Research on Unsupervised Computer Deep Learning Method for Color Image Recognition

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Abstract. With the development of science and technology, face recognition has gradually become the focus of identity verification, which leads to the research of color image recognition. Compared with the traditional gray image, color image contains more information, which requires us to make full use of the complementary information between each color component to remove redundant information. Therefore, color image recognition technology has been an important research field in the field of vision. Unsupervised feature learning (hereinafter referred to as UFL) is an algorithm technology to automatically extract data hidden features, which is an important feature method combined with Deep learning (hereinafter referred to as DL) algorithm. Through the fusion of UFL and DL algorithm model, we can recognize and analyze color images. In this method, we will use self encoder, which can be used as UFL model. By stacking multiple self encoders, we can construct a deep neural network. Then, we can train the network of each hidden layer through unsupervised training, which will optimize the neural network supervised. Therefore, unsupervised learning method has been applied to CNN, which has become an important method in color image recognition.

Keywords: Unsupervised Learning, Deep Learning, Color Image Recognition

1. Introduction

With the development of science and technology, color image recognition has become an important research field [1]. The unsupervised color component features include HOA method and SOA method, which is based on extracting the discriminative features of R, G, B color component image data sets [2]. By making the projection transformation matrix of the three color components, we can meet the similarity between HOA and SOA features, and then fuse the features of the three color components for recognition [3-6]. By training the image set, we can train a self encoder, which will better learn the hidden features in the training set image. Then, we can use the learned features as the convolution core of CNN. At the same time, we can train a classifier on the convolution and sampled features. Therefore,
the combination of UFL method and DL algorithm is a very scientific and effective image recognition method, which is worthy of popularization and application [7].

2. Feature extraction and recognition of color face image

2.1. Feature extraction by fusing the original data of each color component

The feature extraction method based on the original data of each color component is the most common color face image recognition method. Among them, the color image can be based on an existing color space or a new color space data, which can be divided into two sub categories: unsupervised feature extraction method and supervised feature extraction method. The unsupervised feature extraction methods mainly include the following research. Yang J transforms the commonly used RGB color space into HSV space, which can only use s and V color components to form a complex form, which can then be used for feature extraction [8]. Jones C represents color image samples as hypercomplex, which proposes a color face feature extraction method based on hypercomplex Gabor frequency domain analysis. Supervised feature extraction methods mainly include the following research. Shin P proposed the yqcr color matching scheme, which is a kind of party leader who uses enhanced Fisher linear discriminant model for feature extraction and classification. Through supervised feature extraction, we show the effectiveness of yqcr color space in face recognition. Yang J proposed a generalized discriminant model for color face recognition, which fused RGB components weighted and then extracted the discriminant features.

2.2. The feature of each color component is fused before recognition

There are not many methods to recognize after fusing the features of each color component. Liu Z proposed a discrete cosine feature fusion method based on YIQ color space. Each color component obtains a DCT frequency domain feature set at three different representation levels. By fusing the DCT frequency domain feature sets of three color components in each representation level, we can further extract features from the enhanced Fisher model [9]. By calculating the similarity matrix of the three new feature sets, we can use decision level fusion strategy to obtain the final similarity matrix for recognition. Zhao C proposed a two-dimensional color uncorrelated discriminant analysis method, which can use a second-order matrix to represent each color component image sample. By extracting the distinguishing features of R, G and B color components in serial, we can make the projection transformation of the three color components statistically orthogonal as a whole. By removing the correlation between the features of color components, we can fuse the features of three color components [10].

2.3. The decision information of each color component is fused

There are few methods to obtain recognition results by fusing the decision information of each color component. Rajapakse m et al. Proposed a face recognition method using nonnegative matrix function and color channel coding, which extracted the features of RGB component with nonnegative matrix function respectively. By calculating the similarity of each color component feature between the two samples, we can use the decision level fusion strategy to obtain the final similarity value for recognition. Shin w applies sparse representation to each color component of the color face image, which can be recognized by using the residuals obtained from the fusion strategy of decision level [11].
3. **UFL and DL algorithm**

3.1. **CNN principle**

CNN is a multi-layer neural network trained by data-driven model, which is mainly composed of convolution, pool, full connection and recognition, as shown in Figure 1.

![Figure 1. The CNN Architecture](image_url)

3.2. **Training process of the model**

By determining the input, output and hidden layer, we can design a training method, as shown in Figure 2.
3.3. Principle of effective region extraction algorithm

In image recognition, background information often has a great impact on category identification. At present, there are many algorithms for image segmentation and target detection. CNN is a new convolution network which can effectively detect targets, which can complete high quality target segmentation. This paper can achieve image key point detection, segmentation and effective region detection and screening. The principle framework of effective region extraction algorithm is shown in Figure 3.
4. **Color image recognition based on UFL and CNN fusion**

In this paper, UFL-CNN algorithm is combined with UFL and CNN algorithm, which is composed of multi-layer self encoder network. Among them, the hidden layer node of the former layer network will be the input layer node of the later layer network. Thus, each layer of the encoder and the half layer are self hidden. The last layer of UFL-CNN network is a softmax classifier. The number of output nodes of the classifier is equal to the number of categories of the image. UFL-CNN algorithm contains the training process of typical multi-layer perceptron, which can be used for layer by layer unsupervised pre training. Unsupervised pre training is a method of layer by layer unsupervised pre training through self encoder. Through the former layer network training, we can remove the output layer nodes, which will continue to train the self encoder as the input of the next layer network. The input of the classifier is the output of the highest layer self encoder and the label of training data. The training method of UFL-CNN algorithm is shown in Figure 4.

![Figure 3. The principle of effective region extraction algorithm](image)

**Figure 3. The principle of effective region extraction algorithm**

![Figure 4. UFL-CNN algorithm training method](image)

**Figure 4. UFL-CNN algorithm training method**
5. Conclusion

Color image recognition is an important part of image processing research, which has high academic research value. Color image recognition technology can make full use of human vision, which can fully extract image features. Through the complementary information between color components, we can remove redundant information, which will extract as many effective features as possible. Therefore, unsupervised learning method has been applied to CNN, which has become an important method in color image recognition.

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