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The Novel Method of Moving Target Tracking Eyes Location based on SIFT Feature Matching and Gabor Wavelet Algorithm

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Abstract: SIFT is a scale and rotation invariant feature point extraction algorithm, and it has a high robustness of local feature representation. SIFT expression method is based on the detection of multi-scale extreme points of the difference of Gaussian image pyramid and gradient direction. This article describes a face based on Gabor wavelet transform facial area, and it is depression terrain feature points extracted directly from the gray-scale image. The paper presents the novel method of Moving target tracking Eyes Location based on SIFT feature matching and Gabor wavelet algorithm. This method is not sensitive to noise, in real-time positioning and accuracy has greatly improved. Simulation results validate the effectiveness of the proposed algorithm. *Copyright © 2013 IFSA.*

Keywords: Gabor wavelet, Moving object tracking, Scale-invariant feature transform (SIFT).

1. Introduction

Target tracking has a wide range of applications in terms of guidance, navigation, and security monitoring. With the popularity of digital technology, the video moving target tracking has become one of the hot spots of the research in the field of computer vision, and has important application value. Video object tracking problem itself a collection of image processing, pattern recognition, artificial intelligence, automatic control technology, and many other areas of technology, has a good theoretical significance.

The video of moving target tracking means by calculating a moving target in each frame, the position, velocity and other state information and status information between the image frames corresponding to and matching relationship to characterize the target trajectory and the movement trend. In general, target tracking problem contains two parts of the "measured" and "forecast", but sometimes tracking algorithm will only include the "measured" and without "predict" section. The measurement target template and candidate region matching process can be seen as "forecast" for target motion parameter estimates. Target motion "forecast" There are many ways and framework, the Kalman filter is a simple and effective traditional methods. Particle filters method based on a probabilistic framework to get the attention of the researchers.

Face grayscale image corresponding three-dimensional topographic map, here in the center of the pupil shows the topographical features of "depression". This article is as the basis of the

detection of the human eye, of a human eye positioning algorithm (PTL). Although the method can solve the problems of the human eye positioning in the complex background and face attitude changes, high positioning accuracy, but there are some limitations: the original image is converted to a terrain feature maps need to calculate, to judge each of the original image. A point belongs topographical features, computationally intensive, real-time positioning algorithm. Meet the candidates "depression" the conditions of the terrain features focus on a whole lot of face images search, the search range is too large, and the candidate focus more, so to filter out the real eye position consuming more long, which also restricted the real-time nature of the algorithm.

Scale extension problem from the point of view of "measured" considering proposing a tracking algorithm based on gray histogram matching histogram reflects the gray level distribution characteristics to solve the moving target scale change in the proportion of telescopic Robust Tracking [1]. However, due to the histogram does not reflect the structure of the target information, so when a scene with the target gradation information will cause tracking algorithm consistent failure. Robust tracking of non-rigid object tracking system in the case of deformed and rotating the difficulties in the field of video moving target tracking, and one of the hot issues.

The purpose of this research is to solve partial occlusions and scale extension of video tracking of moving targets for video tracking in typical application scenarios, achieved tracking accuracy as high as possible, therefore, designed based on SIFT (Scale-Invariant Feature Transform) feature point matching measurement target tracking algorithm.

The method makes full use of the basic physiological characteristics of the human eye; the retina for different wavelengths of infrared light can be the different amount of reflection to make the obtained image to highlight the location of the pupil, for positioning the eye. The advantage of this method is that its accuracy and robustness, but it requires special hardware support for the camera with infrared light source, the depth of the rotation of the head, the face and the distance of the camera and external light is quite sensitive in false detection rate in the outdoor environment will increase.

This paper begins with the image processing algorithm described in detail; then introduce the face facial area based on Gabor wavelet transform extracted directly from the gray-scale image "depression" terrain feature points, as well as verify the candidate eye on whether eye for real people on the symmetric similarity analysis; Finally, the experimental results of comparative simulation algorithm in the AT & T face database.

Solve the target occlusion method is roughly divided into two categories: Merge-Split (MS) methods and Straight-Through (ST) method. Robust Tracking MS method through a series of create, delete, merge and split operators, merge or split the operations of the target area under occlusion, moving target; ST method is not sensitive to the characteristics of occlusion by direct extraction of target regional track, does not require a complex merger and division operations. Two types of detection methods rely on target occlusion. The paper presents the novel method of Moving target tracking Eyes Location based on SIFT feature matching and Gabor wavelet algorithm.

2. SIFT Feature Point Extraction and Similarity

The SIFT is D. Lowe a scale and rotation invariant feature point extraction algorithm, local features of a high robustness representation essence detection and gradient-based multi-scale extreme points of the difference of Gaussian image pyramid direction of expression, has a high matching accuracy and robustness, mainly for image registration based image retrieval, face tracking. The SIFT having scale retractable Invariance and rotation invariance, and in the case of a certain extent, the affine transformation, the different angle, ambient noise, light intensity change having a high matching precision.

Mean-Shift algorithm is very simple and beautiful; the convergence condition is very relaxed. Just make sure you track the target, the whole tracking process without additional parameter input. Unlike the usual optimization methods, Mean-Shift every step of the probability density is estimated to grow, with excellent stability [2]. By eliminating the need to estimate the density distribution, you can directly search for local maxima along the gradient direction, greatly reducing the amount of computation, this algorithm has good real-time video tracking algorithm development, and thus represents the Mean-Shift-based optimization algorithm level has been widespread concern in the computer vision community.

Moving target tracking algorithm prediction algorithm of Kalman filtering, extended Kalman filter and particle filter algorithm analysis, mainly in the classical linear system is a minimum estimate of the Kalman filter, the mean square error of nonlinear extended Kalman filter algorithm and particle filtering algorithm, as is shown by equation (1).

$$\hat{X}_i(k \mid k-1) = F(k-1)\hat{X}_i(k-1 \mid k-1) \quad (1)$$

SIFT corner has the following advantages: 1) In space and frequency domain have a very good the positioning effect and accuracy, reduce the impact of object occlusion, complex scenes, as well as noise, particularly important for moving target tracking; 2) Have a high good matching efficiency, the feature point can be distinguished, even retained rarely characteristic point of the image also has a high probability of correct match; 3) based on the

structure of the multi-scale image of the pyramid, the calculation of the feature points is greatly reduced.

The value of each component of each feature point by the direction of the gradient of the adjacent sub-blocks histogram, position information, and scale information and the main direction, wherein the size of each sub-block is the pixel, the gradient orientation histogram is characterized the point in the neighborhood of all the pixels in the direction component of the gradient magnitude and a direction corresponding to the peak of the gradient orientation histogram is set for the main direction of the feature point candidate [3]. Histogram component of the direction of the gradient of the characteristic point is with respect to the main direction of the feature point relative amount, when the moving target is rotated, the direction of the goal of the SIFT feature point histogram component is relatively constant, therefore, the SIFT feature point has a certain rotational invariance, as is shown by Fig. 1.

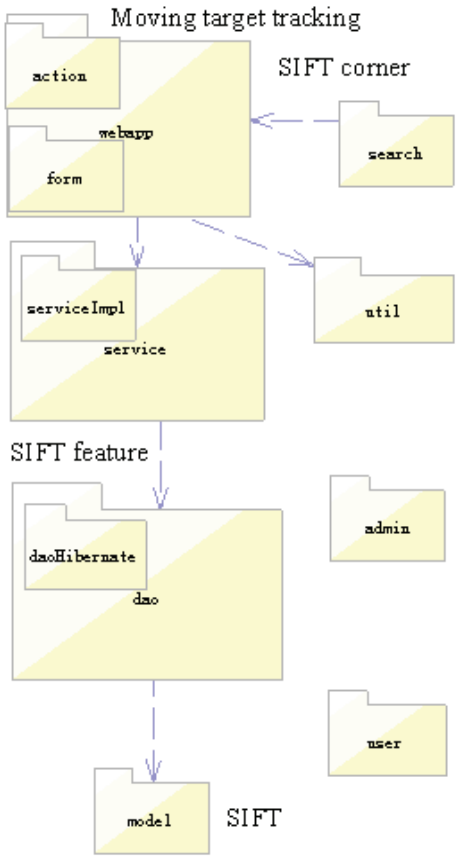

Fig. 1. Moving target tracking algorithm based on SIFT figure.

Moving target tracking process continuity and gradual change, the feature point matching similarity measure can also refer to the feature point position, scale, and other information, including an important basis of the scale information or target template update strategy target template update strategy Next project focus of the study. Euclidean distance as a similarity measure using direction histogram feature points in the tracking experiment has been better tracking results are discussed in detail in the experimental analysis section.

Mean-Shift algorithm for video tracking have several advantages: First, the algorithm computes real-time tracking can be done entirely in the target area known; Secondly, as a non-parametric density estimation algorithm easily as an integrated modules and other algorithms; then the kernel function histogram modeling, partial occlusion, target rotation, deformation and background motion sensitive. However, it also has shortcomings, such as: the lack of the necessary template update algorithm, window width size of the whole tracking process remains the same, when the target scale changes may track failed; color histogram is a relatively common target feature descriptor, when the background and objectives similar to the color histogram tracking algorithm ineffective; Mean-Shift algorithm is locally optimal optimization algorithm, when multiple local peak, the algorithm may converge to local optima excellent value tracking algorithm failure.

SIFT is essentially expressed by the extreme points of the multi-scale Gaussian image detection and gradient orientation histogram of two parts [4]. The calculation method described below original image the operator after the Gauss operator and DoG (Difference of Gauss) were obtained multi-scale Gaussian pyramid image and DoG image, as is shown by equation (2).

$$E\left\{x(t_i)x^H(t_j)\right\}=(A(\theta)R_S A^H(\theta)+\sigma^2 I)\delta_{ij} \quad (2)$$

The algorithm in the Kalman filter prediction improved framework SIFT feature extraction has many invariance advantages, the use of improved matching algorithm to calculate the candidate target the precise location of the feature points, the motion vector of the feature point cluster analysis to effectively eliminate noise interference, false matches interactive template update strategy to efficiently update the target template. The large number of experiments is on the public test sequences show that the algorithm can effectively solve partial occlusion problems, scale retractable problem, scenes the light brightness change issues and non-rigid object rotation, moving object tracking in video.

On the input image, the operator is in the scale by a group of the composition of the Gaussian kernel Gaussian filter is obtained by the formula (3) after a set of filter, the Gaussian image; wherein; use DoG operator calculated by the equation (3) the group of the scale Gaussian image of the adjacent images dog image.

Moving target tracking system based on Kalman filter consists of two parts: prediction and measurement. Prediction for the next time target detection to provide a measurement of the initial position, both to improve the accuracy of the tracking and also reducing the amount of computation;

measurement purpose is to obtain this moment the precise target status information, to provide correction for the next prediction foundation. Since the video of adjacent two of the time interval is very short, and the target motion is continuously changing, so you can use the history of the measurement information to predict the target position in the next frame image.

The filter gain is the tradeoff of prediction and measurement. Equivalent measurement precision should increase the Kalman gain, reduce the Kalman gain and vice versa. Too much reliance on historical measurements, Kalman gain is reduced filtering lost cause after a certain period of time, the improved algorithm adds a gradual elimination factor, reduce the impact of historical measurement, and increase in newly measurement data for traditional Kalman filtering in the role of the filter. Covariance equation is for predicting the improved Kalman filtering.

$$\begin{cases} \Delta p = \vec{g}_{\Omega+\partial\Omega} & on \quad \Omega \\ p\,|_{G+\partial G} = q\,|_{\Omega+\partial\Omega} & on \quad \partial\Omega \end{cases} \tag{3}$$

Step 1) to obtain a set of Gaussian image extraction, in multi-scale space Gaussian image on the new scale, repeat steps; 2) calculate a set of scales the DoG images. Calculated each scale, the scale space DoGa feature point of the image, wherein the feature point scale DoG images 26 of the extreme points of the neighborhood; each feature point by the composition, respectively, said orientation histogram of a feature point of the window, the position information, scaling information and the main direction..

Actual 3D physical knowledge of the target machine learning methods, not just the target image tracking algorithm based on the model, information model, 3D model-based tracking algorithm is perfect, but no a priori knowledge of the actual tracking system. It is difficult to obtain the model of the target of interest. Having scale stretching, rotation invariance of the feature points (such as the SIFT, KLT, Harris Corners, SUSAN Corners, etc.), by extracting a feature-based tracking algorithm to solve the problem of scale stretching and partial occlusion, SIFT D. Lowe proposed the species has a scale and rotation invariant feature point extraction algorithm based multiscale image pyramid extreme point detection and gradient direction histogram indicates.

Best candidate of the feature point matching a feature point of the target template based on the similarity measure of the feature point is calculated in each frame image, matching feature points of these candidate contains the direction histogram, information such as the position, scale, and the main direction, the feature points of the same target having the consistency of the motion information, thus using the consistency of the information of the feature point motion clustering algorithm, to obtain a more robust moving target status information.

Bass vile et al first recognized in it in the importance of family tree. (a) It is pointed out that the wavelet coefficient of the signal, (b) directly in the tree is defined on the process generates a system theory [5]. Note is made of a tree provides the signal representation framework to map to be flexible. For example, it can be applied to a higher dimensional tree (to the signal he is defined in a multi-dimensional space, for example, time, and space coordinate), the tree may be asymmetry can also be a general outline [6]. This flexibility can and signal components in the special multi-scale structure matching. The multi-scale process model to estimate and control research, family tree and its translation will play a very important role, in the next section we will summarize the main definitions, as well as in the subsequent sections using these characteristics.

The test video to be used in this experiment to track the target non-rigid body, and it is the entire tracking process constantly moving target deformation and rotation as well as a significant scale-down. First calculated interested in moving target template SIFT feature points, and then calculate the best prediction of the target area in each frame in the framework of the Kalman filter prediction SIFT feature points, as is shown by equation 4.

$$W_f(a,b) = |a|^{\frac{1}{2}} \int_R f(t)\overline{\psi}(\frac{t-b}{a})dt \tag{4}$$

SIFT feature point scale extension and rotation invariant, and has high matching rate in a different perspective, the changes in the brightness of the light, the ambient noise. Rotation, deformation and significant scale changes in parts and completely blocked and the brightness of the light changes and other complex scenes of the video sequence is proposed in this paper based on SIFT feature matching and Kalman filtering the movement target tracking algorithm in moving target accompanied experiment experimental results show that the proposed algorithm is robust tracking algorithm.

Image scale space adjacent scale Gaussian filtered image and the difference image, this method is a Gaussian image of a set of scales for coefficients of the Gaussian kernel. The eight neighborhood calculating scale DoG image pixels in the current scale image and the neighborhood adjacent DoG images and whether local extreme point, and if it is extreme points put the pixel as a candidate on the scale of the image feature point.

3. The Eye Positioning Method Based on Gabor Wavelet

Physiological characteristics or behavioral traits inherent in using computer technology, and the determination of the individual comprehensive

comparison of data pre-stored in the database, in order to achieve the personally identifiable automation technology is called biometrics. The biometric typically including the retina, iris, fingerprints, palm prints, voice, face like (including the eyes, nose and mouth), such as handwriting, gait. These characteristics due to the uniqueness and invariance, and is closely related with the personal, non-separable, so personal identification (such as security monitoring system based on face recognition) and non-verbal human-computer interaction (such as driver fatigue monitoring system) has been widely used. Which compared with the nose, mouth and other people face pieces, and eyes richer area contains important information for individual distinction.

The gray value in the digital gray image is stored in the computer as a height value corresponding to the coordinate point in the topographic data, the 2-dimensional gray-scale image can be represented as a three-dimensional topographic surface view.

To improve the real-time based on topography human eye positioning, the ability to make use of some kind of transformation, and it is a rough positioning "facial area" where the human eye; then the precise positioning of the human eye "facial area". This can narrow the search range of the eye point of the candidate, and to reduce the number of candidate points of the human eye, and can reduce the computational burden, improve the system in real time, to a certain extent, as is shown by equation 5.

$$I = -\sum_{t=0}^{T} q(t)\log q(t) - (-\sum_{t=0}^{T} p(t)\log p(t)) \quad (5)$$

Gabor filters having a band pass characteristic. If the face image of a certain frequency range, and Gabor filter pass band match, then the filter output value will be large; whereas if they do not coincide, and its output will be inhibited [7]. Therefore, it is possible to by the selection and the frequency of the facial area and direction consistent with the Gabor filter parameters, so that after filtering highlight interest in the output image of the facial area, while the other regions is suppressed.

The Gabor transform kernel can be seen is the mother wavelet parameters scale transformation and rotation transformation, these transformations nuclear self-similar. Each transform kernel is a Gaussian envelope function and the product of a complex plane wave. The square brackets in the formula (5) the first decision Transform Nuclear oscillation portion, the second term is a direct current (DC) value Transform Nuclear. DC value such that the filter response can be more independent of the absolute brightness of the image portion to improve its performance. When the value is large enough, DC can be negligible.

Taking into account a priori knowledge of the human face structure, facial area located in the upper part of the face image, and therefore between the image and for the gradation integral projection in the horizontal and the vertical direction. In the facial region of high gradation value causes vertical gray projection curve having a certain width of the hump, the location of the left and right borders of the convex peaks represent roughly face the left and right border position, i.e. the rising edge of the gradient value of the convex peaks is formed the largest point as the left margin of the facial region, convex gradient of the falling edge of the peak value of the minimum point as the right boundary of the facial region.

The expansion operation is the basis of the morphological processing, which is defined: structural elements translational obtained after, if hit, we note of this point, the new set of all points satisfying the above conditions is referred to as a result of expansion. Expressed is by the formula.

$$f_{SML}\{x_1,\cdots,x_L\} = \prod_{i=1}^{L} \frac{1}{\pi^M \det\{R\}} \exp(x_i^H R^{-1} x_i) \quad (6)$$

The main orthogonal element is defined as a point in the horizontal / vertical direction or in a right angle / left angle direction on two neighboring pixels. If the gradient of the derivative values take the minimum value in the direction corresponding to the value of the gradient of the neighboring pixels of the pixel 2 is monotonic increase or monotonic decrease, then the main orthogonal main elements rotated in the direction of curvature the neighbor pixel in the resultant direction of the .Otherwise, the main orthogonal elements are in the main the curvature direction the neighborhood pixels.

In order to test of GTEL method and PTL sensitivity to the effects of noise, this chapter also conducted the following experiment. Five randomly selected from the AT & T face database two pupils of the eye can be seen, there is no obstacles eye and without noise hominid face image, and then superimposed on the specific type of in five primitive people on the face image noise (such as: a mean of 0 and variance 0.02 Gaussian noise), get face image noise.

After selection of the human eye candidate points from these candidate points, the next step is to determine the location of the human eye. Hough transform method, template matching, the circular frequency filtering method and similarity analysis method commonly used method. Wherein the symmetric similarity analysis method is simple to implement and high accuracy is widely used on the judgment of the similarity of the two objects, so this article on the use of this method is accurate positioning of the eyes position.

Using GTEL method can accurately locate the facial features on the face image region, and the detected candidate eye points far less than the eye points of candidate's detected PTL method. This greatly reduces the number of candidates eye, saving the time required for the precise positioning of the

human eye, the candidates' eyes on the similarity analysis, real-time. Lists using the GTEL methods and PTL method S1, S2, S3, S4, S5 accurately are positioning the human eye the required time.

This chapter uses the Gabor wavelet transform, direct detection of "depression" terrain feature points and symmetrical similarity analysis, an improved fast the human eye positioning. Compared to the human eye in the text positioning method, this method is not sensitive to noise, in real-time positioning and accuracy has greatly improved.

The regional segmentation method first binary image of the face region segmentation the course positioning the eyes, and then set a range of experience and support functions. Less effective methods such as human eyes closed, wearing glasses positioning [8]. Hough transform method first face image edge extraction, then use Hough transform to detect eye structure including eye, eyelid eye template to identify the eyelid with a series of functions from the energy point of view [9]. The need to do a lot of pretreatment parameters excessive eye template does not apply to individual differences too faces. Gray projection method on the face images of the horizontal and vertical direction of the projection, according to the crests and troughs of the distribution information to locate the eyes, as is shown by Fig. 2.

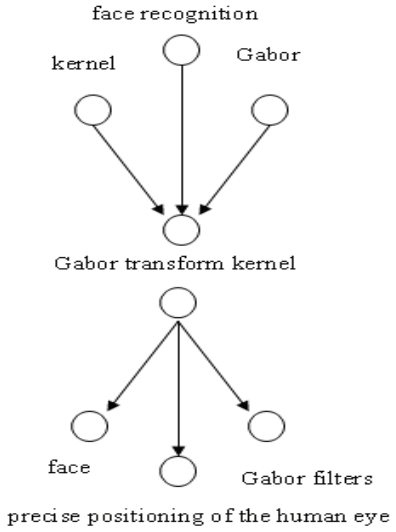

Fig. 2. Precise positioning of the human eye based on Gabor wavelet and radial symmetry operator figure.

Gabor wavelet and radial symmetry operator combining facial area can be in the form of a high-brightness display modality image convolution face images with Gabor wavelet kernel function, which provides a draw for us to solve real-time problems. The key to the human eye localization algorithm based on topography is to solving more sensitive to noise Hessen matrix [10]. If you can evade the Hessen matrix calculation directly terrain features can be extracted from the grayscale image resolution algorithm is sensitive to noise problems, to improve the accuracy of the positioning.

Mathematical morphology is based on the shape of the set theory, some operations by the interaction of objects and structural elements, the form of objects; more essentially, its main purpose is to get the information of the shape and structure of an object [11]. In the image processing in the main application that is: (1) the use of the morphology of the basic operations, the image observation and processing, so as to achieve the purpose of improving the image quality; (2) extracted from an image is useful for expression and reformation region shape the image components, such as the border area, skeleton, connectivity and convex hull. Image processing using mathematical morphology operators do not need to calculate the local features of each point, the method is simple, fast, and strong anti-noise ability [12].

Main curvature direction and the zero-crossing point, a direct method to extract characters from the character grayscale image topographical features, which we solve the sensitivity problem provides a draw. Based on this idea, we will combine the Gabor wavelet and direct extraction of topographic features a Gabor wavelet and topographical features of the human eye localization algorithm (GTEL).

After selection of the human eye candidate points from these candidate points, the next step is to determine the location of the human eye. Hough transform method, template matching, the circular frequency filtering method and similarity analysis method commonly used method [13]. Wherein the symmetric similarity analysis method is simple to implement and high accuracy, is widely used on the judgment of the similarity of the two objects, so this article on the use of this method is accurate positioning of the eyes position. Will be detected by the human eye candidate point combination of two, forming a pair of candidate eyes all candidate eyes application symmetric similarity analysis determined based on the size of the correlation coefficient from real eyes on, as is shown by equation 7.

$$\begin{cases} p_{i,j}^{mid} = p_{i,j}^{4} + \dfrac{1}{4} \times (\Delta p_{i,j}^{t} - \vec{g}_{\Omega+\partial\Omega}) \\ p_{i,j}^{t+1} = (1-r)\, p_{i,j}^{t} + s p_{i,j}^{mid} \end{cases} \tag{7}$$

Positioning speed of this method is faster, but the peaks and troughs of the distribution is very sensitive to changes in face and posture, the positioning accuracy is poor, and is easy to fall into the local minimum result of the failure to locate. The template matching method is a common eye location method, we must first obtain the left eye and the right eye template, the template can be constructed under the eyes parameters can also be selected from the face database, then the left eye template and right eye respectively matching template in the image,

respectively, obtained from two of the biggest similarity points as the positioning of the eyes, this method is easy to use, does not require a large amount of a priori information, but the large amount of calculation, can not simultaneously achieve binocular positioning results also tend can only be targeted to one eye.

The need to do a lot of pretreatment parameters excessive eye template does not apply to individual differences too faces. Gray projection method on the face images of the horizontal and vertical direction of the projection, according to the crests and troughs of the distribution information to locate the eyes. Positioning speed of this method is faster, but the peaks and troughs of the distribution is very sensitive to changes in face and posture, the positioning accuracy is poor, and is easy to fall into the local minimum result of the failure to locate.

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Color images of the human eye positioning commonly used coarse-to-fine strategy, that is first of all based on the color information from the background image split the face region, then the corresponding gray image in the face region within the integrated use of geometric features integral projection edge detection, template matching technique to further locate the precise position of the eyes. The details of the image in the background, the angle of inclination of the human face, the angle of rotation, and scale changes, such methods with a certain degree of adaptability, more suited to the more than the human eye detection and localization problem.

$$E[(X(k)-G(k))^2]=E\left[\left\{X(k)-\frac{\sum_{i=1}^{N}u_iZ_i(k)}{\sum_{i=1}^{N}u_i}\right\}^2\right] \quad (8)$$

Obtained by the method using GTEL little change in the number of eye point candidates; using PTL method, on the added noise of the face image detected by the candidate eye point far more than the number of detected face images of no noise to the number of candidate points. This is because the terrain features in the GTEL method of direct extraction, the only use of the symbol information of the pixel point of the second derivative values, and the symbol information by the noise is not obvious, therefore detected by the human eye candidate point by noise nor obvious; PTL method is more sensitive to noise [14]. With the introduction of the noise because the human eye is used in determining the topographical features of the pixel point for noise sensitive second derivative of the value, resulting in the detected candidate point greatly increased.

Precise positioning of the human eye based on the Hough transform circle detection method, first detected integral projection method to the approximate location of the pupil of the eye, the human eye coarse positioning; then Sobel edge detection operator to extract image edge information, and then using the Hough transform circle detection sure the binocular precise location. The method is suitable for the eye positioning of the frontal face image, but the robustness and real-time poor, as is shown by equation 9.

$$F(\phi,\theta;\phi_0,\theta_0)=\sum_{n=0}^{N-1}A_n e^{j\kappa R[\cos(\phi_0-\phi_n)\sin\theta_0-\cos(\phi-\phi_n)\sin\theta]} \quad (9)$$

Wavelet transform technique to the human eye positioning, first distribution of the color and grayscale information is divided in the face image by the face region; same time, the multi-scale sub-image of the face region obtained after wavelet decomposition by edge distribution information to find the rough area of the human eye; then in the find the eye where the blocks, and thus determines the position of the eyes the low scale sub-picture in accordance with certain principles of the position and size. This method is not sensitive to light, but the selected wavelet parameters can not be selected automatically according to the actual situation, which hampered the performance of the algorithm.

Using different scales, different directions of the Gabor filter to extract the image feature, and then through the frequency and direction of the facial region of choice with human face consistent with the Gabor filter parameters, so that the filtered output image, the highlight of the facial features of interest areas, other regional information is suppressed.

This paper calculated Hessen matrix requires the solution of the second derivative; the second derivative is very sensitive to noise [15]. Therefore, based on the topographic characteristics of the human eye localization algorithm to deal face image deposing smoothing requirements, otherwise it will seriously affect the subsequent detection and localization accuracy, as is shown by equation 10.

$$dist=\sqrt{\sum_{m=1}^{n}[F(h_i)_m-F(T_j)_m]^2} \quad (10)$$

The point in the computer stored digital grayscale image gray value as the height of the topographic data corresponding to the coordinate point value, then the 2-dimensional gray-scale image can be represented as a three-dimensional terrain surface shown. Wherein a local facial features of the face image area portion, and it is three-dimensional terrain

surface after inversion corresponding Fig 2. It can be seen from the figure, a relatively high portion of the dark pupil portion in the facial area and its surrounding gray value in the topographic data were expressed as "depression" the topography of the terrain and the "hill", "depression" topographical feature points is to detection of the human eye candidate point. Note that the definition of the topographic features is limited in a continuous three-dimensional surface within the scope of, but can be computer processed digital image is the number of discrete points, the topographical features in order to extract the digital image.

4. Moving Target Tracking Eyes Location based on SIFT Feature Matching and Gabor Wavelet Algorithm

The image processing usually extracted edge point or corner point as characteristics to perform target identification, tracking and pattern analysis, the angle point of the image color information change significantly with the edge of the intersection or the image of the intensity information in the horizontal and vertical directions are changes significantly with the point.

Eye template traditional template matching method robustness and sensitivity on the left and right eye problem, the proposed method based on fuzzy classification template matching eye location. The method uses a synthetic eye template alternative set of eyes anchor points of the face image matching, then the introduction eyes relative positional relationship information through fuzzy classification techniques, to identify the highest similarity group from alternative collections the anchor points of the eyes.

Then, by the extraction of the edge of the face organ, and it is to obtain a deflection angle of the human face. At the same time, through the boundary chain code algorithm to get the general location of the eyes. Finally, the use of a filter obtained by the learning of a plurality of eyes and a sample of the non-eye, and it is to locate the exact position of the eye. This method has a high real-time, and is not sensitive to rotation. But can not accurately locate the center of the pupil in the eye also can not be accurately positioned in the case of obstruction impact; and finally applied to the filter needs to be given by artificial means, for different races of different pupil color versatility is poor.

The algorithm in the Kalman filter prediction improved framework SIFT feature extraction has many invariance advantages, the use of improved matching algorithm to calculate the candidate target the precise location of the feature points, the motion vector of the feature point cluster analysis to effectively eliminate noise interference, false matches interactive template update strategy to efficiently update the target template [16]. The large number of experiments on the public test sequences shows that the algorithm can effectively solve partial occlusion problems, scale retractable problem, scenes the light brightness change issues and non-rigid object rotation, moving object tracking in video.

$$\mu_i(k) = P\{m_i(k) \mid Z(k)\} = \frac{f_i(k)\sum_{j=1}^{n} \pi_{ji}\mu_j(k-1)}{\sum_{i=1}^{n} f_i(k)\sum_{j=1}^{n} \pi_{ji}\mu_j(k-1)} \tag{11}$$

In order to compare the GTEL human eye localization algorithm and PTL human eye localization algorithm, real-time and noise resistance (or positioning accuracy), compared simulation. Peking University, A & T face database, the experimental select from two eye pupil visible eye no obstacles people face image, image size is 100 * 250.

SIFT feature point scale extension and rotation invariant, and has high matching rate in a different perspective, the changes in the brightness of the light, the ambient noise. Rotation, deformation and significant scale changes in parts and completely blocked and the brightness of the light changes and other complex scenes of the video sequence is proposed in this paper based on SIFT feature matching and the movement target tracking algorithm in moving target accompanied experiment experimental results show that the proposed algorithm is robust tracking algorithm [17]. The tracking algorithm is developed using Visual Studio 6.0 and OpenCV package, all experiments in CPU 2.5 GHz, 2 G memory and discrete graphics on a PC, and experiments using experimental video resolution, frame rate of 25 fps AVI public test sequence, the rest of the experimental video is complex scenes SDL laboratory design AVI video data and resolution are 80 and a frame rate of 70 fps. The paper presents the novel method of Moving target tracking Eyes Location based on SIFT feature matching and Gabor wavelet algorithm.

This chapter uses the Gabor wavelet transform, direct detection of "depression" terrain feature points and symmetrical similarity analysis, an improved fast the human eye positioning. Compared to the traditional human eye localization method, this method is not sensitive to noise, in real-time positioning and accuracy has greatly improved. Simulation results validate the effectiveness of this chapter, the proposed algorithm, as is shown by Fig 3.

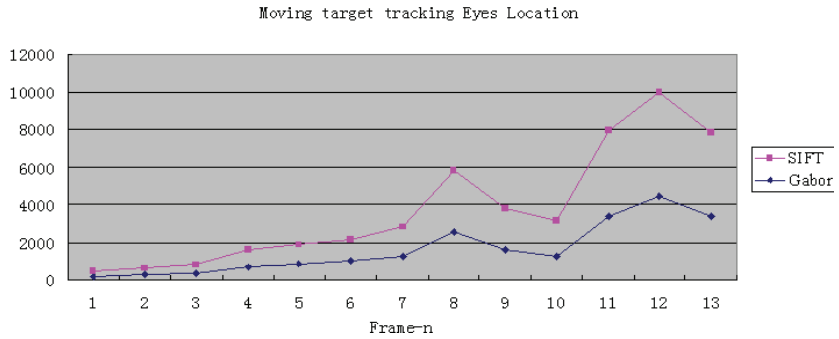

Fig. 3. Compare of Moving target tracking Eyes Location based on the SIFT feature matching with Gabor wavelet algorithm.

6. Conclusions

The fusion Gabor wavelet method and SIFT feature matching measurement method, an effective moving target tracking algorithm. The algorithm first extracts the SIFT feature points moving target, and then based on the Euclidean distance and nearest neighbor search feature matching, and match results clustering analysis to remove noise and mismatching. Finally, Gabor wavelet framework, combined with the feature point matching results and filtering predict target tracking. A large number of experimental results show that, the SFIT characterized target measurement is used herein having a scale the telescopic invariance and rotation invariance is not sensitive to the part of the deformation and the luminance variation. The combination of matching feature points clustering and Gabor wavelet framework can effectively solve the moving target tracking scale extension and partial occlusion problems.

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