Research on Feature Extraction Method in Face Recognition

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Abstract: With the progress of science and technology and the rapid development of computer technology, the ability of computer to process information has been greatly improved. Biometric recognition technology based on digital image has gradually become an important exploration direction in the field of pattern recognition. Among the biometric recognition technologies, face has the characteristics of uniqueness, non-reproducibility, easy collection, and no need for the cooperation of researchers. It has better performance than other biometric recognition technologies. Therefore, face recognition has become one of the important research directions in the field of pattern recognition. This paper briefly introduces the background and current situation of feature extraction in face recognition, leads the analysis of the algorithm of face recognition system, and puts forward the method of exploring face feature extraction.

1. Introduction

With the progress of science and technology and the rapid development of computer technology, the ability of computer to process information has been greatly improved. Face feature recognition technology based on digital image has gradually become an important research direction in the field of pattern recognition [1-2]. Face recognition has always been an important issue in image recognition. Firstly, in research, the task of face recognition is much more complex than that of image classification [3-6]. In face recognition, the most important task is feature extraction. Traditional manual face features cannot meet the needs of the industry in terms of performance. The method of face recognition based on deep learning has gradually replaced manual features [7-9]. Secondly, in application, as the most easily accessible biological information, face is used to locate the identity of people, and there is a great demand in finance, monitoring, security and other industries [10-13]. Face recognition technology is widely used in many fields such as intelligent human-computer interaction, identity authentication, multimedia entertainment, security monitoring, financial security, civil security, customer service and so on. According to the development of science and technology, the application of face recognition technology is expanding and the potential demand is strong.

2. Background and Current Situation of Feature Extraction in Face Recognition

2.1. Current Situation of Face Recognition at Home and Abroad.

As early as the 1960s, the research of face recognition has begun. Until the 1990s, the technology of face recognition has gradually entered the application stage. At present, foreign research institutes have studied the reconstruction algorithm of 3D model and applied it to face recognition. The recognition rate is very high, which enhances the robustness of face recognition system to the changes of light or posture. It is mostly used in entrance guard system and border control system with high accuracy. Domestic research on face recognition technology started relatively late, but the rapid development, more and more scientific research institutions and institutions engaged in this field of research. For example, some domestic companies have introduced intelligent surveillance system based on face recognition, such as the intelligent security technology of Yuncong Science and Technology, with face recognition technology as the core, making airport security comprehensive intelligent, providing more security for public places.

2.2. Function of Face Feature Extraction.

The dimension of the original face image is often very high, and processing the original image directly will increase the complexity of the algorithm. In addition, the original image often contains many redundant features, which cannot directly reflect the nature of the face, and the image acquisition process is also affected by the imaging angle, environment and other factors. Therefore, feature extraction has become a key link and a difficult point affecting the accuracy of face recognition. Face feature extraction is actually the process of extracting features from many original features that can represent face most effectively and reduce the dimension of feature space. The function of feature extraction is to avoid "dimension disaster", improve the generalization ability and operation speed of the algorithm, and reduce the complexity; extract features that can effectively represent faces and have strong discriminant performance, so that the design of subsequent classifiers can be easier to achieve; effectively compress data and reduce space consumption; remove redundant features to a certain extent, eliminate the correlation between features, and reduce the complexity. The influence of noise.

2.3. Difficulties in Face Recognition Technology.

Face recognition has a large variety of categories, everyone is a class, and the face itself has similarities, the difference between different faces may be small, small differences between classes lead to the reduction of distinguishability, and the existence of similar people and the development of cosmetic surgery is a challenge to face recognition. Face images or videos collected under uncontrollable conditions will be illuminated. The influence of posture, expression change, occlusion, noise and other aspects leads to the great difference of multiple images of the same person. The large intra-class difference makes face recognition difficult, and extracting features with strong invariance becomes important and difficult. The change of time also brings challenges to face recognition. Many people have huge changes in their internal appearance at different times, such as fat and thin problems, wrinkles, and even cosmetic surgery, which will increase the difficulty of recognition. Face recognition is a typical small sample problem. In some practical applications, only one or several images of each person may be obtained, such as the case of face brushing in railway station, that is, only the image on ID card. In this case, the contradiction between the high dimension of image data and the small number of training samples is deepened, and the useful and classified facial features cannot be extracted better, which greatly reduces the performance of face recognition. In order to achieve high recognition performance, the first most popular in-depth learning requires a lot of image training. In the case of small samples or even single samples, many traditional recognition algorithms also suffer from serious performance degradation.

3. Introduction of Face Recognition System

3.1. Basic Framework for Face Recognition.

The main purpose of face recognition is to match the unknown face image with the image in the existing face database to confirm the specific identity of the unknown face image. A complete face recognition process is shown in Figure 1, which includes four steps: face detection. Unknown images generally include face and non-face areas, so first of all, face detection is needed to identify whether the area contains face, and segment the face area as a stand-by facial image to be tested. Face detection is the premise of face recognition, because of its important application value, face detection has become a mainstream research direction alone; image preprocessing. The face image to be tested may contain some irrelevant image information. At this time, it is necessary to pre-process the image to eliminate the useless information and enhance the detectability and reliability of the useful information. The main work of pretreatment includes gray scale, filtering, normalization, smoothing, restoration and enhancement. The pretreatment of the measured image lays the foundation for the next feature extraction; image feature extraction. The pre-processed image and the image in the face database are extracted by the same feature extraction method, and

the face features that can be compared are obtained. The advantages and disadvantages of the feature extraction methods directly affect the discrimination results, so the selection of the methods is very important. To select feature extraction methods with strong robustness to illumination, gesture and expression, dimensionality reduction of features should be carried out when appropriate to avoid too large dimension of extracted features; image matching. By matching the features of the face image to those of the face database, the recognition accuracy of the face image can be obtained according to the degree of matching. In this process, the final recognition result can be obtained by using classifier, and the identity of the face to be tested can be identified.
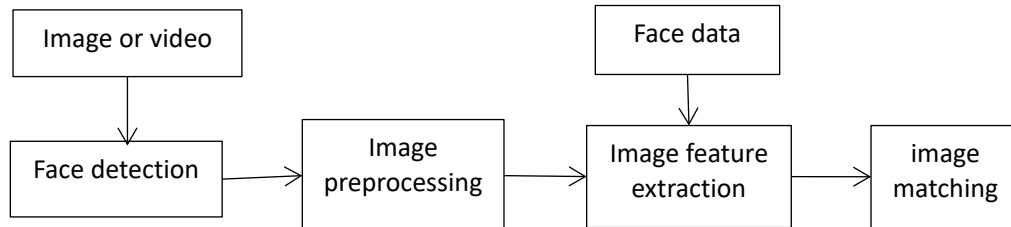
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┌──────────────┐          ┌──────────────┐
│ Image or video │          │   Face data   │
└──────┬───────┘          └──────┬───────┘
       │                         │
       ▼                         ▼
┌──────────────┐   ┌──────────────┐   ┌──────────────┐   ┌──────────────┐
│ Face detection │→ │    Image      │→ │ Image feature │→ │    image      │
│              │   │ preprocessing │   │  extraction   │   │   matching    │
└──────────────┘   └──────────────┘   └──────────────┘   └──────────────┘
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Figure 1 Basic Framework for Face Recognition

3.2. Mainstream Face Detection Algorithms.

Face detection algorithm is the process of judging whether there is a face in an image, if there is a part of the face detected and segmented. Geometric feature-based face detection algorithm is the earliest one. It mainly uses the structural features of face to detect, including prior knowledge-based algorithm, template-based algorithm and feature-invariant algorithm. Face detection algorithm based on feature invariance is a bottom-up method, which mainly detects and processes face invariant features such as mouth, eyes and nose. For example, through the selectivity of band-pass filter, setting the corresponding frequency threshold, finding the mouth, eyes and other areas in the image, so as to realize face detection. The algorithm based on statistical theory is the current face detection algorithm. Mainstream algorithms mainly include subspace method, support Vector Machines method, HMM (Hidden Markov Model) method, neural network method and Boosting method, etc. Face detection based on skin color model is mainly for color images. It is a simple and efficient method to detect face location in color images by using the difference of skin color and background. It is easily influenced by the background color.

3.3. Mainstream Face Recognition Algorithms.

Face recognition is mainly the process of feature extraction and recognition of face images obtained after face detection. After half a century of research, many methods have been formed, including face recognition methods based on geometric features, global features, local features and in-depth learning. Geometric feature-based face recognition algorithm is a process of matching and recognizing face features according to the geometric relationship formed by the face's topological structure. This method is simple in theory and calculation, but it has not been well conquered because of the great influence of feature point location and alignment, so its practicability is limited. Face recognition method based on global feature is based on human. The process of face feature extraction, matching and recognition based on the whole face information includes subspace method, HMM algorithm, Bayesian method and elastogram matching. The most representative of these methods is subspace method, which converts the high-dimensional information of face image features into low-dimensional subspace by changing, so that the subspace has better classification function, and then matches in subspace. Recognition; Face recognition method based on local features is the process of extracting and recognizing face features according to the local information of the face, describing the detailed features of the face, which better imitates the process of identifying other people's identities by natural people.

4. Face Feature Extraction Method

4.1. Principal Component Analysis (PCA)

PCA is a data analysis method proposed by scholars at the beginning of last century, and has become one of the most widely used feature extraction methods in pattern recognition field. The basic idea is: through orthogonal linear transformation, a group of new features arranged in order of importance from large to small are calculated from the original features. They are linear combinations of the original features and are irrelevant. Generally, the eigenvalue problem transformed into the covariance matrix of new features is solved. The larger the variance of new features, the more information they retain. Face recognition based on PCA has many advantages, such as clear concept, no additional parameters, high computational efficiency and strong generalization. But it needs to expand the image matrix into a high-dimensional vector according to row or column in data processing. On the one hand, it destroys the intrinsic structure of face, on the other hand, high-dimensional data increases computational complexity and easily leads to small sample problems, and PCA cannot deal with non-linearity. Data. Therefore, many improved PCA-based algorithms have been proposed, in which Kernel Principal Component Analysis (KPCA) uses the idea of kernel function to realize the non-linear extension of PCA. In addition, the zero-mean two-dimensional face image matrix can be directly used to calculate the covariance of the sample trees, thus avoiding the problem of small samples and effectively maintaining the intrinsic structure of the face.

4.2. Linear Discriminant Analysis (LDA).

As an unsupervised feature extraction method, PCA ignores the differences between different types of samples, that is to say, PCA does not consider the marking information, so researchers began to study how to introduce the marking information of samples in the training process of feature extraction algorithm, LDA is one of the more classic. The basic idea of LDA algorithm is to find the optimal projection direction to achieve the maximum inter-class divergence and the minimum intra-class divergence of data in projection space. Generally speaking, the feature dimension of face image is much higher than the sample number of image, so the intra-class divergence matrix of LDA algorithm is often singular and can not be directly inverted, which is called "small sample problem".

4.3. Manifold Subspace Learning (MSL).

Manifold is a concept in differential geometry and a topological space that can be locally coordinated. High-dimensional images generally have inherent low-dimensional representation, that is, high-dimensional information often exists in a non-linear low-dimensional manifold. Cognitive psychology holds that face perception may exist as a popular structure, so the cognitive process is largely carried out by embedding low-dimensional manifolds in high-dimensional images. The feature extraction and recognition based on non-linear manifolds is in line with human cognition.

4.4. Sparse Subspace Learning (SSL).

Sparse Representation (SR) can reveal the intrinsic structure of signals through a small number of atoms, and with the rise of compressed sensing theory, SR has been widely used in various aspects of signal processing. Sparse representation is combined with linear projection and applied to face recognition. Sparsity Preserving Projections (SPP) achieves good recognition results. On the basis of compressed sensing, the method approximates the original signal by sparse representation reconstruction, and keeps the sparse reconstruction coefficients between the original high-dimensional samples greatly after mapping, so as to achieve the purpose of local structure preservation. In view of the advantages of sparse representation, more and more feature extraction algorithms based on sparse representation are proposed.

5. Conclusion

In recent years, with the development of the network, the amount of image data on the network has increased dramatically. Faced with a large number of face databases, the existing methods are difficult to extract and recognize face features efficiently. Therefore, in the next step, we can consider using distributed platform to process large-scale face images, and further improve the efficiency of the algorithm to meet the needs of real-time face recognition.

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