Research on the Creation of a Rural Agricultural Development Platform Based on the Background of Internet+

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Abstract—E-commerce, as a special form of ICT, plays an increasingly important role in promoting and supporting social innovation, providing a platform for interactive cooperation between people in different regions, economic exchange and development, and the trading and delivery of goods and services, which crosses the boundaries of space, promotes economic growth, and greatly changes people's lifestyles and habits. With the gradual evolution of e-commerce, the countryside has become a new fertile ground for e-commerce development. The transformation of traditional villages into e-commerce villages is driving a new social shift in rural China by changing people's common values about rural life, their emotions about the countryside and the rhythm of local people's lives. Rural e-commerce is seen as a road to rural revival and is supported and promoted by the central government and local governments.

Keywords- E-commerce; Rural E-Commerce; E-commerce model; E-Commerce Policy

1. INTRODUCTION

With the further expansion of e-commerce and the further lowering of barriers to entry, which has a natural attraction for economically disadvantaged groups in rural areas, where the special characteristics of farmers limit the scale of their business behavior inputs, e-commerce offers new ways and means to regional economic development and improvement [1]. The proliferation of the entire e-commerce industry in China from its emergence to the present shows that even traditional e-commerce has some players, such as local governments, who have taken actions to improve the problem of stagnant sales of local regional agricultural products and other specialty products [2]. In the social innovation driven by e-commerce, there are also individuals who are working as innovators and reformers to expand the business of e-commerce within the region [3].

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2. POLICY DEPENDENCE OF RURAL E-COMMERCE IN LIAONING PROVINCE

2.1 The reliance of national e-commerce policy

The State Council of China issued the first official document dealing with the development of e-commerce in 1998. The first document on the development of rural e-commerce was released in 2001 [4]. In addition, relevant policies and official documents were collected on the Chinese State Council website using keywords such as "Internet", "China Rural Internet", "e-commerce" and "rural e-commerce". Its annual change is shown in the following chart:

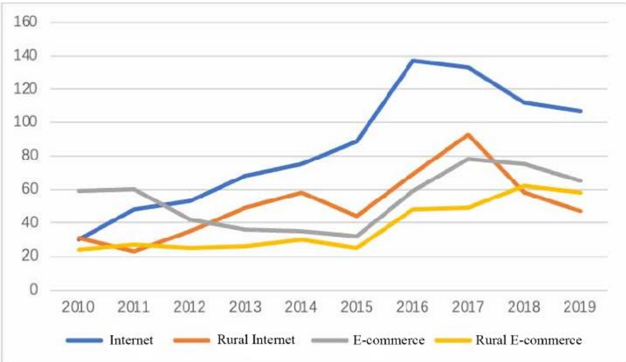


Figure 1. Annual change in the number of e-commerce national policies

Figure 1 shows the number of policy documents issued by the national government each year from 2010 to 2019. This indicates that from 2010 to 2019, the country is paying increasing attention to the development of Internet services, rural Internet, e-commerce, and rural e-commerce [5]. The biggest change occurred between 2015 and 2017. Based on official documents posted on the Chinese national government website, I reviewed policies and projects related to rural e-commerce development. Table 1 shows the main annual concerns of our government in promoting rural e-commerce from 2010 to 2020 [6].

TABLE I. E-COMMERCE NATIONAL POLICY ANNUAL CONSTRUCTION CONCERNS

Year	Construction Highlights Excerpt
2010	Agricultural information network, infrastructure development
2011	Agricultural information technology and infrastructure improvement
2012	Development of modern logistics system
2013	Building a modern agricultural demonstration area
2014	Improve e-commerce environment and development
2015	Reduce logistics costs and create a business environment
2016	Upgrade rural product certification, develop rural e-commerce
2017	Enhance the scale and improve the rural business service industry
2018	E-commerce pilot construction, cultivating rural e-commerce growth points
2019	Facilitate the development of rural

	e-commerce and promote e-commerce poverty alleviation
2020	Continue to promote e-commerce into the village

In short, these policies and official documents are designed to promote rural infrastructure and establish a soft environment suitable for rural e-commerce development. In 2013, the General Office of the State Council issued a document to upgrade the broadband layout, a strategy focused on updating broadband Internet and increasing Internet access nationwide, especially in rural areas [7].

3. CONVOLUTIONAL NEURAL NETWORK FUNDAMENTALS

Convolutional neural is a multilayer parallel neural network model where the input to output is a mapping relationship. CNNs train the weight parameters of the network by learning such mappings so that they can be trained to map relationships from input to output. The specific recognition flow chart of the convolutional neural network is shown in Figure 2. The basic principles and features of convolutional neural networks include two main ones: one is to have a local field of perception, and the other is to share weights. These two basic principles can help the model to reduce the number of parameters and thus avoid problems such as overfitting [8].

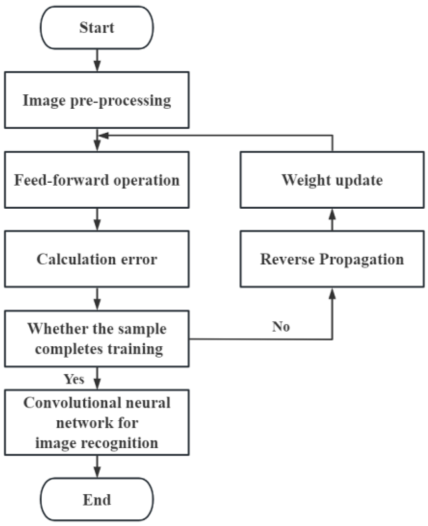


Figure 2. Convolutional neural network image recognition flow chart

3.1 Local connection

Local connectivity, in which neurons are not connected to all neurons in the upper layer but only to some of them, can only perceive local features of the network, and this type of connectivity can also be called as sparse connectivity. The idea of local connectivity mimics the structure of the animal cerebral cortex. In tasks related to computer vision, the correlation between pixels is negatively correlated with their distance, which means that the closer the pixels are to each other, the stronger the correlation between them, and conversely, the further the pixels are from each other, the worse the correlation is. Figure 3 shows the schematic structure of the local connectivity of the convolutional neural network [9].

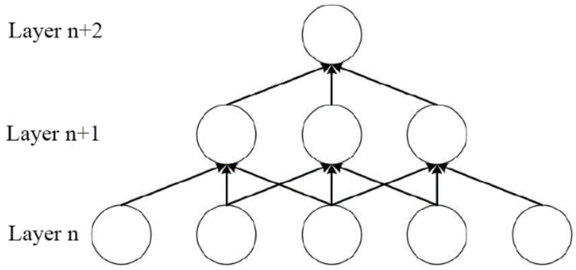


Figure 3. Partial connection schematic

As can be seen from the above figure, each neuron in the $n + 1$th layer of the neural network is not connected to all neurons in the previous layer, but is perceived with only 3 neurons, which makes the network only $3 \times 3 = 9$, 33 weight parameters, which is 6 parameters less compared to all connections. Similarly, layer $n + 2$ is connected to layer $n + 1$ in the same way as a local connection. By using local connectivity, the number of parameters of the network can be greatly reduced, thus improving the learning efficiency, and preventing the overfitting problem [10].

3.2 Value Sharing

Weight sharing means that multiple functions in a model all use the same weight parameter. In the convolutional neural network model, it means that every perceived local feature (i.e., receptive field) in the image uses the same convolutional kernel for feature extraction.

The convolution operation of a convolutional neural network is essentially a feature extraction of an image, so the same convolutional kernel can be used for different perceptual fields to extract features. For example, when the convolution kernel is selected as 3×3, the weights of the nth layer share with the $n + 1$st layer as shown in Figure 4.

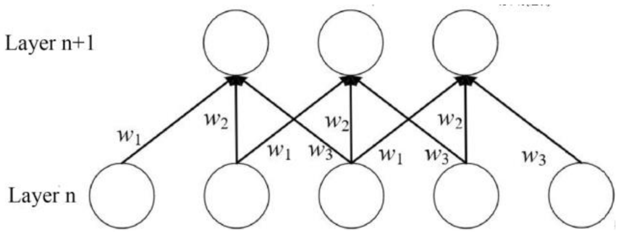


Figure 4. Value sharing diagram

When the CNN uses only locally connected methods, a total of $3 \times 4 = 12$ weight parameters are required, and when the network is added with weight sharing, only 3 parameters are required, which can further reduce the number of parameters. Thus, weight sharing allows the number of parameters of a convolutional neural network to be related only to the perceptual field size of the image, independent of the image size. Different feature extraction is achieved by different convolutional kernels.

4. CONVOLUTIONAL NEURAL NETWORK BASIC STRUCTURE

Convolutional neural networks mainly consist of an input layer, a hidden layer and an output layer. The hidden layer contains multiple convolutional layers, pooling layers, and fully connected layers as well as an activation function. The resolution of image features can be reduced using alternating operations of convolutional and pooling layers, which are then mapped to fully connected layers by activation functions to obtain the sample label space. This process from the input sample data to the output classification prediction is called the feed-forward operation process. In order to improve the learning effect of CNN, the error between the predicted value and its target true value needs to be calculated, and then the loss values are fed backward to forward sequentially using the back propagation algorithm to update the relevant parameters. The basic structure of the convolutional neural network is shown in Figure 5.

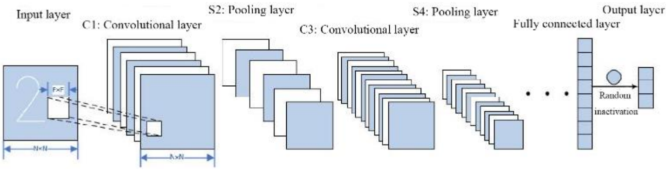


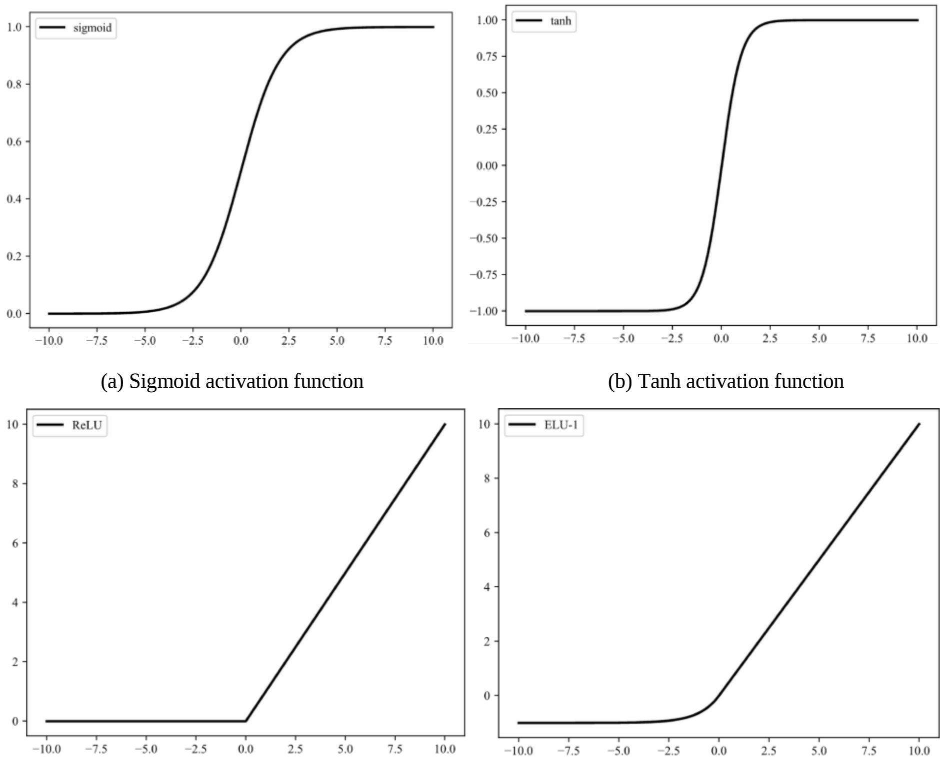
Figure 5. Convolutional neural network structure diagram

4.1 activation function

(1) ELU function

The ELU activation function is also proposed to solve the problems that exist in the ReLU function. Compared to the ReLU function, the ELU function has negative values and thus will result in a faster learning rate with the average value of activation close to zero. However, the ELU function also has a small problem in that it is more computationally intensive. Equation (1) is the expression of the ELU activation function, and Figure 6(d) shows its function image.

$$f(x) = \begin{cases} x, x > 0 \\ \rho(e^x - 1), x \leq 0 \end{cases} \tag{1}$$



(a) Sigmoid activation function (b) Tanh activation function

(c) ReLU activation function (d) ELU activation function

Figure 6. Common activation function images

4.2 Bilinear convolutional neural network model

Since the bilinear convolutional neural network is a weakly supervised learning network model trained end-to-end, images can be labeled only for fine-grained image recognition tasks. The bilinear convolutional neural network is a recognition architecture consisting of three modules: input layer - backbone network - output layer, where the backbone network is composed of three parts: feature function, pooling function and classification function, which is the core module of the bilinear convolutional neural network. As show in figure 7.

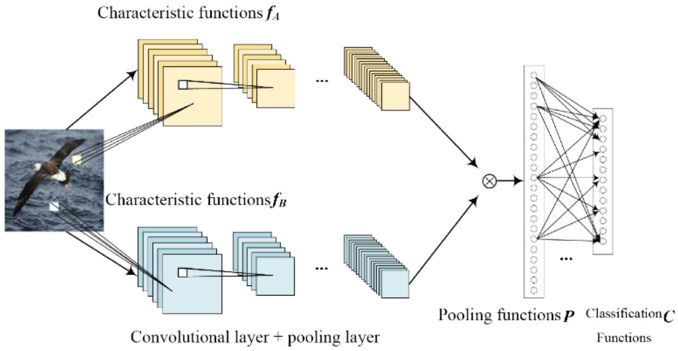


Figure 7. Schematic diagram of bilinear convolutional neural network

First, the features of the images are extracted by feature functions f_A and f_B, and the output feature vectors are u and v, respectively. Next, in the pooling function P section, the bilinear convolutional neural network model uses bilinear pooling to bilinearly combine the output feature vectors in the following way:

$$bilinear = (f_A, f_B) = f_A \otimes f_B = u^T v \tag{2}$$

The bilinear feature $bilinear = (f_A, f_B)$ is obtained by the outer product of the feature vector u and the feature vector v.

On this basis, in order to converge all the bilinear features in the image, the bilinear features at each position are summed cumulatively as follows:

$$\varphi(f_A, f_B) = \sum_{d=1}^{D} bilinear = (f_A, f_B) = \sum_{d=1}^{D} u^T v \tag{3}$$

where D denotes the one-dimensional length of the feature map and $\varphi(f_A, f_B)$ denotes the column vector that transforms the cumulative bilinear feature matrix.

Then, the vectors $\varphi(f_A, f_B)$ are normalized and 2L regularized as follows:

$$y = sign(\varphi(f_A, f_B))\sqrt{|\varphi(f_A, f_B)|} \tag{4}$$

$$z = \frac{y}{\|y\|_2} \tag{5}$$

Finally, the obtained vector z is input to the classification function C for recognition and classification, and the classifier is selected as a Softmax function.

5. Conclusions

This paper is the theoretical foundation of the paper. Firstly, we briefly introduce the knowledge of convolutional neural network, including the basic principle of convolutional neural network, the features of convolutional neural network such as local connection and weight sharing;

secondly, we introduce the basic framework of convolutional neural network, which is mainly composed of convolutional layer, pooling layer, activation function and fully connected layer, the main roles of each layer of the network, and some common network models; finally, we introduce the bilinear convolutional neural network model, which is the fine-grained image recognition method used in this paper, and give the evaluation index of fine-grained image recognition. This paper lays the foundation for the later research on fine-grained image recognition methods based on convolutional neural network optimization.

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