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# Investigation and Analysis of Geodesic Active Contours (GAC)-Gabor-Correlation Matching Based Method of Iris Recognition.

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***Abstract:*** *In this paper we will discuss the methods of iris recognition method and present their simulation results. Start from the novel segmentation method which is based on use of Geodesic Active Counters (GAC) in order to extract the iris from surrounding structures. Further for the features extraction and localization, we have used the well known method called Gabor filters. At the end for the matching we have used normalized correlation-based iris matching method. This proposed matching system is a fusion of global and local Gabor phase correlation schemes. We have measured performance in terms of false acceptance rate, false rejection rate and compared against our previous approach of iris recognition using MATLAB.*
***Keywords:*** *Human iris pattern, Iris Segmentation, Geodesic Active Counters, Gabor filters, False Acceptance Rate, False Rejection Rate.*

## I. Introduction

As it is known, biometrics deals with identification of individuals based on their biological and/or behavioral features. Technologies that exploit biometrics have the potential application of identifying individuals in order to control access to secured areas or services. Now adays a lot of biometric techniques are being developed based on different features and algorithms [1]. Each technique has its strengths and limitations, not being possible to determine which the best is without considering the application environment.

Nevertheless, it is known that, from all of these techniques, iris recognition is one of the most promising for high security applications [2]. Human iris is an overt body, protected by the cornea and highly distinctive to an individual. The possibility that the human iris might be used as a kind of optical fingerprint for individual identification was suggested originally by ophthalmologists. In this enquiry paper we presented the our own procedure Iris recognition in which all modules are discussed such as GAC based segmentation, Gabor filter founded characteristics extraction and localization, and finally association founded matching.

## II. Literature Review

**2.1 Daugman's Method:-** Daugman‘s 1994 patent described an operational iris recognition system in some detail. In 2004 his new paper said that image acquisition should use near-infrared illumination so that the illumination could be controlled. Near-infrared illumination also helps reveal the detailed structure of heavily pigmented (dark) irises. the next step is localizing the iris from image. Daugman‘s approximated the pupil and iris boundaries of the eye as circles. So, he proposed an Integro-Differential operator for detecting the iris boundary by searching the parameter space.

**2.2 Hough Transform**

These pattern matching advances relies mostly on the procedure which are nearly coupled to the noted image intensities. If there happens a greater variety in any one of the iris, one way to deal with this is the extraction as well as matching the groups of characteristics that are approximated to be more vigorous to both photometric as well as geometric distortions in the obtained images. The benefit of this procedure is that it provides segmentation correctness up to an span. The drawback of this approach is that, it does not supply any vigilance to eyelid localization (EL), reflections, eyelashes, and shaded which is more significant in the iris segmentation.

**2.3 Fuzzy clustering algorithm**

A new iris segmentation approach, which has a robust performance in the attendance of heterogeneous as well as loud images, has been evolved. The method begins with the image-feature extraction where three discrete i.e., (x, y) which corresponds to the pixel place, and z which corresponds to its power standards has got extracted for each and every image pixel, which is followed by the submission of a clustering algorithm which is the fuzzy K-means algorithm.

## III. Methodology Of Iris Recognition

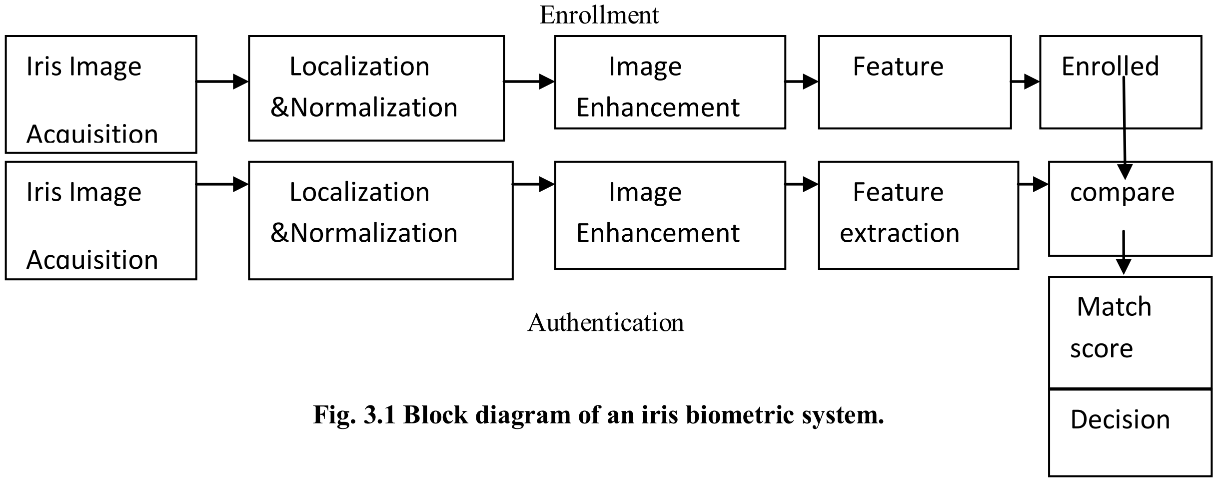


**Fig. 3.1 Block diagram of an iris biometric system.**

### 3.1 Image Acquisitions

Due to the transparency of the cornea, any video or photographic device could be used to obtain a likeness of the iris. In our scheme, a high tenacity digital photo camera has been used, getting a high quality image with the smallest loss of information. Future work will use capture devices such as video cameras and infrared light.

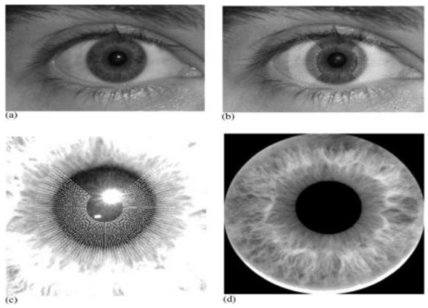

**Fig.3.2. (a) Photograph taken; (b) Outer boundary detection; (c) Inner boundary detection; (d) Isolated iris image[2].**

Exceptional optics are directed to have a zoom that enables the capture of the likeness of the iris from an expanse large sufficient to avoid any client rejection. Therefore, image is taken, covering the entire eye of the user (Fig. 3.2 (a)). After the arrest, the localization of the iris interior the likeness is performed. First, the likeness of the eye is altered to gray scale and its histogram is linearly extended, as to be able to take earnings of all variety given by the 256 levels of the gray scale.

### 3.2. Image Segmentation

Image segmentation utilizing GACS (Geodesic active contours).The iris localization procedure can be simply divided into two stages: (a) pupil segmentation and (b) iris segmentation. In the pupillary boundary, the eye likeness is first smoothed using a 2-D median filter and the smallest pixel worth is determined. The iris is then binaries utilizing a threshold worth. A 2-D median filter is then directed on the binary image to reject the relatively lesser regions affiliated with the eyelashes. This declines the number of candidate iris pixels detected as a outcome of thresholding. So a circle-fitting method is performed on all detected districts. The formula of a around is granted by Gabor filter furthermore, if the unconditional worth of a issue of the kth orientation filter is bigger than those of the other filters in the identical scale, θkcan be treated as the superior orientation at this place. Then, a rotation-invariant characteristic vector for each localized characteristic point with esteem to its dominant orientation can be generated.

### 3.3 Features Extraction: Gabor Filter Based Feature Extraction

The multi resolution Gabor filters are directional band pass filters, which have orientation- and frequency-selective properties and supply optimal joint resolution in both spatial and frequency domains .Comparing to DCT ,Feature Extraction method is more very quick and Gabor filter can be applied on distinct database of iris database. The implementation of Gabor characteristic extraction is an significant computational consideration. For example in the simple Gabor characteristic space, a full seek in a 2D images desires at smallest likeness width × image height ×Row(scale) moves × column moves future vectors to be classified. In this system, the form of Gabor filters proposed in is taken up to notice the iris feature points and to develop a characteristic vector for each characteristic issue.The 2-D frequency domain is partitioned into m frequency and n orientation bands. The impulse response function of the jth radial frequency ($\omega rj$ ) and the kth orientation ($\theta k$) filter is given by

$$G_{j,k}(x,y)=exp\left\{\left\{-\frac{1}{2}(\delta^2 r_j x^{-2} + \delta^2 \theta_k r_j y^{-2})\right\}\right\} \times \exp(i2\pi\omega_{r_j}\bar{x}) \quad (3.1)$$

$$\left[\begin{pmatrix}\bar{x}\\ \bar{y}\end{pmatrix}\right] = \left[\begin{pmatrix}\cos\theta_k & \sin\theta_k\\ -\sin\theta_k & \cos\theta_k\end{pmatrix}\right]\left[\begin{pmatrix}x\\ y\end{pmatrix}\right] \quad (3.2)$$

Where $1 \leq j \leq m$, $1 \leq k \leq n$, $1/\sigma rj$ , and $1/\sigma\theta k$ are the standard deviations of the Gaussian envelopes along the x- and y-axes, respectively.

**3.4 Matching Besed On Normalized Correlation.**

Normalized correlation is also used as classification metric.Correlation addresses the relationship between two different factors.The statistics is called a correlation coefficient.A correlation coefficient describes direction and degree of relationship between two variables . Normalized correlation is advantageous over standard correlation since it is able to account for local variations in image intensity that corrupt the standard correlation calculation. This is represented as:

$$\mu 1=\text{mean of } p1=\frac{1}{mn}\sum_{i=1}^{n}\sum_{j=1}^{m} p1(i,j) \quad (3.3)$$

And

$$\sigma 1=\sqrt{\left(\frac{1}{mn}\sum_{i=1}^{n}\sum_{j=1}^{m} p1(i,j)\right)} \quad (3.4)$$

$$Normcorr(p1,p2)=\frac{1}{mn\sigma 1\sigma 2}\sum_{i=1}^{n}\sum_{j=1}^{m}(p1(i,j)-\mu 1)(p2(i,j)-\mu 2) \quad (3.5)$$

Where p1 and p2 are two images of size n by m pixels.
$\sigma 1$=standard deviation of p1.
$\mu 2$=standard deviation of p2.
$\sigma 2$=mean of p2.

## IV. Result Analysis

Following figures shows the simulated results for GAC-Gabor-Correlation Matching methods.

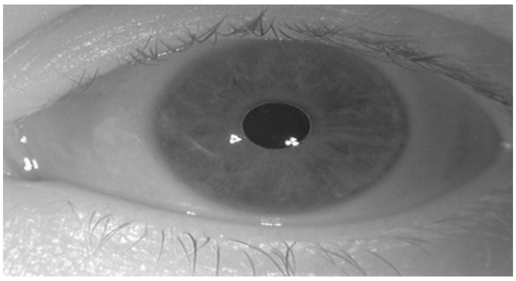

**Figure 4.1: Input Iris Image**

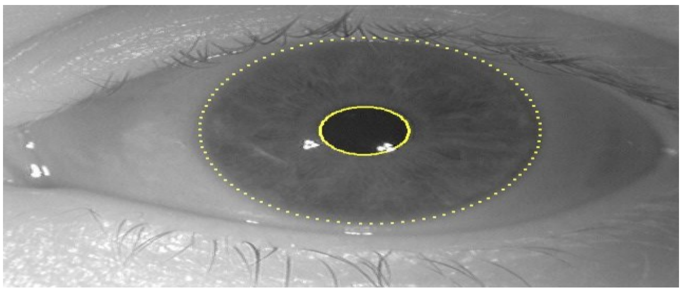

**Figure 4.2: GAC based Segmented Iris Image**

**Figure 4.3: Gabor Filter based Features Extraction and Mask of Iris Image.**

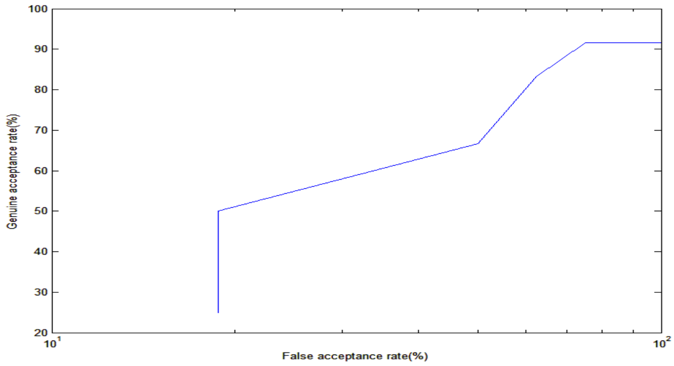


**Figure 4.4: False Acceptance Rate vs. False Rejection Rate**

Above results are showing the outputs for proposed investigated methods.
This process shows the how iris recognition system included the different methods step by step. We have calculated the performance of these techniques in terms of FAR (False Acceptance Rate) and FRR (False Rejection Rate).Finally following table 1 shows that how this proposed methods of Iris Recognition is more accurate as compared to previously presented methods.

**Table 1: Performance of Accuracy**

| Number | Name Author/Method | Accuracy Rate |
|---|---|---|
| 1 | Seyyed M. T et al 2010 | 95.20 % |
| 2 | Chirayuth S. and Somying T. 2009 | 92.44 % |
| 3 | Proposed Method presented in This paper | 97.05 % |
| | | |

## V. Conclusion

It is described an approach to human identification based on iris recognition. comparative result of iris recognition system has been carried out on the basis of FAR(False Acceptance Rate) and FRR(False Rejection Rate) and execution time. The method as implemented also has low complexity, making it superior to the other methods evaluated in terms of both speed and accuracy.

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