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Crop Disease Identification Method Based on Convolution Neural Network

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Abstract: With the rapid development of agriculture in China, the area of crop diseases is expanding and showing a growing trend year by year. However, the traditional recognition methods are inefficient and inaccurate. In order to improve the quality of agricultural products and reduce the economic loss rate, it is necessary to effectively classify crops to achieve efficient production and minimize the loss, so as to achieve the desired effect. This paper mainly introduces the application of several new algorithms based on convolution neural network model, fuzzy comprehensive evaluator and artificial neuron feature extraction technology in agriculture. The experimental results show that this method can identify disease information better. The test results show that the crop disease model synthesis can achieve a high recognition rate of 0.96. Because the number of samples of some categories is small, the category characteristics are weak, and the recognition rate of the model for such samples is low, so it is necessary to increase the number and diversity of samples to improve the recognition ability of the model for crop diseases.

1. Introduction

In recent years, more and more attention has been paid to the identification of crop diseases. In China, the prevention and control of pests and diseases in agricultural production is an important work. However, due to farmers' lack of prevention awareness and related knowledge and technology, many problems have been caused, such as a large number of pesticides and fertilizers being directly discharged into the soil after application. Poisoning can be caused by using toxic substances or toxic and harmful gases when the environment is bad. In order to reduce costs, some farmers use low-quality chemicals (such as sulfur and phosphorus) to irrigate crops, which is not conducive to agricultural production development [1-2].

Domestic and foreign scholars have made great progress in the research of crop disease identification methods. The research of foreign scholars on neural network mainly focuses on the following aspects. First, it is proposed to use artificial neurons to identify crop diseases. This

method requires a large number of training samples, and it realizes recognition by simulating human brain [3-4]. Secondly, a large number of experiments have been carried out to solve the problem of excessive application of pesticides and fertilizers in traditional agriculture and based on convolutional neural network technology. However, these documents are all based on crops. But for most practical applications, the effect of this method is not obvious. Domestic scholars detect and predict crop growth environment parameters in agriculture based on CMMR neural network [5-6]. It is pointed out in the literature that the plant growth process is greatly affected by temperature, humidity and other factors, and the change of meteorological factors will lead to changes in crop yield and quality, which will damage it. At the same time, it is also found that many pests and diseases are a problem that has plagued China for a long time. Because of the adverse effects of climate conditions and uneven rainfall distribution on crops, soil salinization is serious.

This paper mainly analyzes the research status of crop diseases at home and abroad, and finds out the problems of many existing methods. For example, the growth environment, temperature and other environmental factors have a greater impact on biomass changes, and the traditional artificial neural network has no effect on disease identification. Based on literature review and relevant statistics, conclusions are drawn. The paper first introduces the basic principles and characteristics of plant disease identification and the specific implementation process of convolution neural network algorithm model, then analyzes and summarizes the classification of crop diseases and insect pests and applies it to agriculture, providing theoretical support and experience for future research.

2. Discussion on the Crop Disease Identification Method Based on Convolution Neural Network

2.1. Crop Diseases

Crop disease is a common disease, which refers to crop diseases caused by various natural and human factors [7-8]. It is mainly manifested as the lack of nutrients in the leaves due to the lack of nutrients required for growth and development, the lack of nutrients in the leaves due to excessive lipid content in the body, or the plant is not sensitive to changes in the external environment, resulting in dry and withered leaves or a large number of deaths in the leaves. In the long-term planting process, crop yield will be seriously affected due to weather factors, pests and diseases, and pesticide residue pollution. To some extent, humidity and temperature can affect the absorption and utilization of nutrients required by plant growth and development, and also play an important role in soil fertility. In addition, it can also adjust soil water content and evaporation by changing water distribution to reduce crop transpiration energy consumption. However, few studies on crop diseases are focused on the changes of rhizosphere, stem and leaf parts and leaf surface morphology after the occurrence of crop diseases. There are many kinds of crops. When identifying them, we should first pretreat them, and then screen the plant samples collected by the pest net and other nurseries according to different varieties, types, pathogenesis and other characteristics. Combining the analysis of growth cycle and seasonal change, the weather factors will lead to plant variation to a certain extent and cause disease. It can also be classified into multiple levels. According to the unique growth characteristics of different crops, corresponding species are selected for analysis and research. For example, we often find that some plants such as wheat and rice have good properties, while dry and fresh raw foods and stems and leaves have bright colors and good color uniformity, while crops with yellow green leaves or red or yellow powdery gray white leaves can be used as a diagnostic method [9-10].

2.2. Disease Identification Method

Crop disease identification is a complex and arduous task, which requires us to pay a lot of effort. In the early research process, due to different image acquisition equipment, data sample types, acquisition conditions and other factors, image features are different [11-12]. The identification of crop diseases mainly uses plants to identify biological species, acquire corresponding data by collecting samples, and then use image processing tools to convert them into digital signals. This algorithm has the following advantages, and can quickly and effectively extract the required information. However, in practical application, due to environmental factors and other reasons, biological samples are damaged when collected, or external interference factors are large and are not easy to be found and removed, and the feature classification method cannot be used to distinguish and identify crop diseases. Therefore, the accuracy of this method needs to be improved and studied. In order to successfully complete this work, we must first determine whether the required image is the original image. In the process of identifying crop diseases, the most important thing is to input the eigenvalues into the network, and then train to identify the required results. Compared with traditional methods, artificial neural network technology can realize disease diagnosis and prevention by constantly learning and optimizing to find the optimal parameters. Secondly, the model is established from the biosensor acquisition system, and its characteristics are used to complete the classification work. Finally, after analyzing the disease image, the disease type, disease location, development trend and other information data are determined, and then the prediction is made, so as to achieve the comprehensive prevention and control of agricultural products [13-14].

2.3. Convolution Neural Network Algorithm

Convolutional neural network is an unsupervised learning process based on probability. It has strong adaptability, can model things in unknown environments, and is also a typical multi-layer feedforward structure, so as to achieve the fusion of hidden layer and known information. The structure of convolutional neural network model is shown in Figure 1. First, the input space is composed of data sets, input vectors and output nodes. Then, by mapping the sample space to the corresponding location coordinates, the weights of neurons are determined and the corresponding parameters are calculated. At this point, the topology and learning process of the network are simulated. Finally, a group of newly set functions are obtained to predict unknown things. This method is centered on a simulated human brain to establish the model and uses mathematical modeling methods, It is an algorithm that decomposes the problem into multiple small unit modules and then uses the network structure to realize the systematic operation of the neural network to complete the whole process [15-16]. By adjusting the connection weights between the input and output level neurons, the algorithm achieves the minimum output when the error signal propagates forward from the input to the output in a specific time.

This method has the advantages of good learning ability, good generalization performance, robustness and fault tolerance, but also has its own shortcomings. For training samples, it is not easy to get the required data set, which makes the network fall into the local optimal solution to find the best parameter set. In the process of practical application, it is usually necessary to determine the objective function value after multiple iterations [17-18]. When we do not want this parameter to achieve our desired purpose, we cannot use this method. On the contrary, if it is required to meet the requirements, we can use gradient descent method, nearest node marker and feedforward neural network to achieve the above operations.

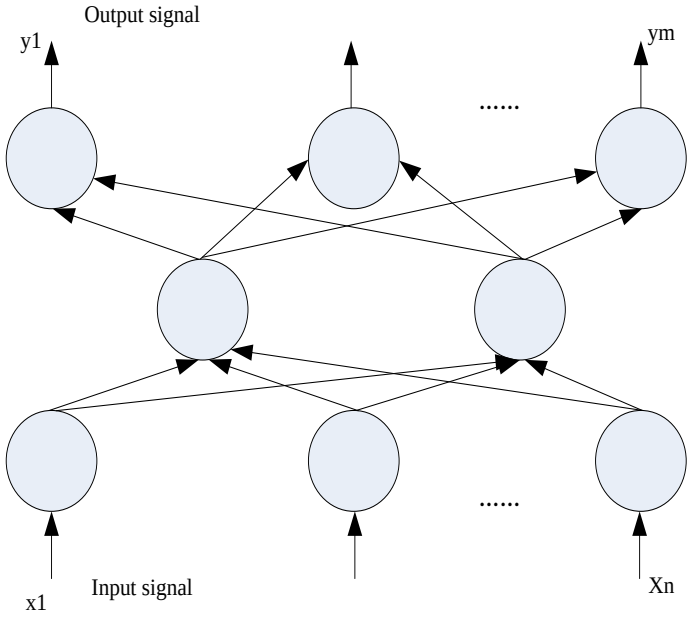


Figure 1. Convolutional neural network structure

The convolutional neural network uses the Softmax classifier in the last full connection layer to classify the results, so as to obtain the probabilities of different categories, and the sum of the probabilities of all categories is 1. The Softmax classifier functions are defined as:

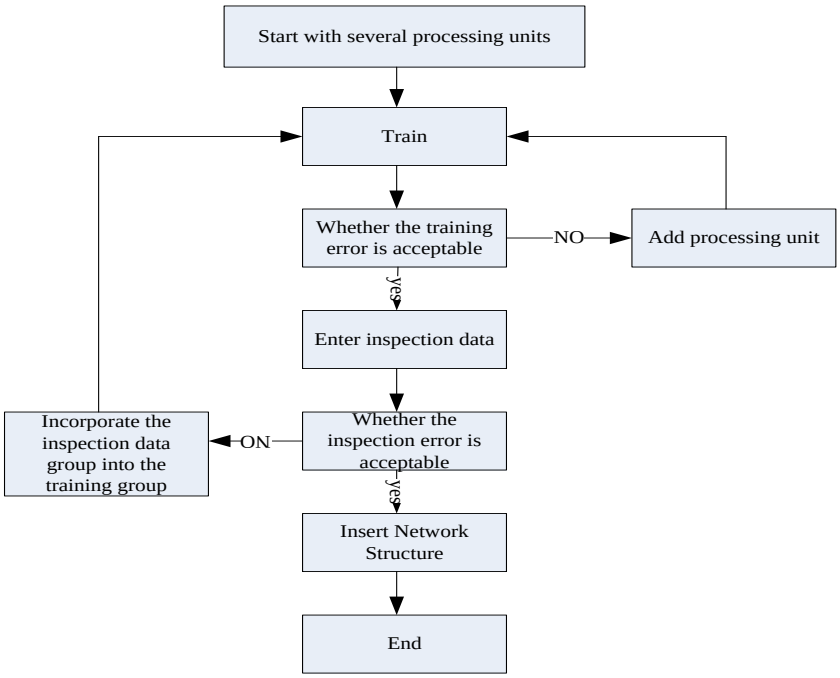
$$y_i(x) = \frac{e^{a_i(x)}}{\sum_{i=1}^{c} e^{a_i(x)}} \forall i \in 1 \sim C \tag{1}$$

In formula (1), a (x) is the output value of pixel x on channel of category i; C is the category, in this study, C=59; y; (x) is the probability that pixel x belongs to category i. The descent gradient is calculated by using the cross entropy loss function, and the formula is:

$$H(p,q) = -\sum_{i=1}^{n} p(x_i)\log(q(x_i)) \tag{2}$$

In Formula (2), p (x) is the real label of image i, q (x) is the network prediction value of image i, and the sum of all elements is the value of loss function. Convolution network is a method of gradient descent and neural structure, which simulates the changes of human brain to the external environment to process information. In the field of biological recognition, it uses the model of neurons to realize disease classification.

A complex and changeable, nonlinear sample with a large amount of data requiring strong timeliness, high precision and large-scale integration of network technology can survive among different kinds of original samples. For some new samples with obvious features or similar attributes, we can get better results by local replacement. Convolutional neural network is a bionic model. It learns by processing data. Before classification, the objects to be identified need to be divided into different parts. In general, we divide a complex function into several summary points. The two neurons interact and connect with each other to form a network structure diagram, as shown in Figure 2. Here, the model is built based on the principle of convolutional neural network.



Figuer 2. Computational process of convolutional neural network algorithm

3. Experimental Process of Crop Disease Identification Method Based on Convolution Neural Network

3.1. Crop Disease Identification Method Model Based on Convolution Neural Network Algorithm

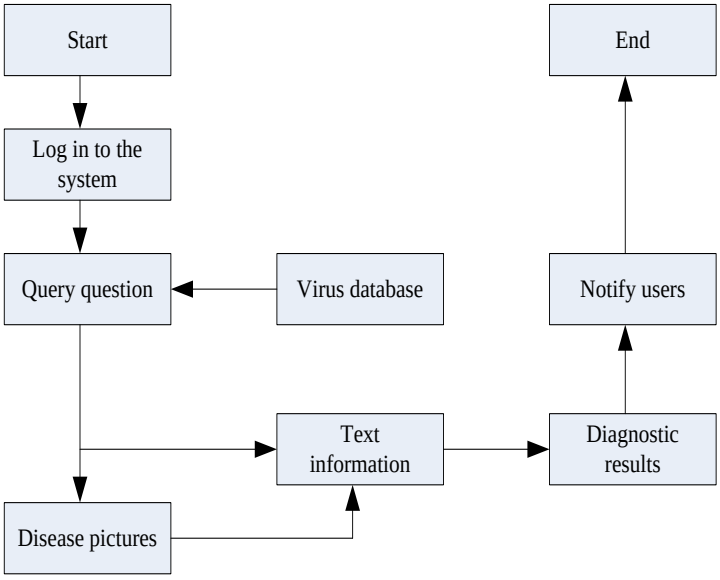


Figure 3. Model of crop disease identification method

The crop disease identification method model based on convolutional neural network (as shown in Figure 3) is obtained by improving the existing algorithm. Its basic idea is to first input the original data into the production boundary region processed in the convolutional neural network, and then use these grid features and the number of neurons to calculate the corresponding point

values (i.e. threshold) on all nodes in the region. If it is calculated under specific conditions, it can be implemented using this algorithm. However, because the actual situation is different from the environment, the model parameters are uncertain, and the test results are inconsistent, a large number of sample data are required for basic support when improving it. The model of crop disease identification method based on convolutional neural network is established manually. In the implementation process of this algorithm, the input samples need to be preprocessed first, that is, the original data should be imported into the convolutional neural network. After the first two steps, the required results are obtained. Then, the convolutional neural network theory is used to calculate the value of each node and the corresponding probability to determine the threshold value. Finally, the results are compared with the actual situation and judge whether they meet the requirements and the advantages and disadvantages of each parameter.

3.2. Performance Test of Crop Disease Identification Method Model Based on Convolution Neural Network

For a complex problem, multi-channel parallel forward transmission and multi-user synchronous backward transmission can be used to deal with it. For multiple nodes, it is necessary to consider the negative impact of mutual interference between different nodes. For the output object, the use of convolutional neural network can achieve global parameter optimization, thereby reducing the computational load and system complexity. Through the analysis of the experimental results, the problems existed in the system operation process, such as data acquisition error, excessive sample number, etc. Select appropriate model parameters according to the actual situation and indicators. In this paper, the convolution algorithm is used to calculate the corresponding eigenvalues and weights, and MATLAB software is used to test it to verify that the method has good performance. Finally, by comparing with the experimental results, the problems in the system operation process are obtained.

4. Experimental Analysis of Crop Disease Identification Method Based on Convolution Neural Network

4.1. Performance Test and Analysis of Crop Disease Identification Method Model Based on Convolution Neural Network

Table 1 shows the performance test data of crop disease identification method model.

Table 1. Model test of crop disease identification method

Test times	Training set loss value	Training set accuracy values	Validate set accuracy values	Model accuracy
1	1.49217	0.79742	0.823 89	0.95
2	0.44272	0.83613	0.106 42	0.93
3	0.97059	0.83065	0.882 37	0.91
4	1.15007	0.86548	0.863 73	0.96
5	0.97059	0.55065	0.843 08	0.90

Figure 4. Convolutional neural network to identify crop disease performance

The crop disease identification method model based on neural network is tested and analyzed, and the following conclusions are drawn. In the experiment, the convolution neural algorithm is used to compare the experimental data with the results, and it is found that the algorithm can improve the classification efficiency. However, the effect is not obvious from the test time. When the number of samples is small, it shows that this method can better solve the sample problem and control the error caused by key factors such as input parameters. For other cases that may cause false recognition, more tests are required to obtain better and more accurate results. Figure 4 shows the test results of the crop disease model on the test set. The model synthesis can achieve a high recognition rate of 0.96. Due to the small number of samples in some categories, the weak category characteristics and the low recognition rate of the model for such samples, it is necessary to increase the number and diversity of samples to improve the recognition ability of the model for crop diseases.

5. Conclusion

With the development of China's economy, people pay more and more attention to the quality of life, and crop diseases also follow. In order to improve the quality and production efficiency of agricultural products. This paper mainly studies the traditional paper based single root analog convolution map recognition method. Firstly, the traditional artificial neural network structure and the theoretical basis of BP neural network model are introduced. Secondly, the experimental results are compared and analyzed to draw a conclusion. Finally, the genetic algorithm is used to classify and test to verify that the method has the advantages of high accuracy, fast speed, good accuracy, and certain application prospects. It has a positive effect and significance on the extraction of crop disease information.

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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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