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Study of Face Recognition based on MATLAB

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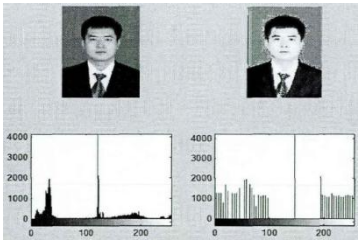
Abstract: **The article introduces the meaning and purpose of research on face recognition technology. On how to obtain the facial information and the automatic face detection is discussed. General also face image database are presented in detail. Secondly, the face image size, angle, sharpness, have very great influence on recognition, so we often first preprocessing the image. This paper provides very rich Pretreatment method that mainly based on image gray processing and image size change. Finally, focus on the PCA face recognition algorithm in this paper. Details of the derivation of the Hostelling transform Singular value decomposition theorem and principle, several methods of measuring image distance. We introduced the principal component analysis for face recognition algorithms in the MATLAB programming ideas. And the simulation results of the algorithm were analyzed.**



Keywords: Matlab; Face recognition; Image preprocessing; Principal component analysis; Singular value decomposition

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1. Introduction

With the social progress and technological development so that people need a reliable, simple, quick identification technology. In recent years, face recognition because of its recognition process of non contact detection method, fast and stable has attracted widespread concern. In this paper, based on MATLAB, the design and implementation of a face recognition system based on principal component analysis.

The technology of face detection and recognition is one of the most widely investigated technologies in the field of Biometric Identification, and it has been used in such areas as identity authentication, security check-up, criminal enquiry, human-computer interaction etc.

In regard to face detection, proposing a detection method with high speed and accuracy remains a research hot spot. As to face recognition, due to the great variations of illumination, expression, viewpoint, age, etc. of face images, obtaining high recognition rates under these conditions still is a difficult task and research focus point. With respect to these two problems, this dissertation takes color and gray static frontal facial images as research objects, and studies face detection and recognition methods based on combination of pattern recognition theory and image processing technology. The main content includes skin pixel extraction method on the basis of LUQ artificial neural network, face detection method using template matching technology, and a novel face recognition method employing (2D) ZPCA and WPD under varying illumination, expression and pose conditions. This research targets for providing technology supports for a high-speed and accurate face recognition system.

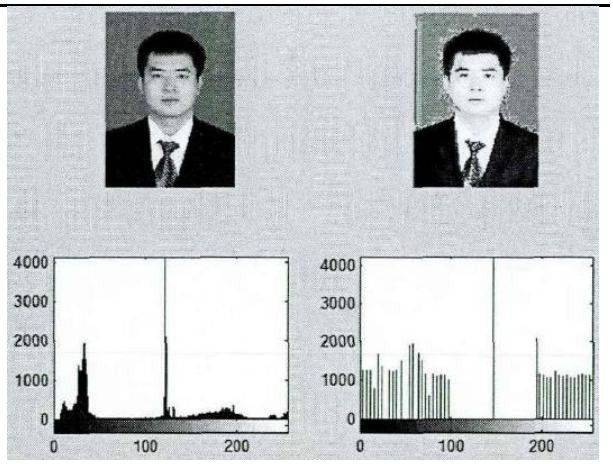

Figure 1. The original image and its histogram and histogram equalization and histogram of the image.

This article mainly researches the implementation process of facial gender identification based on Matlab. In the pattern recognition field, it is always considered to be a very challengeable study to identify people's face utilizing computer science. It can also impose good effect on man-machine communication and information acquisition, and will be a hot study orientation. Face identification is a biometric identification technology that can implement personal identification based on people's facial feature information. Also called image identification or figure identification, it is a series related technology that utilize a camcorder or a camera to collect images or video stream containing people's faces, and automatically detect and track human faces in the image, then to identify them.

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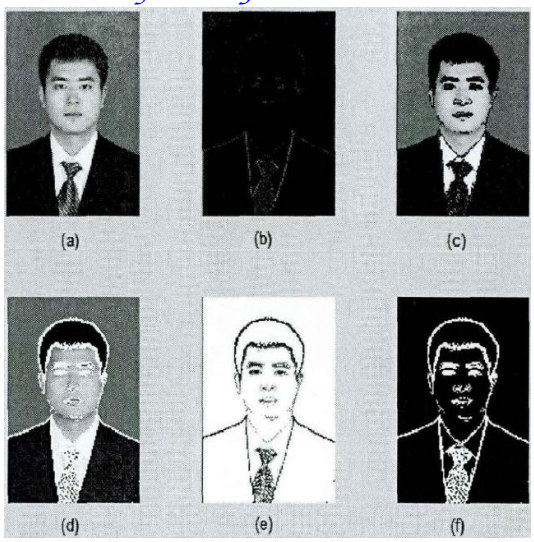

Figure 2. Gradient method for image sharpening example.

2. Methods

2.1. Image Preprocessing

In order to solve the problem that detection speed and accuracy of current face detection system is unbalanced, a method that extracts skin pixels using LUQ ANN and detects face based on template matching is proposed. Firstly, An LUQ ANN is used to extract skin pixels. Then, a Mosaic method is prompted to primarily locate the face region through searching within the whole image. Experiments on images from CVL indicate that the LUQ ANN gains satisfactory extraction accuracy as well as high speed, and the Mosaic method could successfully pre-locate the face region.

$$H[k(x,y)]=\begin{bmatrix}\frac{k}{x}\\ \frac{k}{y}\end{bmatrix}$$

A method using template matching is adopted to detect face in the pre-located face region. First of all, a gray standard face template is gained by using only R channel of RGB images. Then, face is detected in the pre-located face region using template matching by taking relativity coefficient as the matching rule. In the end， the location and size of this face are obtained. Experimental results of three testing sets (normal, smile and big smile sets) from CVL database show that the adopted method obtains good detection accuracy as well as speed. In the concrete, it gains 100%，100% and 93.6% correct detection rates respectively.

$$H_M[k(x,y)]=\sqrt{[\frac{k}{x}]^2+[\frac{k}{y}]^2}$$

Meanwhile, its detection speed increases from 1870.6 second/image to 208.4 second/image compared with only adopting template matching on the original image.

$$\beta=\tan^{-1}\begin{bmatrix}\frac{k}{y}\\ \frac{k}{x}\end{bmatrix}$$

To address the difficult problem of choosing remarkable plots from all plots gained via WPD on the original image, a method that selects "successful" plots according to the correct recognition rates (CRRs) of plots is proposed. These CRRs are obtained by combining (2D) ZPCA with the nearest neighborhood classifier.

$$q(x,y)=H_M[k(x,y)]$$

Aiming at efficiently fusing the feature matrixes of "successful" plots, a distance measurement between testing image and database image is presented. The Ll or LZ distances between feature matrixes of selected "successful" plots of testing image and each database image are calculated, and then taking the weighted sum of these distances as final distance.

This measurement preserves both the local and global features of image; meanwhile, it also takes the CRR contribution differences of different plots into consideration. Experimental results show this measurement improves recognition performance significantly.

$$q(x,y)=\begin{cases}V_G\\ k(x,y)\end{cases}$$

Viewing the difficulty to recognize face in images taken under different conditions, a novel recognition method employing WPD and (2D) ZPCA is developed. Firstly, 20 plots are obtained via two-level WPD on the original image. Secondly, the CRRs of these plots are gained by (2D) ZPCA and the nearest neighborhood classifier, and `successful' plots are selected based on this CRRs. Thirdly, the distance between testing image and each database image is calculated using the proposed distance measurement. Finally, the nearest neighborhood classifier is adopted for recognition on the basis of this distance.

$$y_i=Med\{l_{i-s},...,l_i,...,l_{i+s}\}\qquad i\in Z, s=\frac{n-1}{2}$$

2.2. Face Recognition Technology Based on Matlab

Face recognition is mainly used for identification. Because of the fast widespread of video monitoring, many of the video monitoring application urgently need a rapid identification technology, that can applied in a long distance and under the users' non-cooperation condition, so as to identify personal identity immediately over a long distance, realize the intelligent early warning. Face recognition technology is undoubtedly the best choice; the fast face detection technology can search for a face in the surveillance video images in real time. And with real-time comparison with face database, it can realize rapid

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identification.

The proposed recognition method is accomplished by MATLAB 7.0 and images from CMU PIE, Yale or UMIST databases are selected to test the recognition improvement of the proposed method under different illumination, expressions and poses respectively. The performance of (2D) ZPCA on the original image is defined as `standard' method. As the experimental results suggest, the proposed method obtains better performance than `standard' method under these three conditions. It performs best under different illumination whereas its performance decreases slightly under different expressions and is worst when poses change, and its highest CRRs are 98.795%, 89.796%, 36.047% respectively.

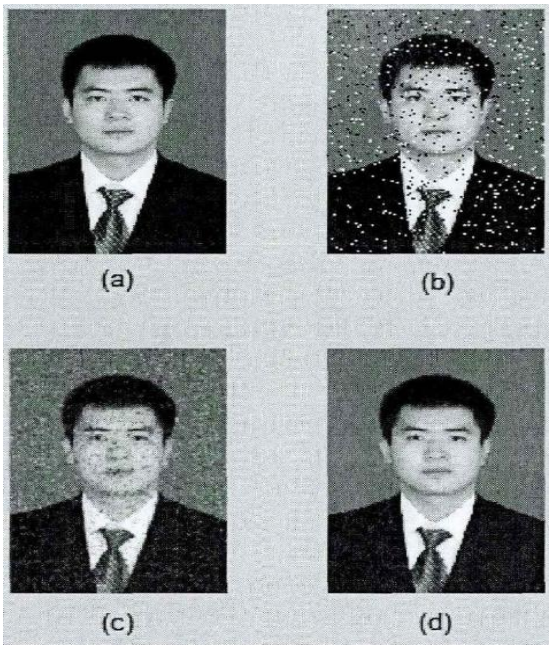

Figure 3. The image example of low-pass filtering and median filtering.

Observed from experimental results, the choice of distance metric has a significant effect on face recognition. In general, Ll shows higher CRRs on approximation plots, whilst LZ performs better on detailed plots. Similarly, the filters also show different performances under three different conditions. Therefore, distance metrics and filters should be selected according to these conditions. In the concrete, L1, Daubechies4, and Al, AZ, HZ, VZ, HHZ are recommended to form the proposed method under different illumination, and Ll, Haar and AZ are recommended to form the proposed method under different expressions. The proposed method fails to gain satisfactory CRRs under different poses, and the highest record is 36.047%. Thus, it is necessary to seek other methods to extract facial features more efficiently. Face image preprocessing is the basis of face detection and recognition. Under normal circumstances, all kinds of objective conditions that can interference and restrict the original image acquisition, such as the position of the light source, the angle of the imaging, are uncertain. In addition, imaging tools, transmission system and so on, will bring the unnecessary noise storage to the image. Affected by these factors, the image data we get have different levels of reduction of quality, or called degradation, such as low contrast, image edge blur, etc. Generally speaking, the face recognition system includes image intake, face positioning, image preprocessing, as well as face recognition(identity recognition or search).System input is usually one or a series of the face image containing uncertain identity, and several human face image with known identity in the database, or the corresponding code. And its output is a series of similarity score, suggests to the identity of the face yet to be identify.

3. Results and Discussion

Face recognition technology is one of pattern recognition and computer vision, the study belongs to the field of biometrics. Among them, feature extraction is the most important in the area of pattern recognition, the key of the face recognition technology research is how to extract discriminate in favor of classification features. Traditional global feature extraction methods cannot be extracted face image local features, local traditional extraction method cannot take into account the global feature face image, and there is data dimensions are too high, fewer samples and identify the effect is not ideal and other issues. In this paper, basis on multi-feature extraction manifold theory and method to do the following related research.

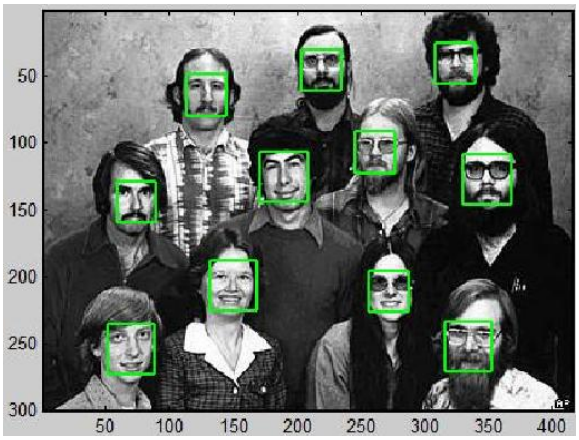

Figure 4. Face Detection Effect.

The overview of face recognition, research background and content, applications and difficulties are all discussed. We will give a brief introduction about some typical face database in the last. Detail description face recognition algorithms of the current classical feature extraction method: principal component analysis (PCA), linear discriminate analysis (LDA), locality preserving projection (LPP) and locally linear embedding (LLE) method.

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The advantages and disadvantages of these four methods were systematically explained. Based on maximum marginal criterion (MMC) algorithm, the maximum margin criterion locally graph embedding feature extraction methods based on multi-manifold (MLGE/MMC) was proposed by introducing multi-manifold thought. Firstly, the algorithm constructed the external divergence of the multi-manifold. Then, the internal divergence of the multi-manifold was constructed by a multi-manifold internal reconstruction weighting matrix. Finally, the purpose to be achieved is to maximize the interval of external manifold and to minimize the changes of internal manifold. This algorithm can be more effectively used for feature extraction and classification. In this method, the objective function is constructed by employment of MMC. It effectively solved due to less training samples resulting in the serious decline of the ability to distinguish. Unsupervised linear differential projection (ULDP) algorithm constructs the local neighborhood graph and the global variorum through manifold distance between the sample data to characterize the structure of the local neighborhood and the global structural information. However, ULDP method has the following shortcomings: 1.

Number of over-reliance in the learning process of training samples, when faced with a one-sample problems, it severely limits the application of this method; 2. Among the many feature extraction, we can not reveal which characteristics of classification and prediction play a leading role. To this end, we propose a multi-manifold unsupervised finer differential projection (MULDP) algorithm. This algorithm can get the low-dimensional manifolds embedded in a high-dimensional space and maintain the local and global structural information effectively.

At last, we created a face recognition system using MATLAB system, in order to verify the classical methods and the proposed method.

4. Conclusion

Grey the colorful image; remove noise using the image filter. Then do the grayscale transform to the image; enhance the image by adopting the method of histogram equalization. There are many kinds of transformation form of this method. In this article, we adopt continuous mean quantization transform to enhance the grey image.

In image face detection and localization of research, there are many feature extraction methods, because of the differences of applicable scope and difficulty, these methods cannot be applied to the study of this article. This article mainly studies the principal component analysis (PCA) algorithm, linear discriminate analysis (LDA) and wavelet transform. According to the analysis and the test results, face detection based on face find function is proposed. In the face gender classification method research, first extract face gender characteristics. In this article, we locate the human eye using gray integral projection and then to extract gender related characteristics of nose, mouth respectively

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