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Algorithm Analysis of Clothing Classification Based on Neural Network

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Abstract

With the rapid development of Internet e-commerce, the online transaction volume of clothing has increased day by day, and the importance of clothing images in transactions has also increased. However, there are many clothing categories and different classification standards. It is difficult for consumers and e-commerce merchants to unify the description of clothing categories, which can easily lead to a poor clothing shopping experience. Neural network has an excellent list in the field of computer vision, which can effectively classify clothing. The purpose of this article is to study the algorithm analysis of clothing classification based on neural network. Starting from the neural network, this paper proposes a clothing image classification algorithm based on a multi-task convolutional neural network (Convolutional Neural Network, CNN). Through hierarchical classification data combined with multi-task technology, the basic structure of the network model is not changed. The accuracy of clothing image classification improves the network's ability to express refined clothing categories. This paper proposes a clothing classification algorithm based on the feature fusion of Hu invariant matrix and CNN network. The feature fusion of the features extracted by the convolutional neural network is initially explored, the information gain of the feature is calculated, and the shape feature is used to eliminate the feature with less information gain. This paper also designs a clothing classification system based on neural network to realize the recognition, detection and classification of clothing images. The experimental results show that the clothing classification accuracy rates under the four combined tasks are 93.54%, 89.26%, 92.14%, 95.66%, and 93.54%, respectively. It can be seen that the model based on convolutional neural network can further improve the accuracy of clothing classification.

Keywords: Deep Learning, Neural Network, Clothing Classification, Target Detection

1. Introduction

In recent years, because of the potential commercial value, people have done a lot of work in the processing of clothing pictures, and there have been some progress in clothing classification, attribute prediction, and image retrieval [1-2]. Neural networks in deep learning are widely used for image

classification and target detection, and convolutional neural networks can directly process two dimensional data, which is particularly suitable for the field of image recognition [3-4]. The classification of clothing pictures provides a good research background for image recognition research, which is helpful for the development of image recognition research work [5-6]. In addition, clothing classification research can also help websites save labor costs and time in clothing image processing. The research on neural network-based clothing classification algorithms is of great significance [7-8].

Many scholars have conducted in-depth discussions on clothing classification. For example, Dabrowska AK proposed the HSC method of learning features directly from clothing image pixels [9]; Dabrowska pointed out that the input layer of the convolutional neural network mainly completes the preprocessing of the input image and hands the processing results to the convolutional layer, while the main work of the output layer of the network is to calculate the processing result of the network and calculate the error between the output data and the data label [10]; Chen W pointed out Convolutional neural network is a very ideal image high-level feature extraction method. A typical neural network model is composed of multiple layers, and each layer can be considered as a special feature extraction process [11].

The purpose of this article is to study the algorithm analysis of clothing classification based on neural networks. Starting from the neural network, this paper first proposes a clothing image classification algorithm based on a multi-task convolutional neural network (Convolutional Neural Network, CNN). Through hierarchical classification data combined with multi-task technology, without changing the basic structure of the network model, improve the accuracy of clothing image classification is improved, and the network's ability to express refined clothing categories is improved. Then, a clothing classification algorithm based on the feature fusion of Hu invariant matrix and CNN network is proposed. The feature fusion of the features extracted by the convolutional neural network is used for preliminary exploration, the information gain of the feature is calculated, and the shape feature is used to eliminate the smaller information gain. Finally, this article also designs a clothing classification system based on a neural network, which realizes the recognition, detection and classification of clothing images.

2. Algorithm Analysis of Clothing Classification Based on Neural Network

2.1. Clothing Image Classification Algorithm Based on Multi-Task Convolutional Neural Network

Strategies for Layered Labeling of Clothing Images

In order to better reflect the hierarchical semantic structure of clothing images, multi-task classification (Multi.task Classification) combining multi-class classification and multi-label classification will be used to deal with the problem of clothing classification [12].

This classification system has multiple basic categories that may have overlapping semantics. For any single basic category attribute, it is treated as an independent label and divided into multiple mutually exclusive categories within the same attribute. For clothing images, the patterns contained in the clothing itself are the most noticeable, and their features have more complex semantics. Multiple tasks share the clever layer in the CNN, and their weight parameters are also shared. Compared with multi-label learning, multi-task learning is more intuitive, and if the number of label attributes is large, multi-label learning requires a very high-dimensional label space.

For example, using patterns as the basic category to construct hierarchical information based on multi-task classification. In addition to the pattern category, this article adds a fabric attribute label that has nothing to do with the pattern. Common fabrics are: denim, knitting, lace, spinning and so on. There are three types of labels, namely, pattern primary label, secondary label, and fabric. The relevant mathematical expressions are as follows:

$$\begin{aligned} P(A) &= \{a1, a2, \ldots ai\} \\ P(B) &= \{b1, b2, \ldots bj\} \\ P(C) &= \{c1, c2, \ldots ck\} \end{aligned} \quad (1)$$

In formula (1), i, i, and k respectively represent the multi-category quantity of the three types of labels. A belongs to the first-level label of the pattern, B belongs to the second-level label of the pattern, and C belongs to the fabric label. From the category information defined above, it can be seen that for any label belonging to the second level of the pattern, it must belong to the first level of the pattern label, and the formula is as shown in (2):

$$(\forall a \in P(A), \forall b \in P(B)) \longrightarrow b \in a \quad (2)$$

Garment Classification Model Based on Hierarchical Multi-task

In the hard parameter sharing method, the convolutional layer of the same convolutional neural network is shared among multiple tasks, and the prediction model of each task is retained. Multi-task learning can reduce the over-fitting risk of the entire network, because when multiple tasks are learning and training, each task needs to learn different features. Compared with the previous single task learning, the features extracted by the network have a wider expression ability, so the multi-task based convolutional neural network has a stronger generalization ability.

In the multi-task classification problem of clothing images, one task corresponds to a multi-class prediction model, the total error function formula is expressed as follows, where n represents the total number of combined tasks.

For the tasks of the multi-task classification network, tasks 1 to n correspond to the multi-class classification problem of n clothing. For example, if the first-level label and the second-level label of clothing patterns are put into the classification network at the same time, n is required to be 2, then the convolutional neural network lists two task pairs for classification output.

2.2. Clothing Classification Algorithm Based on the Fusion of Hu Invariant Matrix and CNN Network Features

Hu moment

The feature quantity composed of Hu moments is used to identify the picture. The accuracy is relatively low when the object is rich in theory. Hu invariant moments are generally used to identify large objects in the image. The shape of the object is described well, and the texture feature of the image is not too complicated, which has a very positive effect.

Information gain

Assuming that X is a discrete random variable, then its probability distribution is:

$$P(X = X_i) = P_i, i = 1, 2, 3,.. n \quad (3)$$

The entropy of the variable X can be defined as:

$$H(X) = -\sum_{i=1}^{n} p_i log p_i \quad (4)$$

The information gain g(D, A) is defined by the difference between the empirical entropy H(D) of the training set D and the conditional entropy H(D|A) of D under the given conditions of the feature variable A, namely:

$$g(D, A) = H(D) - H(D, A) \quad (5)$$

Among them, empirical conditional entropy and empirical entropy are conditional entropy and entropy respectively. The decision tree method is a method that uses the information gain criterion to select features. The feature with too much information gain is more capable of classification. Therefore, the information gain criterion can be used to measure the information gain of the features extracted by the convolutional neural network, so as to select Image features that are most useful to us.

2.3. Clothing Classification System Based on Neural Network

Application requirements

- Server functional requirements

The server mainly realizes the reception of pictures, the invocation of models and the return of processing results. The specific requirements are: publish service monitoring messages; receive messages to obtain clothing pictures, call the trained model to process the pictures, and return the processed pictures and the clothing information in the obtained pictures.

- Client functional requirements

The Android application client mainly realizes the acquisition of pictures and the display of information. The specific requirements are: get pictures from mobile phone albums; save and display pictures; upload pictures to the background system to obtain processed pictures and picture information; display processed clothing pictures and clothing information.

Android application module design

Use Android Studio to complete the establishment of the client. The Android application obtains clothing pictures from the phone storage and displays the pictures on the application interface, and then uploads the pictures to the server. If the upload fails, it continues to upload the pictures. If the upload succeeds, it waits for the picture processing result. If the picture and information returned by the server are successfully obtained, the obtained picture and information will be displayed, otherwise, it will continue to wait for the picture processing result.

Back-end system module design

Use the spring framework to build a background system for image processing. The background system first waits to receive messages through the Tomcat publishing service. If the reception fails, it continues to wait to receive the messages. If the reception is successful, it stores the picture and determines the image processing method that needs to be performed, and then calls the Caffe framework to load the offline model performing image classification or target detection. If it is image classification, the label of the clothing is obtained, and then the specific information of the clothing is obtained by querying the database according to the clothing label. Finally, the picture and the obtained clothing information are sent back to the client; if it is a target detection, a picture with a bounding box bounding the target location and giving the category and accuracy rate is obtained, and finally the picture is sent back to the client.

3. Experimental Research on Clothing Classification Based on Neural Network

3.1. Clothing Classification Experiment Based on Multi-Task Convolutional Neural Network

In order to verify that the hierarchical data and multi-task technology can promote the classification performance of the deep convolutional network, this part of the experiment uses the unmodified classic deep network for experiments. Use GoogLeNet to perform multi-task combination experiments.

The experiment in this section uses the Caffe framework for code implementation. The specific parameters of the experiment: the mini-batch size is 32, the learning rate is 0.001, and the training iterations are 500000 times. Before training, in order to speed up the convergence speed of the network, this part uses Image Net to pre-train each convolutional neural network model, extract its convolution part to each group of experiments, and reinitialize the weight parameters of the fully connected layer.

3.2. Clothing Classification Experiment Based on the Fusion of Hu Invariant Matrix and CNN Network Features

The experiment process is as follows:

- Train a convolutional neural network and output N features;
- Feature selection based on information gain, and sorting according to the size of information gain;
- Use the Hu shape feature vector to replace the feature with the least information gain among the N features

Experimental number set

Use Clothing model gather (CMG) as the experimental data set, the network model is AlexNet, and the auxiliary number set is Image Net. The CMG data set contains 8 types and a total of 2000 images.

4. Algorithmic Data Analysis of Clothing Classification Based on Neural Network

4.1. Clothing Classification Results Based on Multi-Task Convolutional Neural Networks

The combination experiment is divided into: independent non-combination task, pattern first and second task combination, pattern first and cloth combination task. Table 1 shows the clothing classification results of the zodiac combination task. The clothing classification accuracy rates under the four combination tasks are 93.54%, 89.26%, 92.14%, 95.66%, and 93.54%, respectively.

Table. 1. Clothing classification results of attribute combination

Combination tasks	Accuracy (%)	error
Pattern level	93.54	0.1671
Pattern Level 2	89.26	0.2004
Cloth	92.14	0.0541
Pattern level one, pattern level two	95.66	0.4716
Pattern level one, fabric	93.54	0.5068

Figure. 1. Clothing classification results of attribute combination

It can be seen from Figure 1 that the accuracy of the combined tasks of pattern level 1 and pattern level 2 is significantly improved compared to independent training. This shows that the effective combination of hierarchical data combined with multi-task training can make the network have stronger classification and expression capabilities.

4.2. Clothing Classification Results Based on the Fusion of Hu Invariant Matrix and CNN Network Features

Table 2 shows the clothing classification results based on the fusion of Hu invariant matrix and CNN network features. The accuracy rate is up to 96.2%, and the minimum error is 0.0420.

Table. 2. Clothing Classification Results of Feature Fusion

Type of clothing	Accuracy (%)	error
1	92.4	0.4019
2	87.6	0.2614
3	86.4	0.2469

4	89.7	0.4790
5	94.1	0.0791
6	96.2	0.0420
7	95.3	0.1460
8	94.5	0.0451

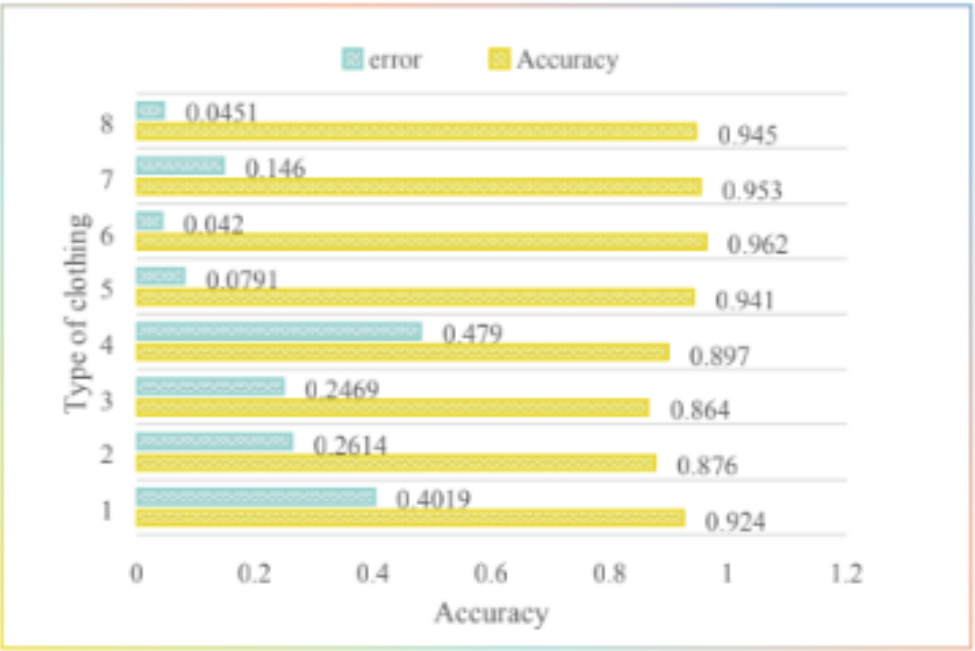

Figure. 2. Clothing classification results of feature fusion

Through the results shown in Figure 2, it can be concluded that using the shape features of clothing to replace the feature components with small information gain in the feature vectors extracted by CNN can eliminate some redundant features and further improve the accuracy of clothing classification.

5. Conclusion

With the rapid development of clothing e-commerce and the explosive growth of clothing image data, it is of great significance to find an efficient and accurate clothing classification method. This paper studies clothing classification based on neural networks, adopts multi-task learning, and designs clothing classification algorithms based on multi-task learning convolutional neural networks, which improves the accuracy of clothing image classification and adds deep convolutional neural networks. The ability to express features of clothing images in complex categories. This paper proposes a clothing classification algorithm based on the feature fusion of Hu invariant matrix and CNN network. The feature fusion of the features extracted by the convolutional neural network is initially explored, the information gain of the feature is calculated, and the shape feature is used to eliminate the feature with less information gain. This paper also designs a clothing classification system based on a neural network to realize the recognition, detection and classification of clothing images.

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