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Research on the Development of Face Recognition

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Abstract: Face recognition method is constructed based on certain similarity criteria and image feature extraction method, so as to realize the biometric extraction of human body, the face image is divided into different regions with special attributes, and the face is extracted to reflect the human face. Geometric characteristic quantity of partial information. Combining computer vision analysis method to simulate face pose expression information, realize 3D feature reconstruction of human face, and combine expert database and priori feature information to train and match samples to realize face feature point detection and recognition. Common face recognition algorithms include principal component feature analysis (PCA) and BP neural network (ANN) recognition. Wavelet analysis methods and so on, this paper analyzes the development of face recognition, describes the main face recognition algorithms, analyzes the performance of various face recognition algorithms, and carries out simulation tests on different face recognition algorithms. The research shows that face recognition algorithm based on wavelet analysis has advantages in recognition accuracy, and face recognition algorithm based on principal component analysis has superiority in time efficiency.

Keywords: face recognition; Image processing; Principal component Analysis; Wavelet Analysis; face feature extraction

1. Introduction

The research of face recognition technology involves image processing, pattern recognition, machine vision, artificial intelligence, cognitive science, physiology, psychology and so on. The characteristics of human vision recognition system have some reference significance for machine face recognition. In real life, authentication is required in many cases. Face is the most important appearance feature of human body. Because facial information can be obtained by non-contact methods such as camera, it is very suitable for identification. And fingerprint recognition, compared with other biometrics such as iris recognition the unique feature of face recognition technology also shows that this recognition technology has the characteristics of direct friendly and convenient and the user has no psychological barriers and is easily accepted by users. The technology is widely used in national security, military security and public security, justice, and other civil security control systems. In addition, the research of face recognition technology also involves physiology, psychology, artificial intelligence, pattern recognition, image processing and other disciplines, so it has important theoretical research value[1].

At present, scholars at home and abroad have put forward a lot of automatic face recognition methods, mainly affine moment invariant feature detection method, template matching method sift moment invariant moment matching method, wavelet scale detection method and system. In reference [2], face recognition algorithms can be divided into two categories: one based on graph theory and gradient descent. The representative face recognition methods based on graph theory are the Graph-based method, J. Shi, Ncut method[3], A. Moore method, and the entropy rate method proposed by Liu et al., which are proposed by Graph-based P. Felzenszwalb and D. Huttenlocher. Among them, Ncut algorithm uses contour features and texture features to minimize the global cost function[4], it can generate regular face recognition, but the edge of the image is not good, the computation is large, and the processing speed of large images is very slow. The Graph-Based method uses the idea of minimum spanning tree to segment the image. It can keep the edge of the image better and the speed is faster, but the size and shape of face recognition are irregular. The Superpixel Lattice method preserves the topological information of the image, but the performance depends heavily on the edge of the pre-extracted image. The objective function which includes random walk entropy rate and equilibrium term is proposed by entropy rate method. By maximizing the objective function to achieve segmentation, it produces a comparison rule and uniformity of face recognition.

By collecting and locating the priori rule of human face and extracting the invariant moment information of facial feature distribution, these methods can realize the effective statistical detection and information classification of face shape and difference feature, combined with training. The training samples are used for face feature informa-

tion clustering mining to achieve the purpose of face recognition. Among them, in reference [5], a multi-information fusion method is proposed to locate facial five facial markers with multi-pose. The affine invariant Affine-SIFT method is used to perform linear mapping and 3D recombination of face feature region, and face pose is combined with face orientation. The 3D information of state is decomposed into local neighborhood, the feature points of face are extracted and the feature points of facial features are located accurately, and the recognition rate is better. However, the computation cost of this method is high, and the real-time performance of this method is not good in large scale face sample recognition. In reference [6], a face detection method based on multi-block local binary pattern features and human eye localization is proposed. The priori rule information is set up to match the multi-block local feature of face training samples in FRGC2.0 and self-built NPU3D database. Automatic localization of facial and eye feature points is realized. The complexity of the algorithm is low, but the robustness of the method is poor and it is easy to fall into local convergence. For the gradient descent method, there are the Watersheds method of L. Vincent [7], the Meanshift method of, D. Comaniciu [8], the Turbopixels method of Quick-shift method, A. Levinshtein[10] and the SLIC method of A. Radhakrishna, they all adopt the basic idea of clustering, but their specific methods have different advantages and disadvantages. Turbopixels is a level set method based on geometric flow, which collides with the initial seed points step by step, and finally distributes face recognition to the image plane approximately uniformly.

2. Several Common Algorithms

2.1. Face Recognition Algorithm Based on Geometric Features

In this method, the face is represented by a geometric feature vector, and the classifier is designed with the idea of hierarchical clustering in pattern recognition. The geometric features often used include eyes, nose, eyebrows, etc. Important local features, facial features and geometric features of facial features. The geometric features used in recognition are feature vectors based on the shape and geometric relationship of human face organs. Their components usually include the Euclidean distance curvature angle and so on between the two points specified by the face[8]. In the recognition based on geometric features, the similarity measurement of different features mainly depends on the matching of feature vectors, for example, based on Euclidean distance. The advantages of the recognition method based on geometric features are: it conforms to human habits and is easy to understand; it is not very sensitive to the variation of light and has a certain ability of anti-interference. The existing problems are as follows: it is difficult to extract stable features from the image, and there will be false extraction when there is occlusion, and the robustness is poor when the facial expression changes greatly or the posture changes greatly. The criterion of geometric feature model is too simple. The general geometric feature only describes the relationship between the basic shape and structure of the organ, neglects the detail feature, and makes part of information lose.

2.2. Face Recognition Algorithm Based on Feature Subspace

Feature face method is a typical method in face recognition, also called principal component analysis (PCA). SIROV ICH and KIRBY first use PCA algorithm to represent face[9]. It constructs the main eigenvector space based on a set of face training samples, namely the feature subspace (feature face), which is composed of the main eigenvector corresponding to the main eigenvalue of the image generation matrix, which are the principal eigenvectors. The energy occupied is more than 90 percent of the total energy. The rest of the small energy vectors are eliminated. The generated matrix can be the covariance matrix of the image, the total intra-class dispersion matrix, and so on. The subspace is dimensionally reduced, and the dimension is much smaller than the original data space. Any face image to be recognized can project into the feature space and obtain a set of coordinate system numbers. The coefficients show that the image is in the subspace. So it can be used as the basis of face recognition. Any face image can be expressed as a linear combination of the set of feature vectors, and its weighting coefficient (the coefficient obtained from the projection of the image into space) is called the algebraic feature of the image. In recognition, the image to be recognized is projected into this feature subspace, and the projection coefficients are compared with the coefficients of each known face image. By using certain criteria, such as k- nearest neighbor method, the unknown samples are obtained. K nearest neighbors, looking at the most of these k nearest neighbors belong to which category, the image to be recognized into which category. The feature face method is easy to understand and has been widely used, but it has a large amount of computation. So PCA is often used in conjunction with other methods, such as wavelet transform and PCA, so the dimension reduction effect of PCA is improved[10].

2.3. Face Recognition Algorithm Based on Template Matching

Template matching has two kinds: static matching and elastic matching. Static template matching: design a library that stores several templates of known faces that can be grayscale images of the entire face, grayscale images of various physiological feature areas, or some sort

of Transform the face image. After the same transformation, the image to be recognized is processed by scale normalization and gray normalization, and the same image size, orientation and illumination conditions are obtained. Then the matching degree between the image to be identified and the image in the library is calculated[11]. The problem of static template matching is: because the library is fixed, if the facial expression changes a lot, or if a new pattern appears, then the template is not suitable, that is, the static template matching method is inflexible. Considering this problem, the elastic template matching is proposed below. Elastic template matching is to define a feature parameter model based on the prior knowledge of face features to be tested. These parameters reflect the variable parts of the corresponding feature shape. In order to get this set of parameters, according to the edge of the image, the peak value, Valley strength information and prior knowledge of feature shapes are designed for appropriate energy functions. The required parameter is the parameter when the energy function is minimized. The advantages of this algorithm are obvious. It is more flexible and robust than the static template matching method, but it also has some disadvantages: high dependence on the initial values of parameters, easy to fall into the local minimum, and long calculation time.

2.4. Face Recognition Algorithm Based on Neural Network

Artificial neural network is developed on the basis of biological neural network. Psychologist McCulloch and mathematician Pitts co-proposed a mathematical model of formal neuron, which became the beginning of artificial neural network. The neural network method has its unique advantage over other kinds of methods in face recognition. It avoids the complicated feature extraction work and can obtain the hidden expression of the rules and rules of face recognition which is difficult to obtain by other methods. The neural network processes information in parallel mode, and the storage mode is distributed. If it can be implemented by hardware, the speed can be improved significantly. Neural network hides the statistical features of the model in the structure and parameters of the neural network. The neural network-based approach has a unique advantage for complex models such as faces which are difficult to display and describe. The robustness of neural network is good, but the training is slow and may fall into local optimum.

2.5. Watershed Method

The watershed method describes an image by topological topographic map. When applied to face recognition, the gray value of each pixel in the image represents the elevation of the point, and each local minimum and its affected area is a catchment basin. The boundaries of the catchment basin form a watershed, as described in Figure 1.

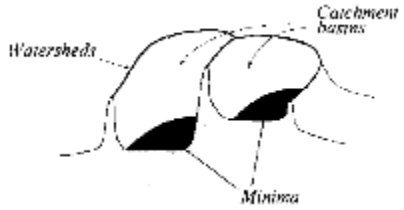
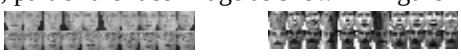


Figure 1. Watershed Method.

Watershed segmentation algorithm is based on the theory of mathematical morphology. At first, watershed algorithm was introduced into the analysis process of binary black and white image by H.Digabel et al. Then, Beucher and Vincent are discussed, and a perfect watershed theory system is established. The more classical calculation method is put forward by Vincen, which adopts the implementation scheme of immersion algorithm. The watershed calculation is divided into two steps: the sorting process and the immersion process. At present, three classical watershed segmentation algorithms are watershed segmentation based on gradient, watershed segmentation based on distance transform and watershed segmentation based on label. The advantages of watershed algorithm are simple, low complexity, short running time, and the extracted edge profile is closed, which can accurately locate the target object. But it also has some shortcomings, watershed segmentation will get tens of thousands of catchment basin, the result is very careful, resulting in a very serious image segmentation phenomenon.

3. Experimental Comparative Analysis of Face Recognition Algorithm

In order to compare the performance of different face recognition algorithms, the simulation experiment is carried out, and the simulation design is carried out by using Matlab simulation software. The step size of machine learning is $l = 12$, and the test database comes from Yale library and PIE library, and the test database is used in the test database. A total of 200 images, a total of 1273 images, part of the face image as shown in figure 2.



(a)ORL (b)Yale

(c)PIE

Figure 2. Face Images.

Different methods are used to test the recognition rate and time cost of face recognition, and the comparison results are shown in figure 2.

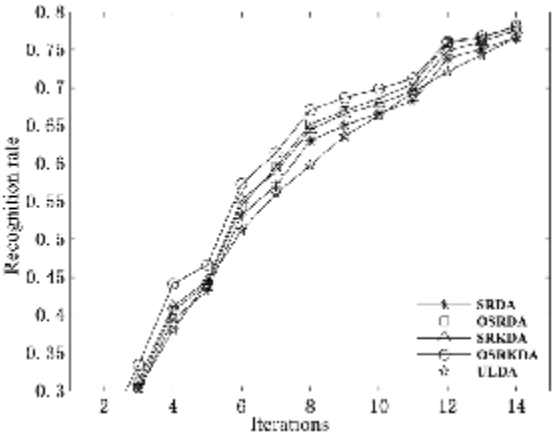


Figure 3. Comparison of Recognition Rate Test.

The simulation results show that the face recognition algorithm based on wavelet analysis has a higher recognition rate and the face recognition algorithm based on principal component analysis has less time cost.

4. Conclusions

Nowadays, face recognition has become an important tool in the field of computer vision, and its wide application field and good practice effect have been paid more and more attention by scholars at home and abroad. How to achieve a more accurate and faster face recognition method researchers face the key problem. The parallelization of algorithm is the development trend of realizing real-time processing. Different face recognition methods have their own advantages and disadvantages. In this paper, face detection technology and face recognition technology are reviewed in combination with the development of face detection and recognition technology. Face detection and recognition, the most important technology in identity verification, have been paid more and more attention due to the rapid increase in the demand for the human-computer interaction (HCI) technology. It has become a hot spot in the world. Face detection and recognition technology involves a wide range of areas, and there are many theoretical problems. Objectively speaking, under the present conditions, it is almost impossible to achieve 100% successful face detection and recognition, due to the huge needs of all aspects of society. Seek, at the same time is a huge power, face detection and recognition technology, this research hotspot will continue to develop, new methods, New ideas will continue to emerge, which will promote the further industrialization of face detection and recognition technology.

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