize the corresponding thresholds and weights to form a feedforward network and return the net value (Attardi 2019).

This section uses batch processing to train the network, and its corresponding function and syntax format are:

$$[net,tr] = train(NET,p,t) \quad (2)$$

In the formula: net represents the revised network, p represents the input matrix, t represents the output matrix, NET represents the network to be trained, and tr represents the training record. The simulation results are shown in Figure 2:

Figure 2. Best training performance is NaN at epochs 24

It can be seen from the figure that when the number of training is close to 10,000 times, the final mean square error of the learning training data is lower than 10^{-15}, which is basically zero, indicating that the established model is very close to the real situation of IGBT device procurement.

5 CONCLUSIONS

One of the important departments of any university is the laboratory, and one of the conditions for measuring the comprehensive strength of the university is the scale and management of the laboratory. However, because the management methods and tools are not very advanced, the level of management personnel is limited, and the public training has not been effectively allocated, so it is difficult to implement effectively. This paper develops a student laboratory information management system to improve the efficiency of laboratory work. There are still many deficiencies in the design of the student laboratory information management system, such as: the system does not automatically generate and print various questionnaires, statistical reports and so on. There is still room for further improvement and improvement for these.

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