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Face Recognition System in Intelligent Building Based on Neural Network

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Abstract: The development of intelligent building is based on its own perception and recognition functions to acquire and process the information of the space environment inside the building and the external world and other resources. This paper is based on the theory of neural network. First, the development status and trend of artificial intelligence at home and abroad are introduced. Secondly, the existing face recognition problems are analyzed, and a new improved neuron mapping method is proposed. Then, a set of face recognition system experiment scheme is designed, which is verified using MATLAB, and its performance is significantly improved through simulation experiments with testers. The experimental results show that the recognition accuracy of the face recognition system based on neural network algorithm is more than 90%. This shows that the recognition rate of the system meets the needs of users.

1. Introduction

With the increasing demand for human-computer interaction in the field of computer technology and engineering and the in-depth research on the issue of decentralization, a new branch concept of artificial intelligence has been proposed, and a good momentum of development has been achieved. At the same time, because people have increasingly high requirements for safety and comfort and need to ensure the real-time transmission of information in practical applications, face recognition in intelligent buildings has become an important topic [1-2].

Neural network is a nonlinear system which is simulated and calculated by a large number of neurons. It has a very high position in the human brain. With the in-depth study of intelligent buildings, scholars at home and abroad have also made some research achievements. Some scholars have proposed a face recognition technology based on the characteristics of strong adaptive ability and low energy consumption of artificial neural network (BP). The face recognition technology can effectively overcome the problems of false judgment rate of traditional recognition, poor timeliness and difficult information processing, and can provide high-precision image features in different

scenes. However, this method requires a lot of computing time [3-4]. Some scholars have proposed to establish a face recognition method in intelligent buildings based on BP algorithm. Other scholars believe that a training and testing model for face recognition based on BP neural network is constructed. Some scholars use the fuzzy C-means fuzzy card theory, combined with human eye technology, visual system, etc., to achieve the identification and information interaction of people in different scenes in a complex indoor environment [5-6]. Therefore, this paper studies and designs the face recognition system in intelligent buildings based on neural networks.

Based on the related research results at home and abroad, this paper proposes a face recognition algorithm based on neural network. This method combines training, learning and judgment based on artificial neuron to obtain a model that can be directly applied to calculation with high accuracy and strong uncertainty. At the same time, simulation experiments show that this system can effectively describe complex and changeable scenes, and can extract the required parameters from its feature information in a short time. It has the advantages of real-time and accuracy.

2. Research on Face Recognition System in Intelligent Building Based on Neural Network

2.1. Intelligent Building

Intelligent building is a process of perception, detection, recognition and control of buildings. Due to the differences between different regions, the design must take into account the climatic conditions, landform and other natural factors as well as other social and environmental factors. Intelligent buildings use computer, sensor technology, communication network and other high and new technologies to automate the management of various facilities in the buildings, so as to achieve the harmonious development of "man machine" [7-8]. At present, there are two views on the definition of intelligent building concept: in the narrow sense, it refers to a science that studies the characteristics and laws of human living environment and behavior based on modern information technology, and controls and optimizes the function. In a broad sense, it emphasizes the role of knowledge and comprehensive application in computer field, electronic communication industry, network technology and other disciplines, so as to form a highly rational structural system with certain characteristics. The intelligent building mainly realizes the information transmission of the internal and external environment of the building through the application of computer and communication technology, carries out scientific management, and provides a safe, comfortable, convenient and fast living space for people. At present, China has a relatively mature system in construction. However, its development progress is restricted by factors such as lack of complete system theoretical guidance and imperfect relevant laws and regulations. On the other hand, there is no unified standard in China to regulate the conversion relationship and coordination between different functional modules in intelligent buildings [9-10].

2.2. Face Recognition of Intelligent Buildings

Face recognition in intelligent buildings is a very complex system, because it requires a lot of data, such as buildings, access control, etc. However, the traditional methods of artificial recognition can no longer meet the requirements of accurate extraction and processing of these information. At present, the domestic research on the application of neural networks in face recognition is not very sufficient. First of all, due to the cultural and environmental differences in different regions, the imbalance of regional development has led to the existence of security risks in intelligent buildings in some regions. Second, because of the vast territory of China and the uneven economic level in various regions, it is also difficult to identify buildings. The development of intelligent buildings originates from the research on the internal environment of buildings,

human-computer interaction and other aspects. But at present, China is still in the initial stage in this regard, so the recognition technology is not fully mature. For neural networks, it is a nonlinear mapping. This characteristic is mainly shown in that neurons have a strong multi degree of freedom and distributed structure, and different types of neurons can be connected with each other and carry out information transmission and processing. Artificial neural networks usually use the process of simulating human brain neural system to process input data and form mathematical models after organization to achieve human functional requirements. It is based on the system and obtained by optimizing the training set in the input-output relationship. It can simulate the information extraction process, pattern recognition, learning and recognition functions of the human brain nervous system and realize the characteristics of automatic simulation and parallel computing. At the same time, it also overcomes the defects of linear instability caused by traditional algorithms and insufficient time-varying phenomena, and can be applied to the fields of complex nonlinear function approximation and unsupervised learning [11-12].

2.3. Face Feature Recognition

Identification is an important link in intelligent buildings, and also the most basic and main part [13-14]. The purpose of face recognition is to distinguish between different environments and different candidates. Under the background of traditional technology, the collected information is the feature description generated by image or text data, but this feature is called static mode or non dynamic state (such as noise point). There is a complete mapping relationship between input and output in neural network. In face recognition, there are many ways of recognition, but there are mainly two kinds: one is based on features. For example, this paper uses a relatively simple, easy to implement and widely used classifier. This method is also called BP neural network. Others need to preprocess the image (including gray scale adjustment) or extract the background to determine whether it is 0 or larger than the real face information, and then use this algorithm to convert the collected data into feature vectors contained in the training sample space [15-16]. Figure 1 is a flow chart of face recognition features.

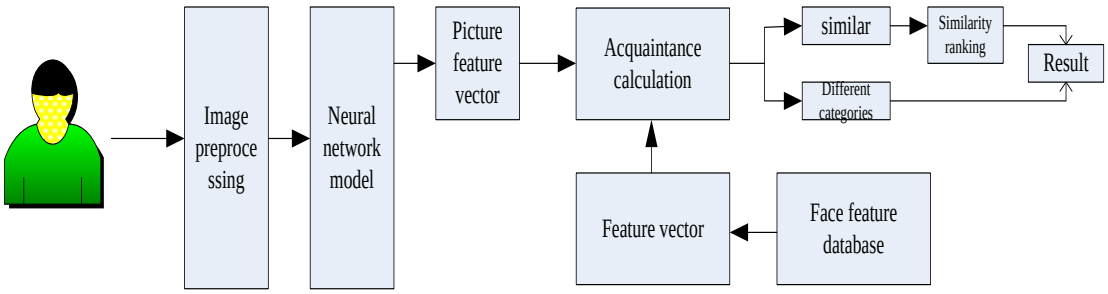

Figure 1. Face recognition feature process

2.4. Neural Network Technology

The structure of neural network is a kind of self-learning, self-learning and imitation function, which can automatically calculate the input-output process under the condition of uncertain objects. Human brain neurons generate corresponding association or state feedback after processing external information. All nodes in the neural network can choose their own weights and connection strength to determine whether the connection parameters are correct. Different connection methods will have multiple obvious end patterns corresponding to specific points, that is, the same node receives the same result when it receives the same signal and inputs it as a training set to the output process, which is called "neural network" [17-18]. Figure 2 is the flow chart of the neural network algorithm.

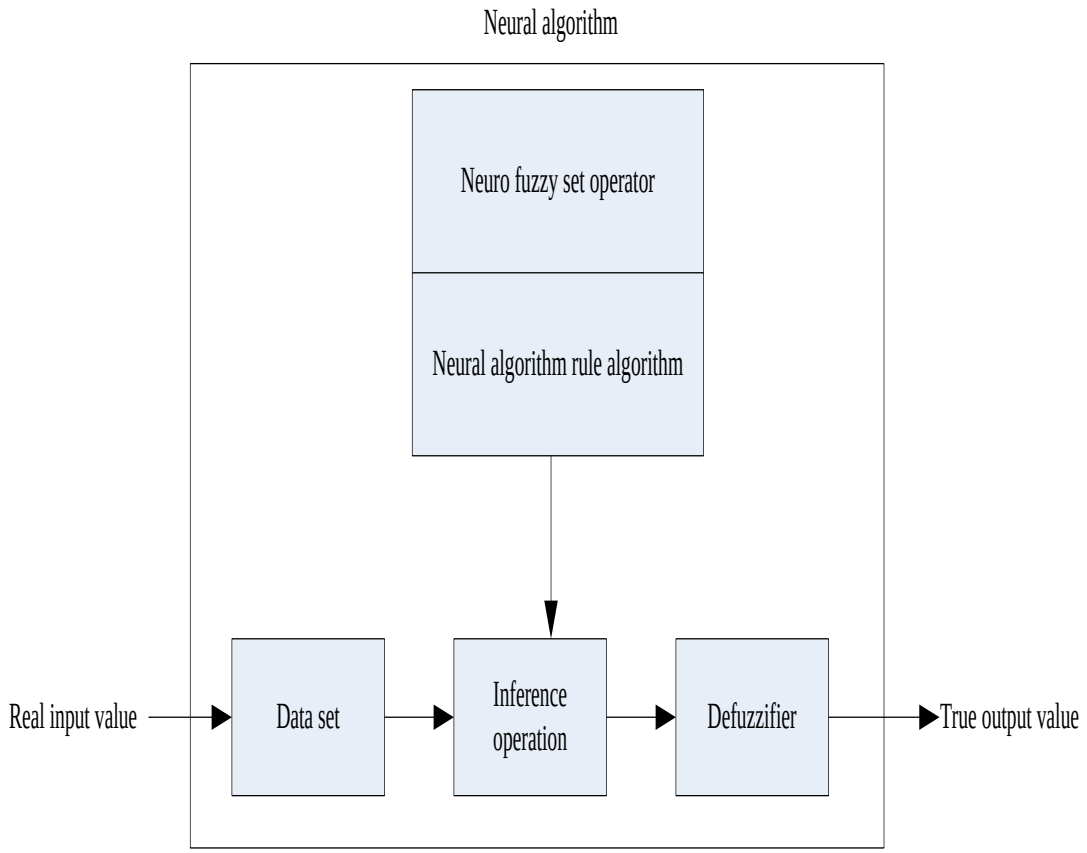

Figure 2. Flow chart of the neural network algorithm

The neural network is a neuron that imitates the human brain and learns by connecting weights in the brain cells and the nervous system. Face recognition technology mainly includes: pattern classification, feature extraction and hidden layer. The structure of artificial neural is simple but not economical, and it is easy to be affected by environmental factors to produce distortion or distortion. However, the diversity, variability and predictability of biological intelligence parameters make it greatly improve and challenge the performance of face recognition. Neural network is a kind of unsupervised computing method. It will simulate the human brain nervous system and be established by imitating, learning and recognizing a large number of connection weights composed of neurons. It can describe the internal relations between input signals and their behavioral characteristics in many ways, such as artificial pattern recognition or classification processing. In supervised training systems, linear mapping is usually used to approximate nonlinear functions, or a simple and easy to implement topology is used to transform complex problems into single dimension and multiple solutions. In order to effectively recognize the face, it is necessary to obtain the feature vector that can best represent the face. Discrete Cosine Transform (DCT) is usually used in the graphic image coding process. It has the advantages of high compression ratio, strong ability to separate high and low frequency information, etc. It is a classical transform coding method for digital rate compression. The edge of the image also contains a lot of effective recognition features. The edge of an image refers to a collection of pixels whose surrounding pixels have a step change in grayscale or a roof change, which contains important features for object classification and recognition. We cannot discard this part of data directly. If f (x, y) is a face image with a resolution of mxn in the spatial domain, the corresponding DCT transformation and IDCT inverse

transformation formulas are:

$$F(\mathrm{x},y)=\sum_{n-1}^{m-1}C(x)C(y)f(x,\mathrm{y})\cos\left[\frac{(2x+1)\pi u}{2m}\right]\cos\left[\frac{(2\mathrm{y}+1)\pi v}{2n}\right] \tag{1}$$

$$f(\mathrm{u},v)=\sum_{n-1}^{m-1}C(u)C(v)f(u,v)\cos\left[\frac{(2x+1)\pi u}{2m}\right]\cos\left[\frac{(2\mathrm{y}+1)\pi v}{2n}\right] \tag{2}$$

The face is segmented according to the position distribution of the edge contour and texture features of the face image, and each face image is DCT transformed. Then, the image block located in the middle area of the face is identified by the low frequency component of the DCT coefficient, and the image block located in the image edge area and containing the image edge contour or occlusion factors is identified by the high frequency component of the DCT coefficient, This can not only preserve the effective local details of the face, but also weaken the impact of occlusion, lighting and expression changes on the essential features of the image.

3. Experimental Process of Face Recognition System in Intelligent Building Based on Neural Network

3.1. Composition of Face Recognition System Based on Neural Network

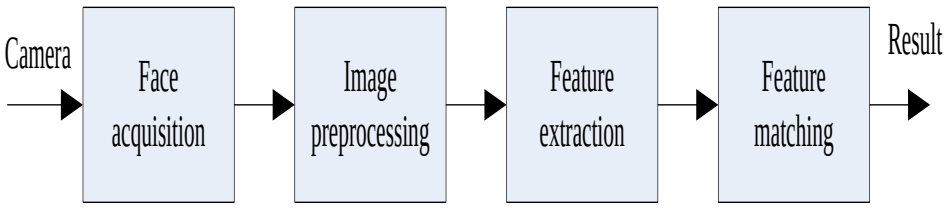

Figure 3. Face recognition system

The intelligent building face recognition system based on neural network consists of two parts, namely, feature extraction module and data preprocessing module. First, the classifier samples are selected from the training set, and the selected samples are zeroed, reverse compressed, etc. Then, the output weight estimation and learning vector space matching (SOLP) are realized at the input layer through an adaptive process. After calculation and storage, a parameter is obtained as the number of God elements N. The neural network algorithm is one of the unsupervised nonlinear function optimization methods, which is a global search strategy based on statistical feature extraction. This link mainly includes three aspects: image preprocessing and binarization. The former refers to selecting a specific pixel in the same area as a sample for training, while the latter means that all elements in the entire space scene belong to the range that the object face recognition system needs to perceive, that is, the segmentation result output object is a single or multiple sub blocks (as shown in Figure 3).

3.2. Performance Test of Face Recognition System in Intelligent Buildings

The performance test of face recognition system in intelligent building mainly includes hardware test and software debugging. According to the system performance requirements, the principle of neural network algorithm is analyzed, the input module is determined to be an external neuron structure, and the parameter matching method based on SOFM for recognition, the distribution model of training samples, and the corresponding relationship between the output vector and the

expected value are designed, The accuracy and reliability of the results obtained after verifying whether the performance indicators of the face recognition system proposed in this paper meet the expected objectives and test environment requirements.

4. Experimental Analysis of Face Recognition System in Intelligent Building Based on Neural Network

4.1. Performance Test and Analysis of Face Recognition System in Intelligent Buildings

Table 1 shows the test data of recognition accuracy of face recognition system.

Table 1. Face recognition accuracy test

Test times	Identify the number of people	Training data	Identification accuracy(%)
1	231	21	95
2	214	23	98
3	243	20	94
4	245	25	97
5	223	23	99

Figure 4. Performance test and analysis of face recognition system

The performance test analysis of face recognition system in intelligent buildings mainly includes the recognition accuracy. In this paper, effective information is obtained through data statistics and calculation of the identified error rate. However, due to the complexity and variability of the actual situation, it is not enough to rely on these feature parameters alone. At the same time, factors such as the frequency of mismatching and the noise after preloading should also be considered to affect the judgment results. In addition, in the training, it is also found that local errors or non optimal accuracy values may be perceived to cause recognition failure. It can be seen from Figure 4 that the recognition accuracy of the face recognition system based on the neural network algorithm is as

high as 90%. This shows that the recognition rate of the system meets the needs of users.

5. Conclusion

With the development of society and the popularization of intelligent buildings, people put forward higher requirements for the construction of smart cities. In this paper, a complete and effective face recognition system is established based on neural network. First, it introduces the research background and significance, the current situation at home and abroad, and the related domain knowledge. Then, it analyzes and expounds the problems existing in the traditional recognition methods. Finally, it gives a specific example that combines neural network technology and applies it to the actual scene, that is, it uses artificial neurons to simulate human body recognition to complete the process of extracting features of human face behavior information in buildings.

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Data Availability

Data sharing is not applicable to this article as no new data were created or analysed in this study.

Conflict of Interest

The author states that this article has no conflict of interest.

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