A Human Iris Recognition Using Fuzzy Matching Technique

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Abstract—The Iris recognition based biometric identification has gradually attracted the attention of researchers due to its richness in amount of features. Iris recognition contains annular region between the sclera and the pupil of the human eye. In this region, there exists an extraordinary texture including many prominent features, on which the recognition is mainly relied. The proposed system uses the iris segmentation canny edge detection and Hough transform method can be applied to detect the inner and outer boundaries of an iris to segment the iris region.For feature extraction Log-Gabor filters are adopted to detect the local feature points from the segmented iris image. After feature extraction the matching algorithm, which is based on the possibilistic fuzzy matching technique, is used to compares two sets of feature points by considering not only the local features but also the relative positions to all the other points. The proposed schemes have been tested using iris images from CASIA IrisV3Interval Iris Image Database.

Index Terms—Gaussian Filter, Iris recognition, Log-Gabor filter, Possibilistic fuzzy matching (PFM).

1 INTRODUCTION

Biometrics has been a popular research topic due to the growing needs of human identification applications in recent years. The recognition system based on biometric technologies has higher reliability and security than traditional systems. Popular biometric approaches with physiological characters like face, fingerprint, palm print, iris, retina, and voice. Among these approaches, the iris has some advantages over the others and has received a lot of attention in the last two decades. The human iris, an annular region located around the pupil and covered by the cornea, can provide independent and unique information of a person. Furthermore, the iris is highly stable with age, and it is difficult to fake the iris under the protection of the cornea.

2 PROPOSED WORK

The proposed iris segmentation method is in order to produce the gradient images around the iris boundaries, the traditional iris localization can be used to estimate the parameters of each iris boundary. In the traditional iris localization method, the canny operator and the Hough transform are used to estimate the circular boundaries. Then, the morphological top-hat filter is adopted to detect and compensate the light reflection inside the pupil, and the Gaussian Filter is used to smooth the iris image.

2.1 Edge Detection

Detection of iris edges includes inner (with pupil) and outer (with sclera) edges. Iris can be introduced as follows: a diaphragm with rich texture encircling a circular region (pupil). Both the inner boundary and the outer boundary of a typical iris can approximately be taken as circles but these two circles are usually not co-centric. The two characteristics in iris are used for detection process having medium gray level of iris that limited between pupil and sclera levels. So that a method is designed for detecting those two boundaries. The first step is to filter out any noise in the original image, and then trying to locate and detecting any edges using canny edge detection. The purpose of edge detection is to decrease the number of points in the search space for the objects. Fig 1.1 shows the original image; Fig 1.2 shows the filtered image and an edge detection image.

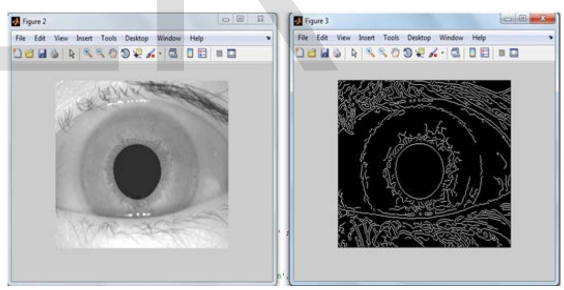

Fig 1.1 Input Image Fig1.2 Edge Detected image

2.2 Hough Transform

For detecting circles in images, the circular Hough transform provides good detection. For each edge point draw the circle with center in the point with the desired radius. When every edge point and every desired radius is used, the accumulator will now contain numbers corresponding to the number of circles passing through the individual coordinates. The discrete space constructed through accumulator and detection of parameters of curves by detecting the peak in the Hough space. Thus the highest numbers correspond to the center of the circles in the image. Therefore, a number of circular filters of different radii are tried and the best fit one is picked out. The center of the pupil and iris as detected by the circular filter becomes a coarse center

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and the coarse radius of the pupil and iris is the radius of the chosen filter Fig(2).

The Hough transform is defined as

$$H(xt, yt, r) = \sum_{j=1}^{n} h(xj, yj, xc, yc, r) \qquad (1)$$

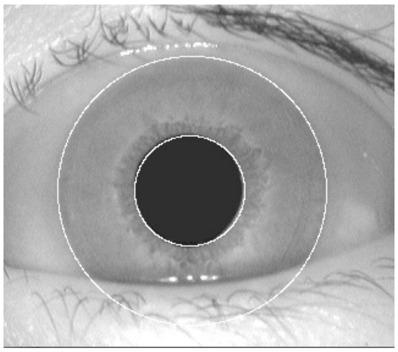

Fig 2 The detection of circles (inner and outer boundary) in an image.

Where

$$h(xj, yj, xc, yc, r) = \begin{cases} 1, \text{if } g(xj, yj, xc, yc, r) \\ 0, \text{ otherwise} \end{cases}$$

With

g (xj , yj, xc, yc,r) = (xj – xc)2 +, (yj – yc)2 - r2

Where h is the Hough transform function, x and y is horizontal and vertical axes from the origin respectively and r represents the radius of the inner and outer circle.

2.3 De-Noising

The unwanted eyelash, eyelid occlusion and the specular reflections, affect the performance of the feature extraction and the pattern classification considered eye lids (upper and lower), and eyelashes are the two main noises. Detecting the upper and lower eye lids, edge detection can be used as a preprocessing stage and thresholding technique was used. Since eyelashes are quite dark when compared with the rest of the eye image. The reflection areas are characterized by high pixel values close to 255. The coordinates of any of these noise areas are marked for the eyelid, eyelash detection process that is on the desired curve in the image space. Finally the output image of Block portion represents region of unwrapped iris Image. The white region denotes the noise that the noise is wiping to the Gaussian Filter.

The Gaussian Filter is defined as

$$g(x, y) = \frac{1}{2\Pi_{\sigma}{}^{2}} \cdot e^{\frac{-x^2+y^2}{2\sigma^2}} \qquad (2)$$

Where x is the distance in horizontal axis from the origin, y is the distance from the origin in the vertical axis, and σ is the standard deviation of the Gaussian distribution.

2.4 Log-Gabor Filter and Feature Extraction

The Log-Gabor filters are used to extract the local feature points from the segmented iris image in the Cartesian coordinate system and to estimate the dominant orientation of each detected feature point. After that, for each feature point, a rotation-invariant descriptor is generated by using its dominant orientation. The log Gabor function is a modification to the basic Gabor function, in that the frequency response is a Gaussian on a log frequency.

$$G(f) = \exp\left(\frac{-\left(-\log\left(f / f_0\right)\right)^2}{2\left(\log\left(\sigma / f_0\right)\right)^2} \right)$$

Where f0 is the center frequency and σ gives the bandwidth of the filter.

The log Gabor function has the advantage of the symmetry on the log frequency axis. The log axis is the optimum method for representing spatial frequency response of visual cortical neurons. The Log-Gabor filters spread information equally across the channels. On the contrary, ordinary-Gabor filters over-represent low frequencies.

2.5 Possibilistic Fuzzy Matching and Recognition

Fuzzy Matching Technique is the process to determine the similarities between datasets, information and facts. This is also used to determine the accuracy of the match. Possibilistic fuzzy matching technique has also been used to matching two sets of iris images.

After feature extraction, the matching algorithm is essential to the comparison of two sets of points extracted from different iris images. The propose effective matching algorithm with scale invariant, translation invariant, and rotation semi-invariant properties for two sets of local feature points. First, review the dissimilarity measure for a pair of Log-Gabor feature vectors, the fuzzy alignment algorithm, and the Possibilistic FCM algorithm. Then, a novel matching method is proposed to compare two feature point sets by taking into consideration the information comprising the Log-Gabor features and the position of each point. Finally, a matching score for two different iris images can be computed. The main contribution of this proposed matching algorithm, which can provide a novel, robust, and effective matching scheme for the feature points obtained from the Log-Gabor filters. In addition, the nonlinear normalization model is adopted to provide more accurate feature before matching.

The Possibilistic fuzzy algorithm can be written as follows:

$$J_{p,q} = \sum_{ij}(a w_{ij}^{p} + b t_{ij}^{q}) d(v_i, \theta_j) + \sum_{j} \gamma_j \sum_{i} (1 - t_{ij})^{q} \qquad (3)$$

Subject to the constraints

$$\sum_{j} w_{ij} = 1 \forall i, 0 \le w_{ij}, t_{ij} \le 1$$

a and *b* are the constants that decide the relative importance of the fuzzy membership (w_{ij}) and typicality (t_{ij})values in the energy function; $p > 1$, $q > 1$, and $\gamma_j > 0$ are user-defined constants; and $d(\mathbf{v}_i, \boldsymbol{\theta}_j)$ is the distance measured between the i^{th} unlabeled point and the j^{th} centre.

The energy function of the PFM is defined as follows:

$$E_{PFM}(I^2, I^2) = \sum_{i}^{n_1}\sum_{j}^{n_2}(a w_{i,j}^{p} + b t_{i,j}^{q}) * D_S(i,j) + \sum_{j}^{n_2}\gamma_j \sum_{i}^{n_1}(1 - t_{ij})^{q} \qquad (4)$$

$$D_S(i,j) = (D_G^2(y_i, x_j) + f D_L^2(V_i^1, V_j^2)) \qquad (4.1)$$

Where f is the distance weight to control the importance of the distance $D_L$between a pair of local feature vector which and D_G is defined in the following equation:

$$D_G(y_i, x_j) = \| y_i - (cRX_j + t) \| \qquad (4.2)$$

By minimizing the energy function of the PFM, can obtain the membership and the typicality of equation(4)

$$w_{ij} = \left(\sum_{k=1}^{n_2}\left(\frac{D_S(i,j)}{D_S(i,k)}\right)^{\frac{1}{p-1}}\right)^{-1} \qquad (4.3)$$

$$t_{ij} = \left(1 + \left(\frac{b}{\gamma_j} D_S(i,j)\right)^{\frac{1}{q-1}}\right)^{-1} \qquad (4.4)$$

3. PERFORMANCE EVALUATION

For iris identification, the system attempts to determine the identity by comparing an input sample with all enrolled templates in a database. The correct recognition rate is widely adopted to evaluate the performance of an identification system. In the implementation, five iris samples of each class are randomly selected to construct a template set, and the remainder images are used as the test samples. Then the test iris image match to the Possibilistic fuzzy matching technique using the two set of iris value then, the fuzzy matching can be computed by the correctly matched data.

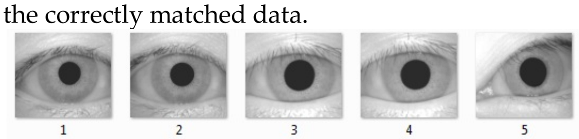

Fig 3 Sample Input

To show the effectiveness of the proposed algorithms, the implementation of entire the CASIA-IrisV3-Interval iris database was tested using MATLAB. The experimental results Fig 4 demonstrate the robustness of the proposed method canny edge detector used with threshold value to remove most of the noise due to the texture and leave the edges of the image.

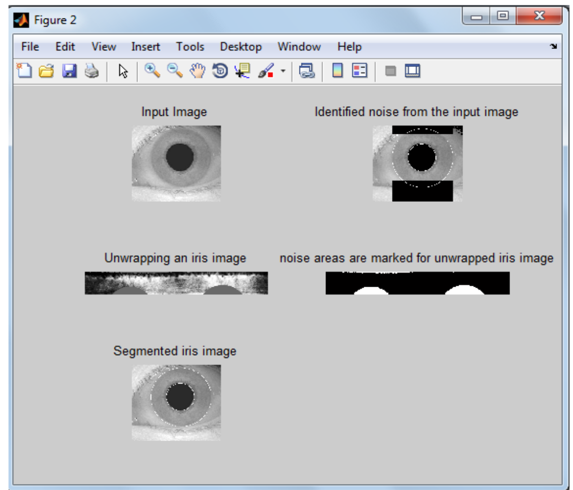

Fig 4 Iris Segmentation

The Hough transform has been applied on these images after canny edge detection to identify the circles of desired radii (i.e., those corresponding to pupil and iris boundary) and then were marked on the image.

For feature extraction extracting features from the input five training images in the dataset. The fig 5 shows the extracting the features using Log-Gabor filters.

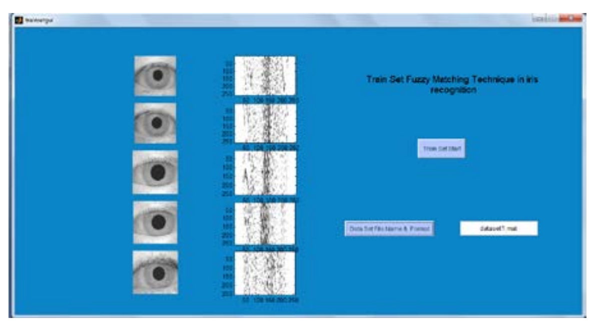

Fig 5 Training the iris image from the dataset

The Table 1 shows five input images and elapsed time in seconds.

Image	Time Value
Image-1	24.708809 seconds
Image-2	25.903141 seconds
Image-3	26.657446 seconds
Image-4	23.491859 seconds
Image-5	17.982251 seconds

Table 1 Train set Image Time value

The fig 6 shows the input iris images and elapsed time in seconds.

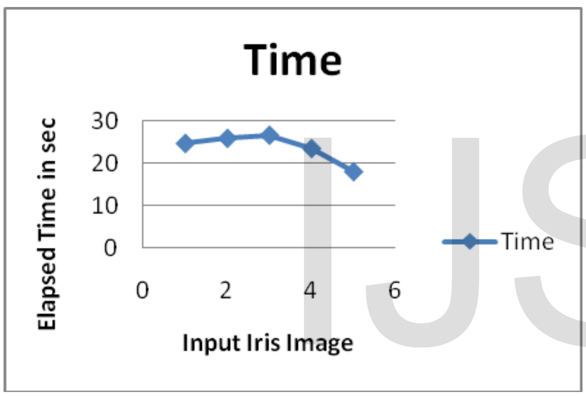

Fig 6 Elapsed time

The figure 7 shows the input image from the database then fuzzy matching process the person is authorized person.

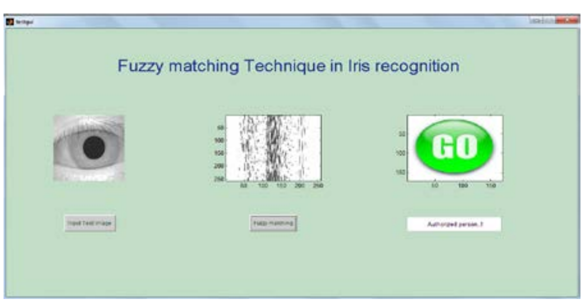

Fig 7 Matching (authorized person identification)

The figure 8 shows the input image not in the database then fuzzy matching process the person is not authorized person.

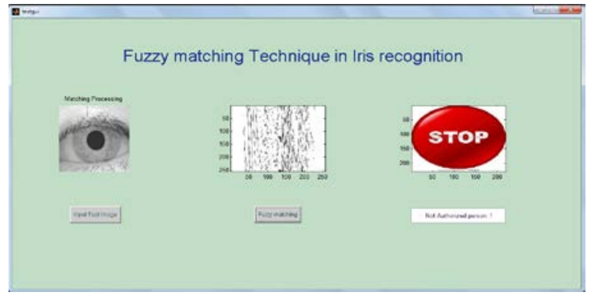

Fig 8 Matching (not authorized person identification)

4. CONCLUSION

Recognizing Iris recognition is quite a challenging task, since Iris recognition is a complex structure and find the unique set of attributes to be able to determine whether a structure is a Iris of a particular person or not. The effectiveness of the proposed algorithm implementation the entire CASIA iris database was tested using MATLAB. The experimental results demonstrate the robustness of the proposed method against influential factors. Canny edge detector used with threshold value to remove most of the noise due to the texture and leave the edges of the image. The Hough transform has been applied on these images after canny edge detection to identify the circles of desired radii (i.e., those corresponding to pupil and iris boundary) and then were marked on the image. Using Log-Gabor Filter extracted the efficient features. Tested the algorithm on different iris images, and obtained an average correct recognition measure train set time respectively (refer Table 1) using higher level approximations when compared with original image. When the iris in the dataset image is same as iris of the test image, relative from threshold is compared to first level. Similarly when two Iris are different, matching to the matching stage using the Possibilistic fuzzy matching.

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