The Research of Face Recognition Method Based on Sparse Representation and Feature Selection

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Abstract: Based on the digital image facial recognition technology is as the research background. Based on the analysis of the existing face recognition methods, combining with the latest theory of pattern recognition is for face recognition of facial expression. Illumination such as complicated conditions is in-depth study of face recognition based on sparse representation and feature selection problem. Sparse representation problem of computational complexity is with the increase of the dictionary size increase rapidly. To this end, this paper proposes a fast decomposition gradient projection algorithm in solving sparse representation (FDGP). By minimizing a quadratic programming problem of bounded constraint to solve the problem of sparse representation, the process of gradient projection iteration does not solve the problem, but a select gradient is the biggest change elements as working set, which converts large-scale optimization problems - small bounded constrained quadratic programming problem to solve and saves memory consumption. It significantly improves the efficiency of large scale sparse representation problem and ultimately increases the accuracy and efficiency of face recognition.

Keywords: Face recognition, feature selection, decision fusion, sparse representation.

1. INTRODUCTION

Face recognition research began in the 1960s. With the development of computer hardware technology and network technology, it made a great progress in recent decades [1]. Face recognition is essentially for a computer that has the ability to distinguish between different human individual equivalent to see the ability of computer vision, which is the intelligent human-machine interface research one of the important problems need to solve. It also is an important performance of machine intelligence. It can greatly improve the man-machine interaction environment [2]. However, due to the environmental light, the change of the posture, facial expression, shade and face recognition technology based on digital image still has a lot of key problems to be solved. In recent years, with the development of the theory of pattern recognition and machine learning, face recognition research is still a hot research direction in the future for a period of time [3]. The famous university and research institute is as well as many companies at home and abroad related to the support of the project. Face recognition problem is received such attention because it has an important theoretical research value and application prospect. It also has huge contribution to the development of many disciplines [4]. Face recognition research is across the mathematics, image processing, pattern recognition, computer vision, artificial intelligence, computer graphics, cognitive science and neural computing.

For the development of these areas it provides a good experiment platform. At the same time, these fields can also be set in face recognition field research. The new method creates the new theory and explains the new point of view.

Face recognition as a biometric identification technology has huge potential application prospects. Such as social it has drifted back towards living and working in the identification and authentication. Though sometimes it is unconscious, we every day to judge the identity of a lot of people [5]. At the same time, each of us should be through a variety of ways and means to prove their identity, such as in a bank to finance the business or enter the need to identify the entrance guard system, etc. Obviously, at present we mostly rely on the traditional method for the identification, such as using the key, keys, id card and other kinds of marker, but these methods have some disadvantages: for example the password may be stolen or lost. Certificates and plaintext carry not convenient. Certificates are often forged or stolen by others.

2. FACE IMAGE PREPROCESSING TECHNOLOGY

Traditional image denoising methods are mostly in the frequency domain of image processing. Useful information is separated from the noise of the image, such as wavelet denoising method thought itself [6]. Image information is distributed in a limited frequency range. The noise is some small changes in the image, mainly concentrated in the high frequency part. In many cases, however, the high frequency part may also contain information of the image itself, such as edge feature and texture feature. So this method is used to remove noise to damage the image of real information and lack of characteristic properties. And some noise in the low frequency part also has a certain weight. Filtering can't remove this part of the noise component directly, so this method is not effective separability.

$$y = \arg \min_{y^T By = \Delta} \sum_{i \neq j} \|y_i - y_j\|^2 S_{ij} \qquad (1)$$

Image sparse representation is based on a complete dictionary denoising method because of its characteristics of image data with sparse. Properties and advantages of separability and is more and more widely used in image denoising. This approach assumes that each atom in the dictionary corresponding to the structure model of the original image and assuming with sparse said in the dictionary. The noise component is impossible to sparse representation in the dictionary, so you can can based on image sparse representation in the dictionary to distinguish between original image and noise image denoising.

$$F^* = \arg \max_{F_1 \in \Pi} F(F_1) \qquad (2)$$

Image super-resolution technology in recent years is one of the most active research topics in image processing field. The basic idea of this technology from a low resolution image or multiple low resolution image gets a high resolution image. Summary of Video Adaptations in Experiments with Different Video Analysis Algorithms is seen from Table **1**. Super-resolution technique can recover cut-off frequency information and make the image more abundant details. Especially for near infrared face recognition, due to the physical properties of the near infrared optical imaging system itself, the face image resolution obtained may be could not reach the requirements of the subsequent face detection and recognition in order to better face detection and recognition [7]. People are eager to the existing low resolution face image with super-resolution technique.

Face for low-resolution face image super-resolution processing can restore the face detail characteristics greatly improve the resolution. Using human face image super-resolution technology is to face the identity authentication and obtain better effect. Video surveillance scenario of combining scaling and compression adaptations to further reduce the bitrate is seen from Fig. (**1**). Therefore, face super-resolution technique has a widespread application in many fields, such as public security criminal reconnaissance certificate identification, customs, airports, hotels, monitoring and control system and entrance guard face recognition system, etc. But due to the people to face is very familiar with and sensitive, thus face super-resolution is also a very challenging topic. Common face recognition method is using interpolation method, however interpolation method for the recovery of facial details is not very ideal.

3. THE THEORY OF GRAPH EMBEDDING FEATURE SELECTION

Generally the process of face recognition with numerous and internal features of data set is not related to the noise and redundant features. Irrelevant features are a great influence on the effect of learning algorithm. Therefore in the process of face recognition for feature selection, the original data set is the most important characteristics of information, eliminate irrelevant features and plays an important role. In addition, the face image data set generally has high dimension so in the process of identification. The

dimensions of the big challenges facing high not only increase the cost of the algorithm based on learning, but also a great influence on the effect of the learning process may even cause dimension disaster. The dimension reduction problem in face recognition attention is such as machine learning applications.

$$f = \frac{f - f^T 1}{\|f - f^T 1\|} \qquad (3)$$

Traditional dimension reduction methods is given priority to with linear, including principal component analysis, independent component analysis and linear discriminant analysis method, etc. The linear method is easy to understand and easy to use. But when the linear hypothesis and the actual access to the data model of distribution is not at the same time to extract the features to reflect the information of original data. Research shows that in the real world many high-dimensional face image sample does not obey the multivariate normal distribution, space face can also be embedded in the original high-dimensional nonlinear submanifolds in image space. Therefore, based on the linear model of the traditional hypothesis of discriminant feature extraction method for high dimensional face data sometimes effect is poorer. In order to improve high dimensional face data feature extraction effect, many nonlinear feature extraction methods have been proposed in recent years. Such as the method based on nuclear, based on the graph embedding model method and so on. With the graph embedding model based on manifold learning method, model based on graph embedding method is to keep the purpose of the different characteristics of the manifold, such as local linear embedding algorithm was designed to make the high-dimensional close as possible to the nearest point in low dimensional space. The characteristics of local keep Laplace projection method is the mapping of linear approximation. Theoretical research proves that PCA, LDA, LPP can be obtained according to the different graph embedding model. Graph embedding model, therefore, can be seen as a more generalized feature extraction methods or called dimension reduction techniques.

$$S_{ij}^p = \begin{cases} 1 & if (i, j) \in P_{k_2}(c_i, c_j) c_i \neq c_j \\ 0 & else \end{cases} \qquad (4)$$

Commonly it is used to solve the problem of dimension restriction dimension reduction method generally divided into two categories, namely, feature extraction and feature selection. Feature extraction is under certain constraints and maps the high-dimensional data into low-dimensional subspace. Feature selection chooses the most important information from the original data set.

4. BASED ON THE CHAIN SAMPLING METHOD OF FEATURE SELECTION

With the development of imaging technology, the resolution of the camera imaging equipment such as more and more high, lead to image dimension has increased dramatically the calculation of digital image processing and storage pressure. For image processing, the dimension reduction problem is more and more important. In the study

of super high dimensional problems, the rapid growth of the data dimension limits the many applications of machine learning algorithms, such as support vector machine (SVM).

Characteristics of sampling and feature selection are similar. The main difference is that choose to try to find the most information characteristics of minimum feature subset in order to obtain a better general performance. In the past few decades, many monitoring feature selection methods have been proposed. From the recent literature theory study, model can be obtained using feature selection methods and a model to predict lower risk. Regularization based on a new feature selection method is proposed, which features generated machine. It has better scalability for high-dimensional data. In each iteration process of FGM, it has a fixed size feature subset of information marked as r. And then through the multi-core learning algorithm the selected feature subsets are of a set of forming nucleus. FGM is a classifier learning process conducted on the selected feature subsets and its training complexity significantly reduced. And so, feature subset produce process sort through simple form. The process is independent of the main training process. Due to have such properties, this chapter puts forward a new feature selection method based on sampling. By using the data of sparse to enhance the effect of the FGM method dealing with high dimensional problems, especially for high dimensional explicit mapping problem. FGM method in the process of each iteration, the features is sorted according to the score and formed a new feature subset. Furthermore, we proposed the method based on the calculation sample seen as birth to death in the process of random process. In the process of feature selection it can guarantee including most useful information. For the feature selection task, our proposed method can achieve better results than the CRS method. The results of the study on ultra high dimensional data set show the effectiveness of this chapter. This article uses the vector/matrix transpose.

$$c_j = \sum_{i=1}^{n} a_i y_i x_{ij} = \sum_{i=1}^{n} a_i a_{ij} - \sum_{i=1}^{n} a_i x_{ij} \tag{5}$$

CRS is a key problem to keep to the distance between the original data set. From FGM in feature selection problem, however, the point of view of good sampling method even in the worst case analysis and cover all r a true features. Therefore, feature selection of sampling should keep more strict than the distance. In the chain sample, sampling size for a given C is able to cover all need to focus on the characteristics of real probability. Strategy II sampling analysis more difficult. Here, the introduction of a cache model to analyze the performance of the proposed the calculation sample model. Our analysis is based on the strategy of sampling method. Into the cache model queuing theory is analyzed from the stochastic process. It can be described as a discrete time markov birth - death process.

5. FACE RECOGNITION BASED ON SPARSE REPRESENTATION THEORY

The traditional method is signal a signal decomposed into the linear combination of a set of orthogonal basis functions. Common orthogonal basis have discrete cosine transform and wavelet transform, etc. But the discrete cosine transform can effectively extract the signal characteristics of time-frequency localization characteristics. Wavelet analysis in dealing with a linear singularity effect is not very good. Complex signal such as image sometimes can't use a set of orthogonal basis effectively. A snapshot frame from a test video for CAMSHIFT face tracking. In (a) it is compressed with quality 100 and in (b) with quality 50. is seen from Fig. (**2**). It is inspired by human visual cortex neuron response of sparse, 1996 Olshausen etc. Put forward a kind of image signal to nature more effective representation is sparse representation. The signal is represented as sparse representation to use a dictionary and a handful of the linear combination of atoms. Sparse representation makes the signal energy only focus on a few atoms corresponding to the nonzero coefficients of a small amount of atomic reveals the main characteristic of signal and internal structure.

Sparse representation can be done by a small amount of atoms in the form of a concise. Sparse revealed the inner structure of the signal and has a broad application prospect. It gets a lot of in the field of image processing and other related research results, such as the target classification, image denoising, image compression, image restoration and digital steganography. In the literature, other ingenious use of sparse representation theory and the robust face recognition. Test face image on the template image sparse coding in the first place, then according to the minimum fitting error it determines the classification results. This makes face recognition method based on the study made a great development. Some improvement based on sparse representation classification algorithms have been proposed, such as sparse representation method. It can effectively reduce the quantization error and improve the performance of sparse coding and its application in the direction of face recognition. The experimental results show that this method improves the robustness of face recognition.

$$\gamma = \frac{|f_{k+1} - f_k|}{|f_k|} \tag{6}$$

First, this chapter introduces the sparse representation theory according to sparse representation problem of dimension higher when solving larger workload and slower speed problem. It puts forward the gradient projection algorithm to solve the sparse representation of rapid decomposition, and combined with the feature of high frequency and low frequency wavelet. Critical drop-gap *vs* compression quality is senn from Fig. (**3**). Wavelet domain sparse representation face recognition method is proposed. Experimental results show that even if the face image there is a strong light expression changes or small block, the proposed approach can be effective and accurate identification and improves the robustness of face recognition.

Signal can be under a bunch of complete orthogonal basis and expressed by the orthogonal basis of a finite number of component signals. This method has achieved good results in simple signal, but it is a complex signal characteristics and different regions different characteristics. A set of complete orthogonal basis can not only achieve the purpose of accurate signal sparse representation. Such as trigonometric function cannot very good reflect the local characteristics of the signal. Wavelet base is not thin enough to signal

Table 1.   Summary of video adaptations in experiments with different video analysis algorithms.

Video adaptation	Degradation pattern	Algorithm	Dataset
JPEG compression	quantizer from 1 to 99 with step 2	face detection, face recognition	MIT/CMU, Yale
	quantizer from 10 to 100 with step 10	face tracking	videos with moving faces
Scaling (nearest neighbor, bicubic, pixel area relation)	2 to 100 percent of original size with step 2	face detection, face recognition	MIT/CMU, Yale
Combination of JPEG compression and nearest neighbor scaling	scaling from 10 to 100 percent of original size with step 10, compressing at each step from 1 to 99 with step 2	face detection, face recognition	Video of the lab door
Frame dropping	drop i out of $i + j$ frames	face tracking	Videos with moving faces

mutation characteristics, etc. Therefore, the use of a dictionary signals sparse representation, it is very meaningful. Sparse representation of a dictionary is mainly based on predefined set of functions of dictionary and according to the study of two kinds of image sample. Prespecified function a set of linear transformation is used to design the dictionary are common. Wave profile Gabor transform and redundant dictionary consisting of a variety of base, etc. This dictionary design method is simple. In many cases, a simple and rapid evaluation algorithm is widely used. The success of this kind of dictionary depends on whether can properly in the form of a sparse signal. Another kind of dictionary to build samples to study the image method, including the k-means algorithm, the optimal direction method and K-SVD algorithm supervised learning method, maximum likelihood method and maximum a posteriori probability method and so on. It can better the sparse representation of signal and direct extension to the image applications. It also has received the widespread attention.
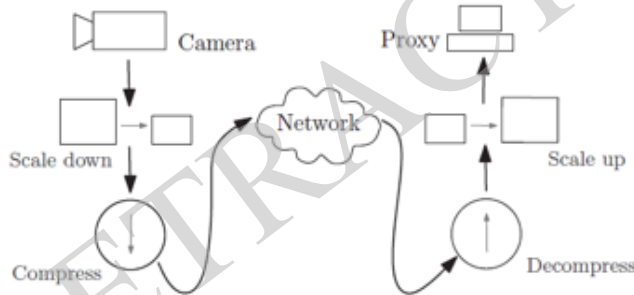

Fig. (1). Video surveillance scenario of combining scaling and compression adaptations to further reduce the bitrate.

Fig. (2). A snapshot frame from a test video for CAMSHIFT face tracking. In (a) it is compressed with quality 100 and in (b) with quality 50.
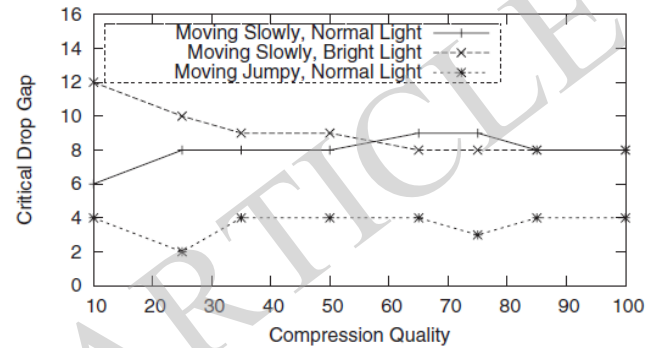

Fig. (3). Critical drop-gap *vs* compression quality.

CONCLUSION

Sparse representation problem of computational complexity increases with dictionary size increase rapidly. To this end, this paper proposes a fast decomposition gradient projection algorithm in solving sparse representation. We by minimizing a quadratic programming problem of bounded constraint to solve the problem of sparse representation and choose gradient exists in the process of gradient projection iterative biggest change elements as a working set. It saves the memory consumption and significantly improves the efficiency of the solution of the problem of large-scale sparse representation. It ultimately improves the robust face recognition accuracy and efficiency.

Due to the high frequency sub-bands of wavelet it can catch small details and low-frequency subband well said contour information. This paper puts forward the sparse representation of wavelet domain face recognition algorithm. Wavelet transform is used to decompose face image. The establishment of multiple frequency dictionary contains high frequency and low frequency information. The high frequency subband sparse representation and low-frequency subband has high frequency and low frequency subband by calculation under the multiple frequency dictionary to classify fitting effect. Experimental results show that even if the face image when there is a strong light expression change or a small shelter. The proposed method can accurately identify effectively to face, so as to improve the robustness of face recognition.

CONFLICT OF INTEREST

The authors confirm that this article content has no conflict of interest.

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