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The Method of Moving Target Tracking Based on 2DPCA and FLDA Face Recognition Algorithm

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Abstract

Moving object tracking technique is to find the exact location of the target in the next frame, and feedback to a tracking system for tracking and to provide an important basis and foundation for the analysis and understanding of the video sequence. Face recognition refers to the method to extract somehow be able to describe the characteristics of each individual's personality. Using 2DPCA image feature extraction, feature dimension reduction is simpler and direct, so the calculation efficiency is relatively high, and it can greatly shorten the training time of the sample collection of images. This method is the first application the 2DPCA optimal representation of characteristics for the original sample matrix, and then apply FLDA optimal discriminate feature for the original sample. The paper proposes the method of moving target tracking based on 2DPCA and FLDA face recognition algorithm.

Keywords: *Moving Target Tracking, Face Recognition, FLDA, 2DPCA*

1. Introduction

When moving target through the detection area of the camera, the image of the moving target may change dramatically, these changes are mainly from the following aspects: scale telescopic change of moving targets, moving targets by other objects or background part and completely blocked movement change of attitude and shape of the target, the light intensity changes. Become more difficult due to the existence of these cases makes detection and tracking of moving targets.

A robust, high-precision real-time moving target tracking system including complementary coupling of two parts: prediction part and the measurement section [1]. The template matching is an excellent measuring method, filtering prediction provides the initialization of a search for computing the next best candidate target position, to improve the accuracy of the track also reduces the unnecessary calculation, while matching the search results obtained the current the moment moving target state parameter information, provide for filtering values and the predicted values for the next time the value of the measurement of the amendment.

Automatic face recognition technology research began in the late 1960s, as an important based on biometric identification technology in recent years to attract from pattern recognition, image processing, computer vision, artificial intelligence, and many other fields many researchers. Face recognition refers to the method to extract somehow be able to describe the characteristics of each individual's personality, a distance metric or classification, recognition or certification of the relationship between the test face image and database storage of face images. In accordance with the different feature extraction and classification,

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face recognition algorithms can be roughly divided into two categories: the geometric characteristics of the methods and statistical methods.

One of the video moving target tracking technology as a core research topics in the field of computer vision, the main purpose is to imitate the motion sensing function of physiological visual system through the camera image sequence analysis, calculation of a moving target in each frame image on two-dimensional coordinate position, and according to different characteristic values of the consecutive frames of the same moving object in the image sequence associated, the correspondence relation between the parameter of the motion of the target in the each frame and the adjacent frame image of moving targets, moving target integrity trajectory, and a continuous video sequence corresponding to the moving target relationship, simply stated, the exact location of the target is to be found in the next frame image, and fed back to a tracking system for tracking and to provide an important basis for the analysis and understanding of the video sequence, and foundation.

The principal component analysis PCA, two-dimensional principal component analysis and Fisher linear discriminate analysis (FLDA) are face statistical pattern recognition, the most commonly used method. Although the above methods are preferably face recognition results can be obtained, but each method in the practical application and has its own limitations. This chapter For comparative analysis of these methods, given the applications and limitations of the method; then through simulation experiments comparing face recognition algorithm based on PCA, 2DPCA-based face recognition algorithm, PCA dimension reduction +the FLDA feature extraction algorithm for face recognition and 2DPCA feature dimension reduction + the FLDA feature extraction algorithm for face recognition pros and cons, and verify the comparative analysis of the results obtained by the above method. The paper proposes the method of moving target tracking based on 2DPCA and FLDA face recognition algorithm.

2. Moving Target Tracking based on Expression and Similarity Measure

Video tracking technology usually two algorithms thought: track and moving target detection by identifying targets to be tracked. The former algorithm ideas by identifying each frame of image tracking target to determine if the moving target position and tracking; the algorithm idea contains two parts of the target identification and target matching [2]. Latter by detecting and found moving target tracking algorithm ideas and determine the position of the moving target to be tracked, the method does not need to consider the shape, size of the target, any object can be detected.

Feature matching-based tracking method without considering the overall characteristics of the moving target, only to be tracked by some of the salient features of the target image. Assumed that the moving target can be characterized by a unique collection of expression, the search for the appropriate feature set on that track on the moving target, feature-based tracking algorithm lies in the characteristics of the detection and expression, as well as similarity measure, as is shown by equation1.

$$E\{\tilde{\sigma}_X^2\} = \frac{1}{N}\sum_{k=0}^{N-1} E\{(X_k - \mu_X)^2\} = \sigma_X^2 \quad (1)$$

Video tracking technology, after nearly 50 years of in-depth research and development, in a wide range of applications and development prospects of military guidance, visual navigation, security and surveillance, intelligent transportation, medical diagnosis, and meteorological analysis. Defense in modern military and civilian aspects have important research value and application prospects, such as the military aspects, the main TV tracking

and infrared tracking technology, and specific applications such as missile guidance, gun control, space flight and shooting range measurement.

When moving target through the detection area of the camera, the image of the moving target may change dramatically, these changes are mainly from four aspects: scale telescopic change of moving targets, moving targets are part of other objects or background and completely blocked movement change of attitude and shape of the target, the light intensity changes [3]. Become more difficult due to the existence of these cases makes detection and tracking of moving targets, as is shown by Figure1.

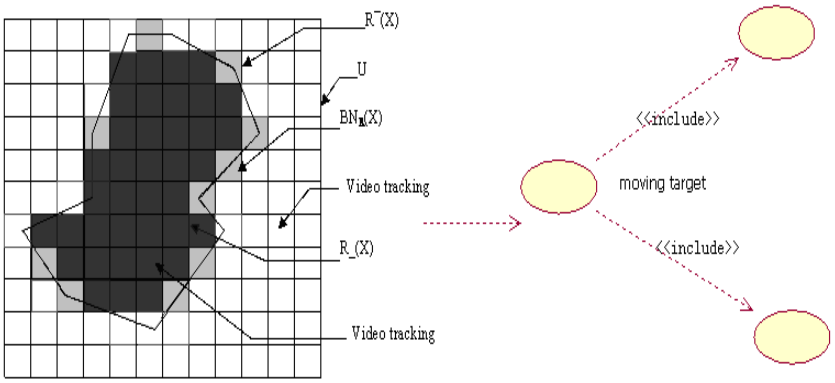

Figure 1. Video tracking technology and moving target process

Target complex motion pattern; tracking algorithm using filtering prediction algorithm, the local search in the region of the moving target may occur, when a target having a complex motion model, such as the speed or direction of the target movement suddenly changed, moving object is not to predict failure caused by a simple filtering prediction algorithm, the search area, and cause the target to be lost.

Video motion tracking algorithm is still one of the hot topics of the field of computer vision research, practical application of these complex dynamic background scale extension of the moving target object occlusion the light brightness information changes, the movements of objects in the background as well as moving targets shadows and other issues, to solve the problems in the above scene is facing a huge challenge in the field, how to improve the real-time, robustness and accuracy of the moving target tracking algorithm, is a hot and difficult of video tracking algorithm [4].

Feature-based target tracking methods take advantage of the characteristics of the location change information to track the target. The implementation of this algorithm is usually divided into three steps: the first step, feature extraction. Significantly extracted from the image sequence features, such as corners, edges, there are clearly marked region corresponding to the points, lines, curves, *etc.* Effective features to extract sensitive scale extension, and deformation and changes in brightness are still active in the field of image processing research aspects.

Region-based tracking and region-based segmentation process more closely linked, so it can take advantage of a split with tracking combined method to track. For example, Franco-area tracking method depends on the previous detection of to distinguish moving target, and then track the target. Filter tracking technology accurately estimate the regional geometry and speed. Jorge et al. Region tracking algorithm not only take advantage of the segmentation results to provide information to the trace, can also make use of the information provided by

the tracking to improve segmentation results, goals match up consecutive frames reach the purpose of tracking the target, as is shown by equation2.

$$\sigma_{\Omega}^{2} = \frac{1}{A_{\Omega}} \iint_{(x,y)\in\Omega} [(I(x,y) - \bar{I}_{\Omega}]^{2} \mathrm{d}x\mathrm{d}y \tag{2}$$

Tracking methods based on model matching is through the establishment of the model to represent the target object, the definition of a good model to achieve the goal of tracking and tracking in image sequences. For rigid target, its state of motion transform translation, rotation, *etc.*, can use this method to achieve the target tracking [5]. Tracked not only in the practical application of a rigid body there is a majority of the non-rigid body, the exact target geometry model is not easy to obtain, so you can use the deformation profile template to match to the target to be tracked.

Posteriori estimate error covariance minimum target state vector Kalman filtering in each moment, is composed of two-step prediction and correction; forecast section includes state forecast and priori estimation error covariance prediction; correction part, including the calculation of the filter gainthe predictive value of state and a posteriori error covariance and the use of filtering gain correction, calculated a posteriori state vector estimation and minimize the a posteriori error covariance, as is shown by equation 3.

$$\left.\begin{array}{c} \|x(l)\| < \delta(\varepsilon) \\ l \geq k_0 \end{array}\right\} \Rightarrow \|x(k)\| < \varepsilon \quad \forall\, k > l \tag{3}$$

Particle filter (Particle Filter), also known as Bootstrap Filter, Condensation algorithm, Sequential Monte Carlo (Sequential Monte Carlo) filtering is a research more non-linear non-Gaussian environment state estimation algorithm. Compared to the Kalman filter method, the particle filter algorithm can be considered to be a weaker target tracking algorithm suboptimal. The basic idea of the algorithm is a set of random samples with associated weights, and estimates based on these samples to represent the state of the posterior probability distribution.

The theory of image processing and analysis, the common Euclidean distance, blocks from the chessboard distance, weighted distance, Bart Charlie Asian coefficient, Hausdorff distance similarity measurement method, in which the most widely used and most simple Euclidean distance [6].

HD improved algorithm are to have the amendments to the definition of HD. Part of the HD, the first point of focus distance for all point-to-point set is obtained, then these distances ascending sort, wherein the distance of the NO that is, the part HD defined to HD.

Now target tracking method and it are an algorithm to establish the basis of robust statistical probability analysis Mean Shift algorithm. This algorithm by non-parametric estimation, the probability distribution Find a moving target along the gradient image probability density estimation method to track the target in video image [7]. The algorithm is to select the time the result of the determined object position as an initial position of the current frame image of the target.

Kalman filtering method advantages are: linear recursive filtering method can be any point initialization start recursive; small amount of calculation, and real-time calculation; forecast has no bias, stability and optimal characteristics. Which has been proposed for the development of modern control theory has made a huge contribution, first used in the field of aerospace, later in robot navigation, control, sensor data fusion, and many in the military field have been widely used. Video tracking algorithm, Kalman filtering method has also been a

very wide range of applications, primarily used to predict the location of the target the next time, as initialization starting point for measurement method matches the search elements, thereby increasing the speed of operation.

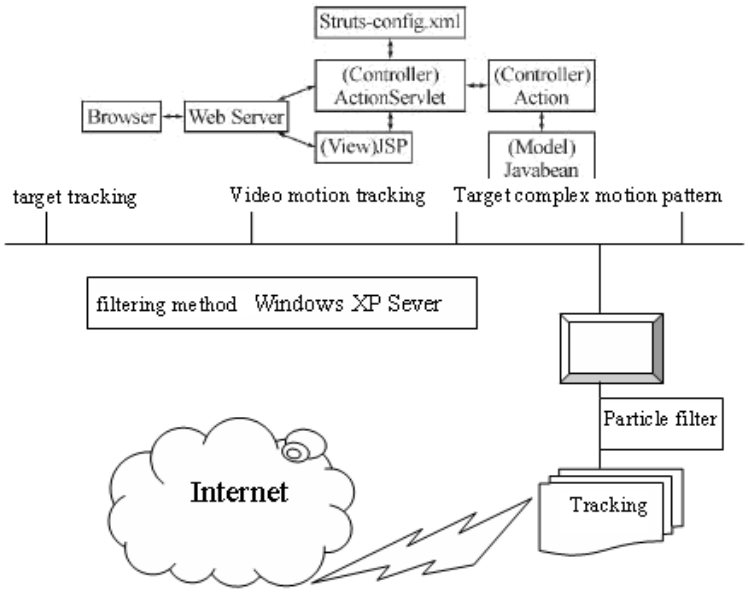

Figure 2. Particle Swarm Optimization genetic operations application

Using the Kalman filter to estimate the target movement, when the position and velocity of the system target movement With reliable estimate can be carried out in a relatively small area within the search, to complete the target of template matching, and when the target is obscured by Kalmanfilter reliably predict the trajectory of the target, can easily search targets in a specific area, and wait for the re-emergence of the target [8].

The Kalman filter has an extremely important role to improve the processing speed and performance of the tracking system. In the tracking process, due to the adjacent two images of the time interval is relatively short, the target status change in such a short time interval is relatively small, it can be assumed that the targets in the unit time interval is uniform motion, so the speed is sufficient to reflect the target movement tendency, as is shown by equation4.

$$\hat{X}_{oi}(k-1) = \sum_{j=1}^{n} \hat{X}_{j}(k-1)\mu_{j|i}(k-1) \quad (4)$$

Image registration and tracking with high matching accuracy and robustness, but the detection and extraction of the characteristics of their own often computational complexity is difficult to meet the requirements of real-time processing of the tracking system. Similar characteristics of regional statistics based on the regional statistical properties of tracking algorithm using global description of the target image, is difficult to accurately target position when the background or other target tracking algorithm will fail.

The need to keep track of each individual closed using a rectangular box; the centric of the closed box is selected as the target tracking characterized. In addition to the single characteristic to achieve the tracking can also be used a plurality of feature information together as a tracking feature, to improve tracking effect. Use of a plurality of target feature

tracking algorithm are joint. If the moving target object is simple, the entire target may be as a feature to be tracked, and this method is also referred to as template matching.

The characteristics of such a method, the moving target of the scale, deformation and changes in brightness, *etc.* is not sensitive, but is more sensitive to image blur, noise, etc. Image feature extraction effect is dependent on a variety of extraction algorithm and its parameter settings. The characteristics of the image appears to be simple, but susceptible to noise, does not apply in many circumstances. Further, the consecutive frames feature correspondence relationship is also difficult to determine, particularly when the number of features in each frame image is inconsistent, there are undetected, characterized increasing or reducing [9]. So, generally speaking, such algorithms are mainly used in texture information rich, clear structure target.

There are two types of variability models: one is a freestyle deformable model, mainly to meet a simple constraint a condition (continuity and smoothness, *etc.*) is used to track the arbitrary shape of the moving target. This method uses a parameter formula, or a modification of formula to describe the shape of an object.

3. The Research of 2DPCA and FLDA Face Recognition Algorithm

The principal component analysis originated in KL transform (Karhunen Loeve Transform) is a classic feature extraction and data representation techniques are widely used in the field of pattern recognition and computer vision. In face recognition, PCA is often for face image feature extraction and dimension reduction. First introduced KL expansion based on the principle of minimum mean square error.

Occupy the mainstream position in face recognition research in recent years a number of algorithms including: Fisher face method based on the Eigenface method of principal component analysis, based on Fisher linear discriminate analysis and neural network methods, support vector machine [10]. Eigenface method is a simple, fast, and effective face recognition method deficiency that did not take into account the reparability between different classes of image brightness and face attitude change adaptation. Fisher face method is the development of the eigenface law based on it as the theoretical basis, the subspace generated by linear discriminate analysis based on Fisher criterion the best reparability purposes, so more than enface applied to identify the problem, as is shown by equation5 [11].

$$F(x,y)=\frac{\sum_{i} w(d(x,y))I_i(x,y)}{\sum_{i} w(d(x,y))} \tag{5}$$

PCA's aim is to find an optimal set of the unit orthogonal vectors, i.e., the so-called main, so that these main shows the original vector error minimization. The specific algorithm is as follows: expand the size of a face image column formation dimensional vector, which is the number of samples. Referred to as the overall average vector of all the samples and it is the sample covariance matrix.

Converted into the number of dimensions of the one-dimensional vector in the face recognition technology, based on the PCA by the two-dimensional face image matrix is usually high and the number of dimensions of the corresponding covariance matrix is also high (orders of magnitude in the left-right), to cause an arithmetic the amount is too large, can not meet the real-time requirements of the application [12]. On the other hand, and non-linear independent, so the sample covariance matrix is likely a non-full rank, as is follows.

$$\begin{cases} p_{i,j}^{mid} = p_{i,j}^{4} + \frac{1}{4} \times (\Delta p_{i,j}^{t} - \vec{g}_{\Omega+\partial\Omega}) \\ p_{i,j}^{t+1} = (1-r)\, p_{i,j}^{t} + s p_{i,j}^{mid} \end{cases} \tag{6}$$

Based on the above theory, 2DPCA directly with the two-dimensional image data matrix to build a covariance matrix, find the eigenvalues and eigenvectors of the covariance matrix, and to build a projected coordinate system with several characteristics corresponding to the maximum value feature vectors, and then every the image matrix projector to this coordinate system, the image feature matrix.

2DPCA Unlike traditional PCA, it is a direct projection technology, *i.e.*, the sample image data matrix without prior conversion into a one-dimensional vector, sample covariance matrix can be directly built by the two-dimensional data matrix, whose dimension than the PCA Coco variance matrix to be small and easy to direct, to accurately calculate the eigenvalues and eigenvectors of the sample covariance matrix.2DPCA same optimization sample expressed as a criterion to discard the portion of the image carrying less information feature vector best reconstruction of the original image, and the use of feature vectors to be retained, so that the minimum reconstruction error, so as to achieve the image matrix characterized drop dimension or feature extraction purposes [13].

Meet divergence criterion of maximizing the total vector is called optimal projection axis, *i.e.*, the image projected on the projected sample, the total divergence enables the direction of the largest: the maximum projected on the sample image having maximum reparability [14]. The optimal projection axis is maximized normalized vector, *i.e.*, the feature vector corresponding to the maximum eigenvalue. Under normal circumstances, only one optimal projection axes is not enough, the need to select a set of mutually orthogonal, and takes the maximum value vector, and this vector is exactly previous largest eigenvalue corresponds to a normalized feature vector, as is shown by Figure 3.

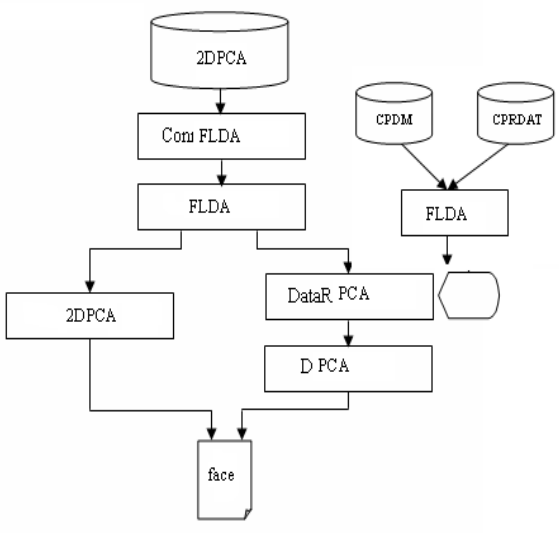

Figure 3. The 2DPCA and traditional PCA with FLDA algorithm analysis

Linear discriminate analysis to make sample reparability best for the target, compared with PCA is optimal, said the guidelines, linear discriminate analysis applies to the pattern

recognition problem. The research in this area began in RA Fisher's classic paper, the classical linear discriminated analysis is also known as the Fisher linear discriminate analysis (Fisher's Linear Discriminated Analysis / FLDA).

On this basis, obtained by FLDA, the optimal discriminate characteristics of the original sample, and face recognition. But the complexity of the method of calculation is relatively large, the corresponding calculation time is long, can not meet the requirements of real-time image processing. 2DPCA using two-dimensional matrix can be directly constructed covariance matrix, the smaller the resulting covariance matrix, and the calculation time, so this article that 2DPCA and FLDA combination of face recognition algorithm taking into account the (2DPCA & FLDA) is a more effective method. The specific approach is: first application the 2DPCA optimal representation of characteristics for the original sample matrix, and then apply FLDA optimal discriminate feature for the original sample.

The nearest neighbor method is one of the most important methods in nonparametric method of pattern recognition, this chapter also using it as face recognition classifier. The method is to determine the unknown sample and its nearest sample belonging to the same by comparing the unknown sample and all known Euclidean distance category between samples.

Its main element is a vector of 2DPCA, they constitute each sample matrix are not vectors. This section first gives the definition of the distance matrix between the unknown samples and known samples. Any given two feature matrixes, defined as the distance.

Affected by the change of illumination and occlusion serious geometric feature extraction, and geometric characteristics susceptible to the impact of gesture and facial expression changes, the stability is not high, resulting in the algorithm of recognition accuracy rate is not high. The template matching method by comparing the test sample and the standard template, according to the setting of the evaluation function, given the similarity measure. This method of calculation of the amount of addition to illumination, expression, image translation, rotation and scaling can also seriously affect the calculation of cross-correlation template matching, thus affecting the accuracy of identification, as is shown by equation7.

$$Z = \begin{bmatrix} \frac{\partial I}{\partial x} \\ \frac{\partial I}{\partial y} \end{bmatrix} \begin{bmatrix} \frac{\partial I}{\partial x} & \frac{\partial I}{\partial y} \end{bmatrix} = \begin{bmatrix} g_x^2 & g_x \cdot g_y \\ g_x \cdot g_y & g_y^2 \end{bmatrix} \tag{7}$$

Zhang this vector into a sub-space, and the sample vector of the face image of a person to this sub-space projection, the formation of the projected component (under normal circumstances, according to the image represented by the optimization criterion to determine).Dimensional vectors called constituted by the projected component of the image feature vector, as the basis of face recognition, so that put the face image vector reduced from the original dimension to a dimension.

SVD technique, usually, singular value there is always some small enough to be ignored, but almost not bring what error value, so SVD is often used for image compression. The entire image is compressed into a diagonal elements, but for each piece of the compressed image, and is unique and therefore be able to reconstruct the image. While this chapter is based on the above derivation using matrix eigenvalue and its corresponding eigenvector are seeking phalanx eigenvectors.

Thereby to obtain a one-dimensional projection vector, it is referred to as an image in the projection direction of the projection of feature vectors. In fact, the introductions of a total divergence of the projected samples are to measure the discriminate ability of the projection

of the direction of the sample. Projection sample total divergence trace of the covariance matrix of the vector projection characteristics to describe.

4. Moving Target Tracking based on 2DPCA and FLDA Face Recognition Algorithm

Video tracking technology, the integration of image processing, advanced technology and core ideas in many areas of pattern recognition, artificial intelligence, automatic control and computer. Video tracking system, compared to the conventional radar systems, the use of relatively inexpensive equipment, such as camera and the optical system, and is a passive operating mode, the work does not outwardly radiate radio waves, the enemy's electronic surveillance equipment can not easily be found, and therefore have a more high price, certain degree of secrecy and resistance to electronic interference [15].

Part of the moving target and completely blocked; blocked between background occlusion of the target, and the target is a problem in the video tracking system, blocking is one of the important reasons causing the target image expression suddenly change, and this change has suddenly and continuity, which is easy to cause the failure of the tracking algorithm, as is shown by equation8.

$$\begin{cases} C_{j,k,m} = \sum_{l,n} \bar{h}_{l-2k} \bar{h}_{n-2m} C_{j+1,l,n} \\ D^1_{j,k,m} = \sum_{l,n} \bar{h}_{l-2k} \bar{g}_{n-2m} C_{j+1,l,n} \\ D^2_{j,k,m} = \sum_{l,n} \bar{g}_{l-2k} \bar{h}_{n-2m} C_{j+1,l,n} \\ D^3_{j,k,m} = \sum_{l,n} \bar{g}_{l-2k} \bar{g}_{n-2m} C_{j+1,l,n} \end{cases} \tag{8}$$

2DPCA for image feature extraction or feature dimension reduction is simpler and direct, computational efficiency is relatively high, it can greatly shorten the training time of the sample collection of images from the algorithm. Inadequacies 2DPCA image feature extraction matrix requires a relatively large storage space.

Actual application, how to improve, robustness and accuracy of real-time moving target tracking algorithm, to solve the problems in the above scene is a moving target tracking algorithm research focus, is also a huge challenge facing the field.

The basic principle of measurement is a moving target template image, in the image sequence search to find the best matching position, according to a certain similarity measure which matches the search strategy is a key issue. If the traversal searches the entire frame image, the computational complexity is very large, and there is no need. Able to predict in advance the position of the moving target, you can match smaller forecast neighborhood search, measurement and filtering prediction of moving target matching is a good method to calculate the best candidate target location, as is shown by equation 9.

$$\mu_i(k) = P\{m_i(k) \mid Z(k)\} = \frac{f_i(k)\sum_{j=1}^{n} \pi_{ji} \mu_j(k-1)}{\sum_{i=1}^{n} f_i(k)\sum_{j=1}^{n} \pi_{ji} \mu_j(k-1)} \tag{9}$$

In order to verify the characteristics of the of 2DPCA and FLDA algorithm summarized in face recognition applications, but also in order to compare Based on PCA, 2DPCA, the PCA & FLDA and 2DCPA & FLDA the Face Recognition Method in run time and recognition rate

on the pros and cons of this paper were simulation, gray-scale image of the gallery, including 1000 individuals (s2 ~ s850), the size of each image is 522 × 852 pixels, each 20, a total of 2,000 face images, which in many people's image posture, facial expressions as well as facial occlusion (hair, glasses, *etc.*) have different degrees of change. The experimental simulation environment the P4, frequency 3.8GHZ, Memory 2G personal computer, matlab6.5 programming, as is shown by Figure 4.

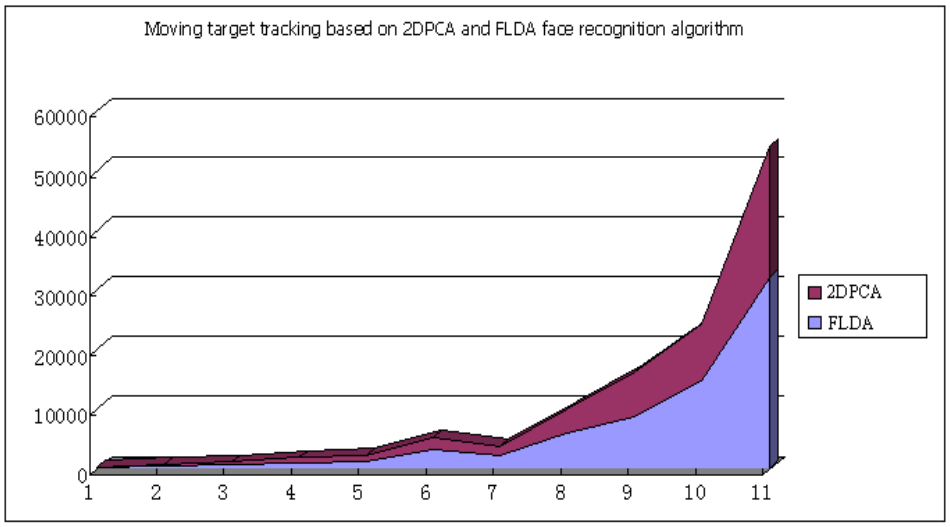

Figure 4. Compare of mechanism of moving target tracking based on 2DPCA and FLDA face recognition algorithm

The paper proposes the method of moving target tracking based on 2DPCA and FLDA face recognition algorithm. Using PCA and PCA & FLDA algorithm to get the each piece of the image of the characteristic vector is a one-dimensional vector, equal to used to the number of sheets into the characteristics of sub-space of the base vector of, in the experiment values obtained respectively for 654 and 852; while 2DPCA and 2DPCA & FLDA algorithm the characteristics of each image matrix size for 8521, of which 100 2DPCA algorithm to extract the main element number, therefore they need for storing feature matrix is much larger storage space than the former, and this also led to the two the images in the test time in the algorithm is slightly greater than the test time in the former.

Video tracking algorithm based on tracking the target expression and similarity measure can be roughly divided into: contour-based tracking algorithm, feature-based tracking algorithm, based on the regional statistical properties of the tracking algorithm and model-based tracking algorithm. Target segmentation and edge extraction, contour-based tracking algorithm to achieve tracking of a moving target, but when the target was part and totally obscuring tracking algorithm is much more restricted.

5. Conclusions

Moving target tracking algorithms can be divided into four categories: contour-based methods, feature-based approach, the method based on the statistical characteristics of the area and the model-based approach. Tracking algorithm accuracy and robustness of expression and the definition of the similarity measure depends largely on the moving target; real-time tracking algorithm depends on matching the search strategy and filtering prediction

algorithm. The paper proposes the method of moving target tracking based on 2DPCA and FLDA face recognition algorithm. 2DPCA for image dimensionality reduction is simple and direct, high computational efficiency advantages and of FLDA can maximize sample reparability of the advantages of combined 2DPCA & FLDA-based face recognition algorithm; the recognition time is short and the higher accuracy rate.

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"Application of fuzzy classification system based on simulated annealing in data mining", Computer Engineering and Design, Beijing, vol. 31, pp. 3483–3486, August 2010.

"Research of the Tracing Interpretation of the Three-Dimensional Interactive Layers of Seismic Data", Computer Engineering & Science. Changsha, vol. 32, pp. 77–79, October 2010.

