Face Recognition Based on Monogenic Binary Pattern and Deep Learning

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Abstract

In order to solve the problem of extracting facial image features in deep learning, it is easy to ignore the local structural features and lack of learning about its rotation invariance. A high combination of single-deduction local binary mode (MBP) and deep learning is proposed. Efficient face recognition method. Firstly, the image is filtered by multi-scale single-player filter to obtain amplitude and direction information. Secondly, LBP algorithm and quadrant bit method are used for encoding, and block histogram is combined to calculate its histogram feature. Then, the extracted single-player will be performed. As the input of Deep Belief Network (DBN), the feature is optimized layer by layer to optimize the network parameters, and the excellent network model is obtained. Finally, the trained DBN network performs face recognition experiments in the ORL face database to calculate the recognition rate. The rate is 98.75%. The proposed method uses an unsupervised greedy algorithm, the hidden layer is set to 2 layers, and the back propagation algorithm is used to optimize the network. Compared with the known face recognition method, MBP+DBN has better robustness to illumination, expression and partial occlusion changes. It has higher recognition rate in face recognition and has certain advantages, which provides a feature for image features.

1. Introduction

Since the 21st century, face recognition systems have been applied in various fields, but in practical applications, there are changes in factors such as occlusion, posture and illumination[1-2]. In order to solve such problems, domestic and foreign scholars have proposed various methods for face feature extraction and classification. Among them, representative methods are: Gabor feature based classification (GFC) method[3], local binary value Mode (LBP) method[4], deep learning method[5], etc.

The MBP algorithm can solve the problem of ignoring the local structure when extracting deep learning features. The characteristics of deep learning unsupervised learning can make up for the shortcomings of MBP algorithm feature extraction and subjective factors. The author applies the two to face recognition. The MBP algorithm utilizes the characteristic that the single-shot signal is truly invariant, and uses the log-Gabor filter to obtain the image amplitude and pixel point direction information, and obtains the MBP feature information after encoding. Then it is used as the input data of the DBN network to learn the training DBN. The network reduces the learning of invalid features of the network and significantly improves the recognition performance. The algorithm is tested in the ORL database, and the effectiveness of the algorithm is proved.

2. Face Recognition Based on the MBP and Deep Learning Method

The texture features of the face image have a certain stability, and will not change much when affected by factors such as illumination, posture, expression and occlusion [6]. The single-shot signal indicates that the image amplitude and the pixel point direction information can be obtained. The process takes less time and the space complexity is low. The single-shot local binary mode (MBP) can be used to extract the structural features of the image simply and effectively. In the process of deep learning, the face image pixel can be directly used as the input data of the deep belief network, but the input of the data is in the form of vector, and the local structural features of the face cannot be learned. Therefore, this paper combines MBP algorithm and deep learning to face recognition. The algorithm is divided into MBP feature extraction and DBN network construction and recognition.

Feature extraction is the key to face recognition. The MBP feature extraction is

performed in two steps: first, the local variation of the single signal and the local intensity (pixel point direction) are separately coded, and then the two are combined.

The local amplitude A of the single-shot signal is a measure of the local change information of the pixel point z_c, which is encoded by the LBP operator[4] (LBP8-3), and the obtained 8-bit binary number is taken as the lower 8 bits of the MBP feature.

Pattern recognition is the focus of face recognition. The DBN network performs pattern recognition in two stages: pre-training and fine-tuning. The MBP features extracted are input into the DBN network to learn to train two layers of hidden layer networks. The specific process is as follows.

1) The deep belief network is divided into several adjacent RBM models, and the parameters are trained layer by layer to initialize the network. First, the training data $\mathbf{v}$ is input in the visible layer, the first layer hidden layer vector h_1 is obtained from the equation (8), and then the visible layer is reconstructed by the equation (7), and the first layer weight coefficient matrix W_1 is learned and trained; Enter h_1 into the second layer hidden layer and learn the training matrix W_2; repeat the above training process to obtain the weight coefficient matrix W_i of each layer.

2) For the pre-trained initialization network, the supervised backpropagation algorithm (BP algorithm) is used to fine-tune the parameters of the DBN network to make the network performance better.

3. MBP+DBN algorithm

The MBP+DBN algorithm is obtained from above. The specific steps are as follows:

1) Divide the face image into a training set and a test set, then input the image, perform single-play filtering, obtain multi-scale amplitude and pixel intensity information, and perform binary coding on the filtered image (LBP). And quadrant bits) to obtain the encoded feature image.

2) Dividing the encoded feature image into 5×5 blocks, each small block is divided into 2×2 sub-blocks, and the histogram feature h_i of each sub-block is obtained $i \in \{1,2,\cdots,r\}$, then calculate all local block histogram features $H_j, j \in \{1,2,\cdots,b\}$, and finally combine all local histogram features into histogram vector H_{MBP}, using H_{MBP} Represents a face image feature.

3) The training set image H_{MBP} feature obtained by steps 1) and 2) is used as the input data $\mathbf{X}$ of the DBN to train the deep learning model. According to the DBN network training process in Section 2, learn the abstract features of the training set from bottom to top, learn the training network layer by layer, and then fine-tune and optimize the network parameters to get the final DBN network model.

4) Input the H_{MBP} feature of the test set image into the DBN network trained in the previous step, classify it at the uppermost layer of the network, and statistically identify the result Y.

5. Experimental and Analysis

In order to verify the effectiveness of the algorithm, LBP algorithm, EPMOD algorithm, M-PCANet algorithm and MBP algorithm were used to compare experiments on ORL face database. The accuracy of each algorithm was the best. The ORL database has a total of 400 images (10 for each of 40 people) with different lighting conditions, gestures, expressions.

It can be seen from the experimental results in Table 1 that the LBP, MBP, EPMOD, LBP + DBM and M-PCANet algorithms have achieved good recognition results in the ORL face database, but the MBP+DBN algorithm proposed in this paper has the highest recognition accuracy.

Table 1. Recognition Rate of Different Algorithms on ORL Face Database

Algorithm	Accuracy/%	Average time/s
LBP	87.86	0.0383
MBP	95.36	0.2202
EPMOD	96.43	0.1903
LBP+DBN	97.33	0.3339
M-PCANet	98.50	5.2490
MBP+DBN	98.75	0.5537

6. Conclusion

Based on the research of local structure feature extraction and deep learning face recognition, this paper proposes a face combining MBP and deep belief network based on the combination of single-place local binary mode (MBP) and deep learning. recognition methods. MBP combines the single-shot amplitude and single-play direction information of the single-player signal. After filtering the image, the local variation of the pixel is encoded by the LBP algorithm, and the local intensity information is encoded by the quadrant bit method. Together, the

histogram features are statistically chunked. The method can effectively extract facial image features and improve face recognition performance. When training the deep learning model DBN network, the unsupervised greedy algorithm is used, and the hidden layer is set to 2 layers. The face features extracted by the MBP algorithm are used as input of the DBN and layer-by-layer training. After 2 layers of training, it is very small. The reconstruction error indicates that the model parameters are selected reasonably. The back propagation algorithm is used to optimize the network. The experimental results on the ORL face database show that the proposed algorithm has better recognition effect in face recognition.

References

[1]J. Neves, F. Narducci and S. Barra, "Biometric recognition in surveillance scenarios: A survey," Artificial Intelligence Review, Vol,46, no.4, pp. 515-541, 2016.

[2]A. Opitz and A. Kriechbaumzabini, "Evaluation of face recognition technologies for identity verification in an eGate based on operational data of an airport," IEEE International Conference on Advance Video & Signal Based Surveillance, 2015.

[3]C. Li, W. Wei and J. X. Li, "A cloud-based monitoring system via face recognition using Gabor and CS-LBP features," The Journal of Supercomputing, Vol.73, no.4, pp.1532-1546, 2017.

[4]C. Tortorici, N. Werghi and S. Berretti, "Boosting 3D LBP based face recognition by fusing shape and texture descriptors on the mesh, "2015 IEEE International Conference on Image Processing, 2015.

[5]D. Sawatd and S. R. Hegadi, "Unconstrained face detection: A deep learning and machine learning combined approach," CSI Transactions on ICT, Vol.12, no.3, pp.301-307, 2017.