

Hough Transform, SURF Technique For Automatic Iris Recognition

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ABSTRACT: In last decades human identification didn't gained more attention. Ever increasing demand of internet came with more advancements and security threats. The detection of an iris from a human eye is still critical step in internet world. There are various existing wide areas where huge demand of biometric methods like medical diagnosis, immigration control, aviation security, bank & other financial transaction, access to defense organization etc. This manuscript introduces an alternative algorithm for automated biometric iris recognition where segmentation and matching process implemented using Hough transform and SURF technique. CASIA images databases digitized in grayscale use for this work, validated in MATLAB providing satisfactory results.

KEYWORDS: Iris recognition, Segmentation, SURF, Normalization, Matching

I. INTRODUCTION

In traditional system, one need to remember password, pin, identification card to access personal computers or database, ATM Machine, pass through restriction areas in the airport respectively. So, require a highly reliable and accurate personal identification infrastructure system in order to replace the conventional security systems. Iris Recognition has become most reliable biometric technology which provides unique feature. It means probability of finding two irises with identical iris feature of same person is almost zero. To identify individuals, feature extraction from the iris is used. This technique competes those are computer vision based such as faces, figure prints, voice, palms because of limited capabilities in recognizing relatively complex features in realistic practical situation.

Iris is a colored ring around the pupil contains distinctive features such as ridges, corona, freckles, furrows, rings, crypts and thus it poses a great degree of randomness. As an internal (yet externally visible) organ, iris is well protected from the environment and stable over time.

Like Other biometric system, iris system has two modes: Enrolment process and matching process.

Enrolment process: adding templates to a database. The templates are stored (on a card or within a database or both).

Matching process: a template is created for an individual and then a match is searched for in the database of pre-enrolled templates.

In this paper, we proposed an Iris Recognition system. The recognition system relies on four fundamental stages:-

Pre-processing is the first stage in iris recognition system. Second phase consists of iris segmentation and localization from an eye image using Hough transform. In the subsequent phase, iris image is normalized into a fixed dimension rectangular strip. Then finally, using SURF technique, local features are extracted from the normalized region and paired the two iris image using matching strategy.

II. RELATED WORK

Dr. Flom and Safir proposed the concept use of iris for human identification [9]. Parteek et al. [13] implemented Hough Transform segmentation method for Iris Recognition. Normalization of segmented iris was using Daugman's Rubber Sheet Model. Then 1D Log-Gabor filters were used to encode the normalized region in order to produce a bit-wise biometric template. For matching of templates Hamming distance was chosen, which gave the measure of how many

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bits disagreed between the templates of the iris. Daugman [5-6] algorithm using an integrodifferential operator first locates inner and outer boundaries of the iris. Then the region of iris image is converted to a dimensionless polar coordinate system and this process is known as normalization. Features are obtained using a 2D complex valued Gabor filter to demodulate texture phase information of the iris and only quadrant of the phase is encoded. Hamming distance was chosen to make decision of matching of two iris codes. John Daugman [3] the aim of this research is analyzes the statistical variability i.e basis of iris recognition, using new large databases. The principle underlying the recognition algorithm is the failure of a test of statistical independence on iris phase structure encoded by multi-scale quadrature wavelets.

Boles and Boashash [7] implemented a feature extraction algorithm using a zero-crossing representation of 1D wavelet transform at various resolution levels on concentric circles of iris image and matching is done for identification and verification purpose. Li Ma et al. [2] localized the iris in several steps which first 24 finds a good approximation for the pupil center and radius, and then applies the Canny operator and the Hough transform to locate the iris boundaries more precisely. The iris image is converted to dimensionless polar coordinates, similar to Daugman, and then is processed using a variant of the Gabor filter. A careful statistical performance evaluation is provided for the author's work, and for most of the algorithms mentioned above. Kong and Zhang [1] iris recognition system is developed based on the algorithm of Boles and Boashash [7] with the addition of an eyelash and reflection segmentation model. The iris segmentation is implemented by using curve fitting approaches. Four types of 1-D wavelets (Mexican hat, Haar wavelet, Shannon, and Gabor) were used to extract the features and the dissimilarity between a pair of iris codes is defined by L1 norm. S-iris encoding generated from the inner product of the output from a 1D Log Gabor filter and secret pseudorandom numbers is proposed by Chin et al. [11]. Iris segmentation is done by creating an edge map using Canny edge detector and then using circular and linear Hough transform. Hamming distance is used to indicate the dissimilarity between a pair of iris codes. Schmid [12] proposed an algorithm to calculate the iris biometrics system performance on a larger dataset based on the Gaussian model constructed from a smaller dataset. In the matching stage, it uses a sequence of K iris codes to represent an iris subject. So the distance between a pair of iris subjects is defined as a K-dimensional Hamming distance, modeled as Gaussian distribution.

Xu [8] proposed a new method instead of using the traditional method where images are normalized and then feature vector are extracted. The proposed method first extracts global features by wavelet filter and then by applying SIFT method achieve the local features of an iris. Then different weights are applied to get the similarity distance between them.

III. PRE-PROCESSING

In this pre-processing stage, Histogram Equalization is performed. In this technique, adjusting image intensities to enhance contrast of an image which automatically determines a transformation that seeks to generate an image with an identical histogram of intensity values. Basically, it is the redistribution of gray level values uniformly. This process portioning a digital image into multiple segments (set of pixel) and histogram is computed from all of the pixels in the image. Histogram is act upon in a grayscale images. This method usually increases the global contrast of many images, especially while the usable data of the image is represented by close contrast values. Through this adjustment, the intensities are able to be better distributed on the histogram. This allows for areas of lower local contrast to achieve a higher contrast. Histogram equalization achieves this by effectively spreading out the most frequent intensity values.

IV. IRIS SEGMENTATION & LOCATION

In this, iris region is extracted from an eye image. Following are the steps used for this stage:

1. Define range of pupil and iris radii.
Lower pupil radius= 5, Upper pupil radius= 20
Lower iris radius = 20, Upper iris radius = 80
2. To find the iris and pupil edge detection following steps are applied:

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- a. Using Gaussian smoothing filter and convolution matrix enhance the quality of image and reduce noise, unwanted effects from an image for further processing. We take the filter size = $[6\sigma+1, 6\sigma+1]$ where σ is spread of Gaussian that control the smoothing.
- b. Obtained the gradient in horizontal and vertical direction to detect actual edges.
- c. Then non-maximum is carried out with the magnitude images to find out the edge point strength is locally maximum in direction of gradient.
- d. Double thresholding is performed to determine possible edges and remove the false edges from the image.
- e. Track edge by hysteresis: Finalize the detection of edges by suppressing all the other edges that are weak and not connected to strong edges.
- f. Canny image is shown in fig 1:

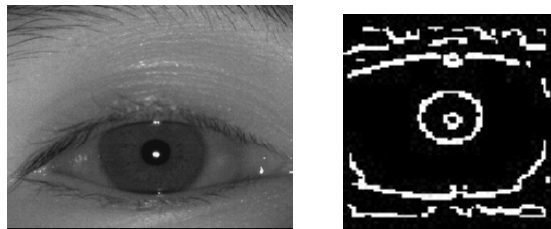


Fig 1: canny image with respect to original image

3. Steps used to find top and bottom eyelid:

- a. Using canny find line with the following code
Lines= find line (top eyelid)
Canny (image, σ , scaling, vert, hori) with the following parameters as:
Canny (image, 2, 0.6, 1.00, 1.00)
- b. Lines= find (bottom eyelid)
Canny (image, 2, 1, 0.00, 1.00)
- c. Values for applied gamma and non maximum up are 1.9 & 1.5 respectively.
- d. Thresholding is done with 0.20 and 0.15.
- e. Line is drawn with the points which has maximum sharp change in intensity values (consider the presence of eyelid if points are greater than 25).

After that, a non-linear operation, gamma is added with value must be greater than zero used to improve the brightness levels of both high and low gray, is known as gamma correction. It is represented by γ symbol. If there is a need to rescale an image then gamma value range should be between 0 & 1. Image behavior due gamma correction depends upon γ value strictly. If $\gamma < 1$, expand the input range lower region (dark tones) and the upper region compressed (light color). If $\gamma = 1$ does not modify the gray levels of the image. If $\gamma > 1$, compress the lower region of the input range and expand the upper region. The γ value depends upon the distribution of gray levels of input image. Gamma is performed after applying canny edge detection as shown in Fig 2:

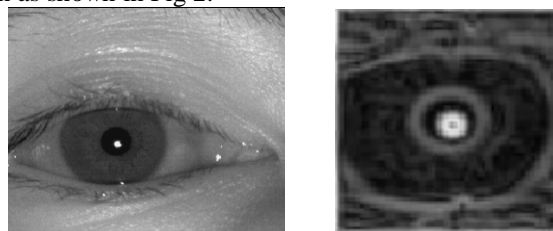


Fig 2- original image with their gamma correction image

4. Following steps are used for detection of pupil and iris boundary using Hough transform as:

- a. For each edge point from edge image, draw circles for different radii.

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- b. Boundary is taken where circle with maximum sum of intensities.
- c. Find maximum in Hough space and hence parameter of circle.
- d. Fill in the 8-way symmetric points on a circle given coordinates.

V. NORMALIZATION PROCESS

This process transforms the iris region from Cartesian coordinates to polar coordinates.

- a. Calculate displacement of pupil centre from the iris centre.
- b. Calculate radius around the iris as a function of the angle using equation:
$$r = (\sqrt{ab}) + (\sqrt{a(b)^2 - (a - r^2)})$$
- c. Exclude values at the boundary of pupil-iris border and the iris- sclera border as they may not corresponds to areas in the iris region and will introduce noise.
- d. Calculate Cartesian location of each data point around the circular iris region.
- e. Extract intensity values into the normalized polar representation through interpolation.
- f. Start diagnosis and obtained circular pattern as shown in fig 3:
- g. Get pixel coordinates for circle around iris and pixel coordinates for circle around pupil with radial resolution of 20 and angular resolution of 240.

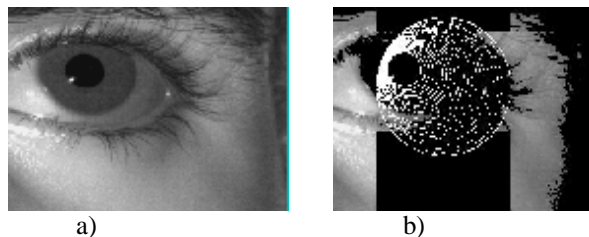


Fig 3: Result of normalization process.
a) Original image. b) Normalized image.

VI. MATCHING PROCESS

In this final stage, SURF technique is used for feature extraction and matching purpose. Normalized iris region is considered for feature extraction. SURF provides the following steps:

- a. Detect interest points using blob detector based on Hessian Matrix.
- b. Fix a reproducible orientation based on information from a circular region around the interest point. Then construct a square region aligned to the selected orientation and extract the SURF descriptor from it.
- c. By comparing the descriptors obtained from a processing image and already got stored, matching pairs can be found.
- d. The smallest Euclidean distance between the same points represents a good match.

VII. RESULT

In the proposed iris recognition system, techniques Hough transform with Speeded Up Robust Features are being used and to make this more perfect, here Histogram Equalization with Gamma Correction has been used to enhance the iris region. The experiment was performed with a sample of 67 grayscale images selected from the CASIA database. An experimental result shows that the iris and the pupil have non-concentric point on the circle. Because of this few pixel spaces between iris and pupil centre, contour is wrongly segmented by Hough transform. Subsequently adjusted parameters and Hough transform with SURF technique, satisfactory result was obtained by test in 58 of the 67 images corresponding to a 92.37% correct segmented images and 7.63% wrong segmented. And this can be seen in the results of Fig 4 (a) and 4 (b).

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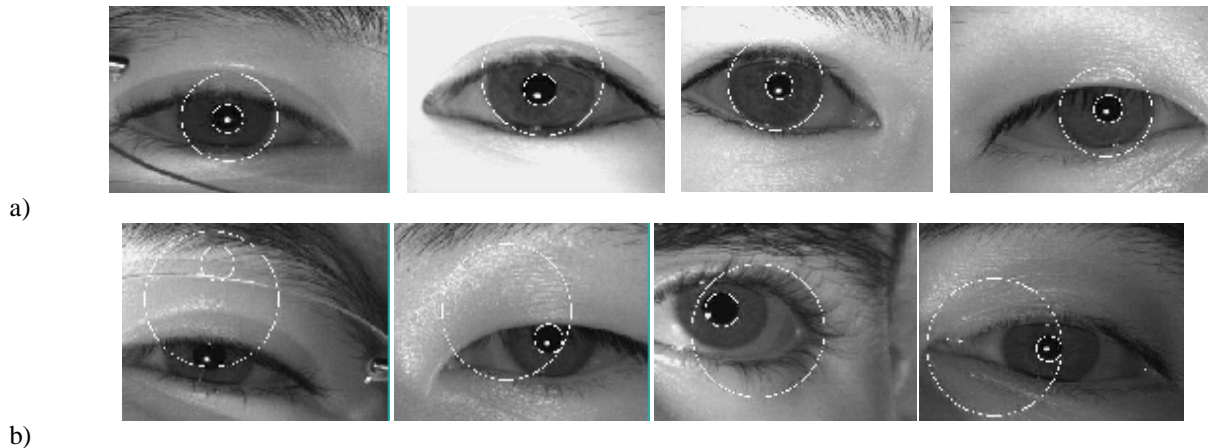


Fig 4: a) Correct segmentation algorithm
b) Failed segmentation procedure

VIII. CONCLUSION

The Proposed Scheme provides efficient way for iris recognition in different mode using Hough transform algorithm for segmentation stage and SURF technique for matching purpose. Practical approach demonstrates that proposed method is feasible.

The procedure implemented on MATLAB R2012a with a core i3 Intel processor. This iterative algorithm can be beneficial in real time based systems if there is an appropriate image acquisition interface. That reduces user involvement, in other words, minimizes computational time. The feature of long lasting existence of iris makes it more important for security purposes like banking, airports, defense etc. Here, the scheme used enhances the exactness of experimental result.

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