Evaluation Model of Public Building Design Scheme Based on Neural Network Algorithm

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Abstract. With the development and popularization of computer technology, computer technology has made a strong contribution to the development of all walks of life. This paper mainly analyzes the structural model of the evaluation index system. It also summarizes the application of BP neural network algorithm in the evaluation model of public building design scheme.

Keywords: BP Neural Network, Public Building, Design Plan

1. Introduction

There are many types of public buildings in our country. With the development of science and technology, computer technology provides a broader prospect for the public construction industry. In the evaluation of today's public building design plans, there are still many problems that need to be resolved.

2. Project evaluation index system structure model

2.1. Design of evaluation index structure model of public building design scheme

According to the characteristics of public buildings and the requirements for evaluating the comprehensive benefits of the design plan, first-level indicators and second-level (single) indicators have been set. These indicators summarize the commonality and particularity of the main functions and social consumption of various public buildings, and are universal.

2.2. Application of project evaluation index system structure model

According to the evaluation index system structure table, design the expert evaluation data table. The evaluation value of the program on the measurable evaluation index can be directly entered into the data table; the program evaluation on the non-measurable evaluation index requires the development of a
3. Comprehensive evaluation model of the scheme

3.1. Mathematical model for comprehensive evaluation of public building design schemes

At present, the comprehensive evaluation mathematical models commonly used in evaluation problems in various fields have their own characteristics and have good application effects, but they also have shortcomings. For example, when using fuzzy mathematics evaluation model, there is still no good theoretical basis to explain the type of membership function fully and reasonably. We have thoroughly studied the evaluation of public building design plans. In terms of design comprehensive evaluation mathematical models, based on the principles of architectural technology and economics, the theoretical methods of system analysis, and taking into account the nonlinear relationship between evaluation factors, we established a public building design plan [3]. The multi-objective comprehensive benefit evaluation model is shown in public notice (1):

\[ \max y = f(V,X) \]  

Among them, \( V=(v_1,v_2,...,v_n)^T \) is the weight vector of the evaluation index. In the application, it is found that methods such as AHP need to be used when determining the index weight. Since this method uses a 9-level scale criterion, an unavoidable weight error occurs. When calculating the weights of multi-level indicators, this error is gradually enlarged with the level of the indicators. Further research should be carried out on how to reduce the errors of qualitative evaluation, and new comprehensive evaluation models and algorithms should be found.

3.2. Comprehensive evaluation model of public building design scheme based on BP neural network

1) The design of neural network theory and its comprehensive evaluation model. In recent years, the theory and algorithm of Artificial Neural Network (Artificial Neural Network abbreviated as ANN or Neural Network) have been widely used in the study of nonlinear system problems. Artificial neural network has the characteristics of nonlinear approximation, self-training, and strong fault tolerance. After in-depth analysis, we are convinced that it is feasible to use it to study the comprehensive evaluation of public building design schemes [4].

The neural network evaluation model can be recorded as shown in publicity (2):

\[ y = f(\text{net},W,X) \]  

It should be emphasized that in the neural network evaluation model (2), the concept of network node connection strength (weight) \( W \) is essentially different from the concept of weight in the formula (1) of the AHP method: weight \( V \) is subject to artificial qualitative evaluation factors Influence; and the connection strength (weight) \( W \) of formula (2) is generated by the training of the network model itself. During network training, the initial weights should be randomly selected, and they should be constantly revised and stabilized during network training. Network training has the characteristics of artificial intelligence, which reduces the subjective evaluation error.

2) Comprehensive evaluation model of public building design scheme based on BP neural network:
1. Comprehensive evaluation of BP network structure model. According to the non-linear characteristics of the evaluation of public building design schemes and the step-by-step transferability of the index system, a three-layer BP neural network (Back Propagation Neural Network, referred to as BP network) is designed. The network contains an input layer, a hidden layer and an output layer. The input layer has 21 nodes, and the corresponding input vector is set to $X=(x_1,x_2,...,x_{21})^T$, which corresponds to 21 evaluation indicators such as the land use environment of the public building design evaluation index system; there are 3 hidden layers Node: The output diagram of the comprehensive evaluation layer of the public building design plan has 1 node, and the corresponding output variable is set to $y$, $y$ corresponds to the comprehensive evaluation value of the public building design plan [5]. The network structure is shown in Figure 1.

2. The main model of BP network calculation. It mainly includes neuron activation function, objective error function, weight correction formula and so on. The error objective function is shown in publicity (3)

$$J = \sum_{p=1}^{P} J_p, J_p = \frac{1}{2} \sum_{j=1}^{n} (t_{pj} - o_{pj})^2$$  

Where J represents the total error function of BP network training; $J_p$ represents the error function of the BP network of the p-th training sample (p=1,2,...,m corresponds to m architectural design schemes); $t_{pj}$ represents the BP network error function under the condition of "mentor". The expected output value of the jth node of p training samples. When there is only one node in the output layer, take $j=1$, or $t_p$ in short, $t_p$ is the standardized comprehensive evaluation output value of the p-th building design plan; $O_{pj}$ represents the input-output relationship based on the comprehensive evaluation BP network node, namely The training output value of the j-th node of the p-th training sample under the condition of "mentor" [6].

3.3. Algorithm of BP network public building design scheme evaluation model
(1) Establish an evaluation index system and construct a BP neural network structure model;

(2) Evaluate the standardized processing of data, determine the input and output samples of the BP network, and select training and test samples from them;

(3) Based on the offline training and online application of the BP neural network, output the ranking results of the design schemes [7].

4. Application of BP neural network algorithm

(1) Standardize the evaluation data and design the BP network: take 3 hidden layer neural elements, set the activation function to logarithmic S type, training times 100,000 times, target error 1e-5, and learning rate 0.5.

(2) Network training

(3) Network inspection: 10 samples are used to test the performance of the network, the output value of the neural network is compared with the comprehensive benefit value obtained by the comprehensive benefit evaluation formula (1), and the error curve is drawn [8].

5. Evaluation model of public building design scheme based on self-organizing competitive neural network algorithm

The self-organizing competitive artificial neural network is a network model generated through an unsupervised (mentor) adaptive process. It has the characteristics of "no teacher". We designed a neural network public building design evaluation model based on separation and classification algorithms [9,10]. The self-organizing competitive neural network evaluation model and algorithm flow are shown in Figure 2:
Figure 2. Algorithm flow chart

6. Conclusion

In short, using neural network algorithms in the evaluation and design of public building design schemes is an inevitable trend. Through neural network algorithms, the theories and ideas of public buildings are turned into reality, and the prospects of the construction industry and related design industries are broader.

Acknowledgments

Analysis of parking demand in old residential quarters and countermeasures

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