Research on the Application of Deep Learning in Agricultural Technologies

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Abstract

In the recent years, deep learning has made significant progress in many technology fields, such as voice recognition, computer vision, natural language processing and information retrieval, most of which are used in agriculture. This paper introduces the application of deep learning in agricultural technologies, including plant leaf identification, prediction of regional ecological security, online agricultural product sale prediction,etc. It also explains the related algorithm and theory of deep learning. It summarizes the significant roles deep learning has played in agricultural technologies and forecasts the great value of deep learning in future agricultural technologies.

Keywords

Deep learning, agricultural technologies, recognition and identification, prediction

1. Introduction

In recent years, with the gradual promotion of deep learning technology, in various industries can see the deep learning. Not only is in the emerging industry, in traditional agriculture, deep learning studies have also getten success, it has been significantly improved the recognition rate in the traditional recognition task of agricultural science and technology, shows its ability to handle complex recognition tasks, it attracts a large number of scholars to study on its. This paper expounds the present situation of deep learning in the field of agricultural science and technology, and reviews relevant research results. Based on the above contents, the research prospect of deep learning in agricultural science and technology field is put forward.

Deep learning originated in the study of neural networks, and can be understood as deep neural networks. Through it, we can get the deep characteristic representation. From the complicated characteristics of the dimension disaster problem of miscellaneous and high dimensional data of artificial selection. The basic model is accepted at present that the deep learning includes a deep belief network [1-2], Stacked automatic encoder based on automatic encoder [3], convolutional neural network[4], recurrent neural network[5]. About more knowledge of deep learning, you can refer to a summary of deep learning areas[6-10].

2. Research of Deep Learning in Agricultural Technologies

Many studies have shown that deep learning has been applied to the field of agricultural science and technology, this paper focuses on the research of deep learning forecasting research field and flower

identification in the field of agricultural science and technology classification field, online sales of agricultural products.

2.1 Research on the Application of Deep learning in agricultural science and technology of recognition classification.

Zhang Shuai and Huai Yong-jian[11] designed a study.In this study,plant leaf images were used as recognition objects.Plant leaf images were divided into single and complex background and were treated by using image segmentation method.We design a deep learning system which includes eight layers of Convolution Neural Network (CNNS) to identify leaf images. And then the deep learning system was tested with 33 293 leaf sample images which come from PI@antNet libraries and our extending leaf libraries for image training and recognition. Compared with the traditional identification methods, the classifier provided in this paper has achieved better recognition effect. For CNN+SVM and CNN+Softmax recognition system,the simple background leaf recognition rate reaches 91.11% and 90.90%, The system has higher recognition rate for the large amount of leaf images with no more optimization, and has a higher recognition rate especially for the recognition of complex background images.

The convolutional neural network based on depth learning consists of two convolution layers, two sub sampling layers, two local contrast normalization layers, one fully connected layers, one classification layer. As shown in Figure 1.

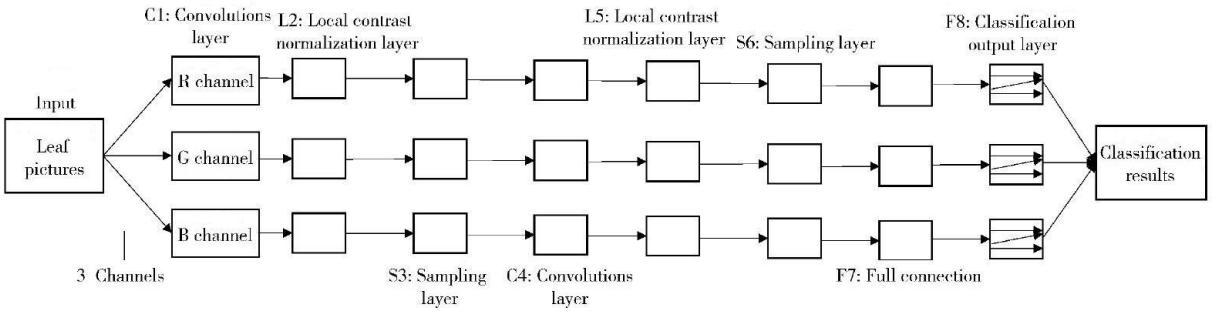

Fig.1 Layered convolutions deep learning framework

Among it, the Cn layer is the convolution layer, which completes the extraction of the input features. In order to avoid the overfitting caused by many features, the Sn layer is used as the sub sampling layer. The Ln layer is a local contrast normalization layer, which mainly performs local reduction and division operations normalization, and competes the adjacent features in the feature graph to force the matching of the spatial position features of different feature graphs. The F7 layer is the full connection layer and calculates the dot product between the input vector and the weight vector. The F8 layer is the classified output layer.

The difference between leaf image features of this method with the traditional multi classifier recognition system is in a large amount of data to make more optimization, can greatly improve the recognition rate, especially in leaf images in complex background, can obtain excellent recognition effect.

2.2 Online agricultural product sales foreast model research based on deep learning

Liu Jing, He Shuqun and so on[12], in order to solve the problem of information asymmetry of agricultural products on-line, combined with the advantages of deep learning and the characteristics of transaction data and put forward the sales predicting model-Imperial Crown Model(short for ICM). The main idea is to establish the factor evaluation index first, sales can be divided into four levels. Secondly, adopted two lalyers autoencoder network to extract feature, and generated the new feature vector. Then, the classifier is trained with labeled sample set and the classifier is used to classify the unlabeled training samples. Finally, the optimal parameters of the whole network parameters were

fine-tuned by using the backward propagation algorithm got the minimize value of the loss function, and achieved online sales of agricultural products classification predict.

The training steps of ICM are: (a) input training samples and unsupervised training by two layers of automatic encoders. (b) the label free output obtained by step a is used as the input of the Softmax classifier, and the Softmax classifier is trained using a labeled sample set. (c) compute the kernel function of the automatic encoder, the reconstructed error function, the cost function of the Softmax classifier and the partial derivative function of the whole network. (d) the network parameters obtained for the step (a) –(c) are used to initialize the whole depth network parameters, and then the back propagation algorithm is used to obtain the optimal parameters for supervised training.

ICM algorithm specific steps, as shown in Figure 2.

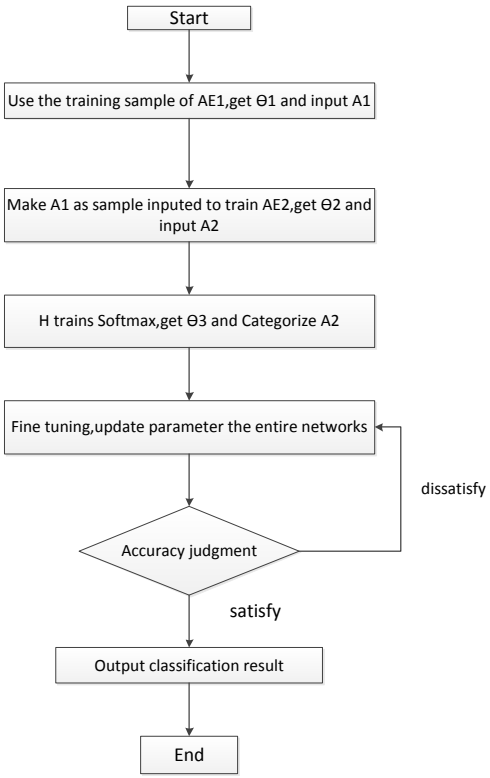

Fig.2 Algorithm flow diagram

Compared with the traditional shallow classification algorithm, the design of ICM has higher prediction accuracy when dealing with large-scale datasets. The accuracy of online agricultural product sales forecasts is further improved.

2.3 Automatic Classification of Flowers Based on Deep Learning Model

Shen Ping and Zhao Bei[13] propose a new architecture of deep Convolution Neural Network with multi-hidden layers, this CNN architecture can play a good role of rigid object recognition. Followed by the Flowers Recognition as a example, they analyze the architecture of CNN, convolution process, pooling process and the errors back-propagation in the article, then they construct a new CNN model for recognition.

It mainly employs five convolutional hidden layers and three fully connected layers of neural network architecture. Three dimensional images by 224*224*3 data input channel, the neural network extracts 4096 dimension feature as the output, the final output obtained 80 recognition results using the softmax activation function, corresponding to the 80 categories of flower image. With the combination of pooling operation, the dimension of the results is reduced, the scale of parameters is reduced, and the time complexity of training flowers samples is improved.

3. Research prospect of deep learning in agricultural science and technology application

With the in-depth study, in the future, deep learning technology will become a part of an application in agricultural science and technology, however, application of deep learning in the field of agricultural science and technology is still in its infancy, many problems have not yet found a satisfactory answer. Such as the ability to adapt to large agricultural data and improvements in relevant depth and hierarchy.

The ability to adapt to large agricultural data: large data contains a lot of valuable information, but how to find data from large data to express the characterization of this data is a question that researchers need to pay attention to. For example, the selection of modeling sample data sets, and how to judge the selected modeling samples are the most representative samples.

In the improved depth on the structure: hierarchical model structure than the shallow depth while the model has a breakthrough in the structure, the hierarchical structure of biological visual system simulation, information processing structure but did not match the cortex. For example, the classification of plant leaves does not take into account the influence of time series on learning. The leaves of the same plant have different characteristics in different seasons and different years.

Although deep learning in agricultural science and technology application still belongs to the primary stage, many problems have not been solved, but deep learning currently in agricultural science and technology application success shows that deep learning technology can make a big step forward in the agricultural science and technology.

4. Summary

1) This paper begins with a brief overview of deep learning, a brief account of the main approaches to deep learning and the origins of deep learning.

2) The study of successful examples in the field of agricultural science and technology shows the important role of deep learning, and points out its future direction.

3) By summarizing and reflecting the application of deep learning in the field of agricultural science and technology, it shows that the deep learning will become the focus and hot spot in the field of agricultural science and technology.

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