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# Research on Face Recognition Technology Based on Multi-feature Integration and Deep Learning

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## Abstract:

The development of artificial intelligence and the growing demands of national security and public needs have significantly heightened the focus on face recognition technology, marking it as a critical area of interest within the fields of pattern recognition and computer vision. This technology faces numerous challenges due to variations in facial expressions, poses, lighting conditions, and aging, which often hinder its effective implementation. Current methodologies frequently fall short of meeting the stringent requirements necessary for robust and accurate recognition.To address these challenges, this paper proposes an integrated approach that combines multi-feature face recognition with deep learning techniques. The goal is to enhance the robustness and accuracy of facial feature extraction and classification, thereby supporting the ongoing enhancement and broader application of face recognition technology. This approach aims to provide a foundational framework for future research and practical applications in the field.

## Keywords:

Integrated learning, Face features, Recognition.

## 1. Introduction

Face recognition through the input image, after pre-processing the image, then face detection, and at the same time after the cutting process to obtain the face image, and then extract the face features, extracting robust and discriminative The facial features are finally combined with the extracted facial features to perform matching recognition, thereby completing the recognition process and simultaneously feeding back the recognition results to the user. The matching identification mainly includes two methods of identification and recognition, and the identification mainly involves a certain category. Judging whether it belongs to a certain person, but the identification is for a plurality of categories and implementing identification of a certain individual. All processes in the face recognition system belong to one research object, and any research is very important for face recognition results.

## 2. Multi-feature integrated face recognition

### 2.1 LBP face recognition.

Local binary mode LBP is mainly used to describe an algorithm of texture. It has the characteristics of complexity bottom, gray and rotation invariance, high discrimination, etc. Its essence is a way to encode the points in the image. The key point is Combining the information around the point to implement the LBP verification data, the specific process is: the pixel value of each point in the domain is compared with the pixel value of the intermediate point, and the setting of the pixel value exceeding the intermediate point can be set to 1, such as the middle The point pixel value is set to 0, and then the obtained 0-1 code is connected according to the corresponding order, thereby combining into a set of binary codes, and then converting the obtained binary code into a decimal number, this group The value is the LBP code value [1] unique to the intermediate point itself. Usually choose to use 8 fields, so set the center pixel point, the nearby 8 pixel points need to be arranged in the clockwise order from the upper left corner, $g_{0,}g_1 \ldots g_7$ use the formula to calculate the LBP value of this

pixelNormally, the LBP value of the entire image is not directly treated as a face recognition feature. The image of the LBP value is subjected to histogram statistics, and then the resulting histogram feature vector is regarded as the LBP face of the image. Identify features.In order to ensure that the obtained LBP face features can retain a corresponding amount of structural information, the image is usually subjected to block processing, and individual block LBP histogram statistics are implemented for each block region, and then the histograms are connected to each other. Final face LBP recognition feature vector.Finally, the recognition result is obtained by combining the matching of the feature vectors. When performing block processing, the image is basically divided into four blocks, and the final LBP feature vectors are obtained by connecting the blocks.

Through the above arguments, the face image feature extraction process based on LBP algorithm can be obtained, namely:

1) traversing each pixel of the image by using 3×3 module,Combining pixel calculation formula:

$$LBP(x_c, y_c) = \sum_{t=0}^{7} \left( s(g_1 - g_c) * 2^t \right) \tag{1}$$

2) Sorting the binary values obtained in the first step into an order of the hour hand, thereby forming an eight-bit binary code.

3) Perform conversion on the 8-bit binary code obtained for each pixel, thereby obtaining a decimal number, and taking the decimal number as the original central pixel LBP value, thereby obtaining the LBP value of the entire image.

4) Classify the resulting LBP values into 58 identical modules and one non-uniform module.

5) The obtained LBP value image is subjected to area division, and then 59 kinds of module histograms of each area are obtained.

6) For the resulting histograms, they need to be arranged according to the order, and finally the LBP feature vector of the original image [2] is obtained.

The recognition process, combined with the extraction process of the above LBP features, performs LBP feature extraction on all images of the training set, and retains them, then extracts the LBP features that need to be identified, and finally calculates the image to be recognized and all the training set images. The distance between the LBP features, from which the minimum distance is found, which is taken as the final recognition result.

### 2.2 GIST face recognition.

In recent years, a GIST feature that mimics the characteristics of the human eye has emerged. This feature has also been used by many scholars as face recognition research, and it has also obtained corresponding recognition effects. This feature is mainly obtained in the image. The information content, that is, the important rough information is proposed, which belongs to a face feature extraction method with high visual characteristics. The working principle is mainly combined with multi-scale and multi-directional Gabor filters to form a filter combination, thereby processing the image to obtain relatively key facial contour information in the image, and then implementing the facial information. The height set finally leads to the GIST feature. The Gabor feature does not respond to illumination and has the characteristics of rotation invariant within the specified range. In addition, there are not many requirements for the data to be processed, and the real-time performance is strong. Through the above discussion, the GIST feature extraction process is determined, that is, 1) clear the Gabor filter bank size number m and the direction number n, thereby combining into a filter combination; 2) combining the obtained Gabor wave filter to convolute the image The calculation results from the image information in each direction of each scale; 3) Cascading the information in each direction of each scale to obtain the GIST face recognition feature [3].

In the recognition process, all face images in the training set are combined with the GIST face recognition feature extraction process to extract the GIST features, and the obtained results are saved.

Then, the images to be identified are extracted, and then the images to be identified are extracted. The

GIST feature is compared with the distance between the GIST features of the training set image, thereby obtaining the final result of the recognition.

## 3. Integrated deep learning face recognition

In order to detect the effect of multi-feature fusion face recognition recognition, experiments were carried out in the ORL face database. Because the image size of the two face libraries is small, the image in the ORL face database is 112×96. If the 2×sampling method is used, and then the fifth time, the image in the ORL becomes 7×6, so the resolution is If the rate is too small, the information about the face features contained in the face will be very small, and the recognition effect will not be great. Therefore, the face image of the ORL library should be upsampled to 184×224 before the experiment, and 2 times sampling is used at the same time. The ORL library implements Gaussian sampling and will get images of 5 face libraries.

Based on the convolutional neural network, the data can be automatically extracted from the characteristics of high-level sampling. It is necessary to determine the image recognition advantage without human intervention. However, considering the realization of convolutional neural network to achieve high performance can be realized based on the practice of a large amount of data. Therefore, a new integrated deep convolutional neural network model learning method is proposed, which can improve the face recognition efficiency under the premise of small samples. First, multi-scale adjustment of the data set is required, and the multi-scale training set image is obtained by using the lifting and sampling method. In this paper, we use 10 different scales of training sets. After that, we perform convolutional neural network training on the images of each scale training sample set. How many scales will have convolutional neural networks corresponding to the parameters, so we can train 10 convolutional neural networks of different scales; combined with the obtained convolutional neural networks of various scales, the integration process is implemented by the integrated strategy stacking method, and the four-layer BP neural network is used as the lower classifier. The main operation flow is: connecting the output probability values obtained by the SoftMax layer in the convolutional neural network of each scale training, that is, the output of each convolutional neural network is K, then a 10*K dimensional vector is formed after full connection. This value is treated as a 10*K element feature and input into a four-layer BP neural network, and then training is performed to obtain the final output result [4].

1. Initialize sample weight D(i)=1/n,i=1,2……n； n is the number of samples.

2. Generate a sub-training set $x^j_k$ on each feature space using the random subspace method xkj, Different eigenvalues of different faces;

3. Training different base classifiers based on sample weights and different subtraining sample sets $h_j^k$, Classifier selection support vector machine and KNN algorithm;

4. Calculation error$\xi_i=Pr(h_i(x_i)\neq y_i)$ $y_i$ is the training sample eigenvalue;

5. Calculate classifier weights

$$A_{j=}1/2\ln^{1-\xi_i}\Big/_{\xi_i} \tag{2}$$

Update sample weight;

6. Update sample weight

$$D^{i+1}(i)=\frac{D^i(i)\exp(a_i h_i(x_i)y_i)}{z_i} \tag{3}$$

$z_i$ is the normalization factor

7. Output final integrated classifier.

## 4. Experimental result

In order to prove that 15 results were obtained through the extended 5 face database, the integration of these recognition results is better than the single recognition results of the single library. In the ORL5 human library, each library randomly selects 5 pictures per person to construct the training set. The remaining 5 pictures are used as the recognition test set, and the integrated recognition rate is calculated for the three results of each library and the 15 results of the five libraries. Among the five face databases formed by FERET, 4 pieces per person are selected. As a training set, the remaining 3 pictures are taken as images to be recognized. The other images are the same as the ORL operation. In order to prevent the occurrence of random factors, the above experimental operation was repeated 10 times, and the average value was taken as the final result, as shown in Table 1 below:

Table 1 Results of different integration methods

| Integration method | Library 1 | Library 2 | Library 3 | Library 4 | Library 5 | Method of this paper |
|---|---|---|---|---|---|---|
| Orl | 93.75% | 92.15% | 95.1% | 94.15% | 93.15% | 98% |

## 5. Conclusion

In general, face recognition technology is regarded as a biometric feature technology. It is the most intuitive, natural, attractive and suitable non-contact image recognition technology for social and various fields. Development and work have very important value. However, because of the complexity of face features, they are more susceptible to environmental and small samples, so that their performance can not meet people's needs. The most obvious effect on face recognition is the extraction and recognition of face features. For this reason, this paper focuses on the face recognition of multi-feature integrated face recognition and integrated deep learning, which enhances the face. Identify technical efficiency and contribute to social development.

## References

[1] Wang Zhengyu. Neural network integration classification method and its application in parallel computing environment [D]. Doctoral thesis. Guangzhou: South China University of Technology, 2015.

[2] Yuan Ceshu. Research on text sentiment classification based on Stacking combination [D]. Master's thesis. Wuhan: Central China Normal University, 2017.

[3] Ding Chunhui. Research on Violence Detection and Face Recognition Based on Deep Learning [D]. Doctoral Dissertation. Hefei: University of Science and Technology of China, 2017.

[4] Zhang Shaohua. Research on Face Reference Point Location Based on Deep Convolutional Neural Network[D]. Doctoral Dissertation. Wuhan: Huazhong University of Science and Technology, 2016.