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IRIS Recognition Techniques: A Review

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ABSTRACT

Iris recognition has been done by many researchers in last decade. Iris recognition plays an important role to improve efficiency in biometric identification due to its reliability in highly secured areas. Such as In Airports And Harbors, Access Control In Laboratories And Factories traditional issue is focused on full fingerprint images matching and face detection are used for identification of humans, but iris recognition system is more reliable and gives more accurate results for the identification. Iris recognition works on pattern recognition. In iris recognition the signature of the new iris pattern is compared against the stored pattern after computing the signature of new iris pattern and identification is performed. This paper discusses various techniques used for Iris Recognition.

Keywords: Segmentation, Normalization, Feature extraction, matching.

1. INTRODUCTION

All these biometric identification technique, iris recognition is most prominent technique. Iris recognition systems are gaining interest because it is stable over time. Iris scan has been developing an identification/verification system capable of positively identifying and verifying the identity of individuals. The unique patterns of the human iris, used for overcoming previous shortcomings. The iris indicates the color part of the human eye. It is a circular membrane of the former face of the ocular sphere. It is pierced with a black hole called the pupil which allows the light penetration to the retina. The iris is used to adapt this light quantity by papillary dilation or constriction. The iris is a combination of several elements. It is richest distinctive textures of the human. The pigment accretion can continue in the first postnatal years. The complex pattern of iris has many distinctive features such arching, zigzag collarets, ligaments, furrows, rings corona, ridges, crypts, freckles.

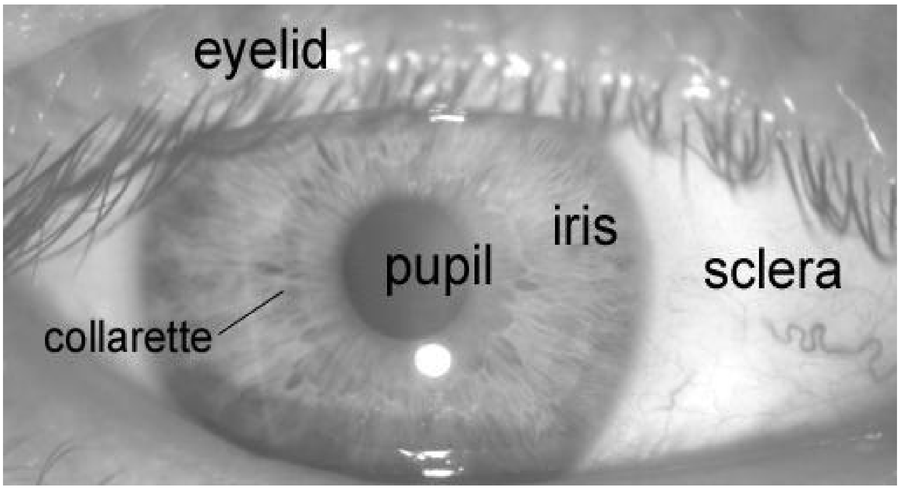

Figure 1. 1 Eye Anatomy

This Iris stored an unique information in the form of objective mathematical representation, this will make a biometric template, it allows comparisons to be made between templates. A subject to be identified by Iris recognition system, then take a picture of eye and make a template of its iris region, then compared the template with other stored template in a database, when matching has been done if template is found it means subject is identified, or if no match is found and the subject remains unidentified.

2. DOUGHMAN'S WORK

In daugman's work [1] the visible texture of a person's in real-time video image is encoded into compact sequence of multi-scale quadrature 2-D Gabor Wavelet coefficient have MSB comprises of 256 byte in iris code. The final outcome of this work was a mathematical proof that there were sufficient degrees-of-freedom, or form of variation in the iris among different humans, to impart to it the same singularity as a conventional fingerprint. Uncertain was whether efficient algorithms could be developed to extract a detailed iris description reliably from a live video image, generate a compact code for the iris which make comparison between minuscule length and image data size, and make a decision about individual identity with high statistical confidence.

The problem was whether the algorithms involved could be executed in real time on a general-purpose microprocessor. In the process of recognition these question were resolved and a working system was described. Daugman's work divides in four main parts namely:

- Segmentation
- Normalization
- Feature extraction.
- Matching

SEGMENTATION

where I(x, y) is the eye image, r is the radius to search for, $G\sigma(r)$is a Gaussian smoothing function, and s is the contour of the circle given by r, $x0$, $y0$. The operator searches for the circular path where there is maximum change in pixel values, by varying the radius and centre x and y position of the circular contour. The operator is applied iteratively with the amount of smoothing progressively reduced in order to attain precise localize.

$$\max_{r,x_0,y_0} \left| G_{\sigma(r)} * \frac{\partial}{\partial r} \oint \frac{I(x,y)}{2\pi r} ds \right|$$

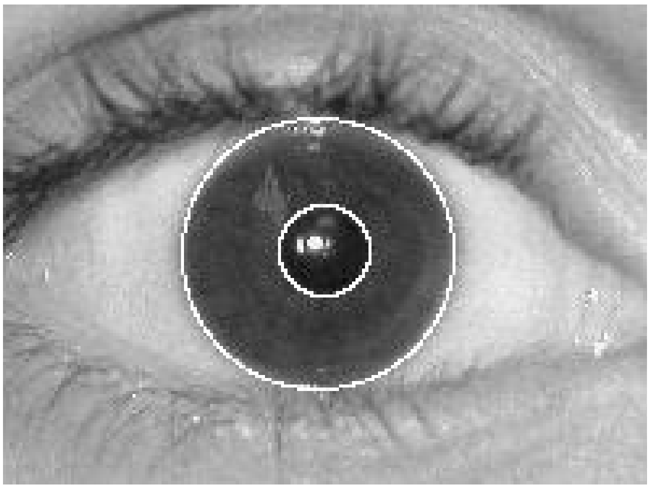

fig 2. 1 localised image

Normalization

The remapping of the iris region from (x, y) Cartesian coordinates to the normalized non-concentric polar representation is modeled as

$$I(x\ (r,\theta), y(\ r,\theta\ ) \rightarrow I(r,\theta)$$

With

$$(\ r,\theta\ )= (1-r)\ x_p\ (\theta) + (\ \theta)$$
$$(\ r,\theta) = (1-\ )\ y_p\ (\theta) + r y_i(\theta)$$

Where I(x, y) is the iris region image, (x, y) are the original Cartesian coordinates, (r, θ) are the corresponding normalized polar coordinates, xp, yp and xi, yi are the coordinates of the pupil and iris boundaries along the θ direction. The rubber sheet model takes into account pupil dilation and size inconsistencies in order to produce a normalized representation with constant dimensions. In this way the iris region is modeled as a flexible rubber sheet anchored at the iris boundary with the pupil center as the reference point.

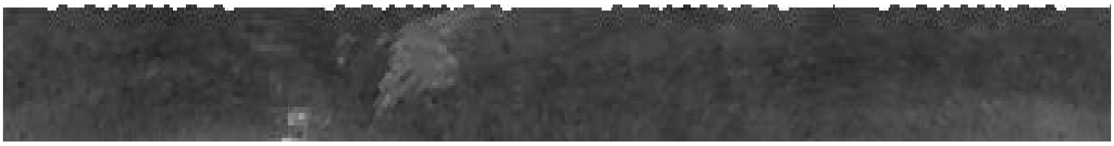

fig 2. 2 Normalized Image Extracted from the Segmented Image.

Feature Extraction

Daugman demodulates the output of the Gabor filters in order to compress the data. This is done quantizing the phase information into four levels, for each possible quadrant in the complex plane. Taking only the phase will allow encoding of discriminating information in the iris, while discarding redundant information such as illumination, which is represented by the amplitude component.

$$\mathrm{H}(\mathrm{r}, \theta) = e^{-\omega(\theta-\theta o)} e^{-(r-r_o)^2/\alpha^2} e^{-i(\theta-\theta_o)^2/\beta^2}$$

Where $(\alpha,\ )$ are the same as describe earlier, and $(r0,\ 0)$ specify the centre frequency of the filter

Iris Matching

Duagman's use hamming distance a matching metric developed by him, and calculation of the Hamming distance is taken only with bits that are generated from the actual iris region.

$$\mathrm{HD}=\frac{1}{N}\sum_{j=1}^{N} X_j (XOR)\, Y_j$$

3. D. M Monro

In Monra's work [2] This work is basically done on the DCT technique, In this method The DCT is a real valued transform whose variance distribution resembles that of the KLT with much lower computational complexity [9]. Due to its good energy compaction properties the DCT is widely used for data compression. In addition the feature extraction capabilities of the DCT coupled with well-known fast computation techniques [10] have made it a candidate for pattern recognition problems such as the one addressed here. The DCT has been produce good results on face recognition [11], where it has been used as a less computationally intensive replacement for the Karhunen-Loeve transform (KLT). Although no transform can be said to be optimal for recognition, these properties motivated us to investigate the DCT for effective non-semantic feature extraction from human iris images.

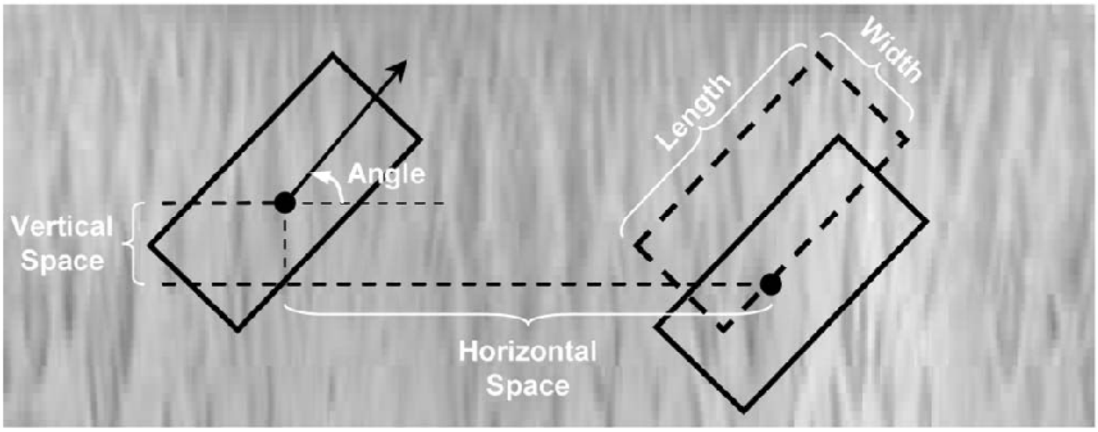

Fig. 3. 1 Overlapped Angular Patches from Normalized Iris Image [2]

The Fig. 3. 1 shows the overlapped angular patches from normalized image. Individual feature bit and patch position parameters are optimized for matching through a product-of sum approach to Hamming distance calculation. For comparing two iris codes, a nearest-neighbor approach was taken, the distance between two feature vectors were measured using the product of- sum (POS) of individual sub feature Hamming distances (HD). To reduce the feature vector length, the most discriminating binaries DCT coefficients were extracted and the remaining ones werediscarded. 1D DCT to code each patch along its length, giving low-computational cost. This system need to improve searching speed in a huge iris database.

$$C_k = \frac{2}{N} w(k) \sum_{n=0}^{N-1} x_n \cos\left(\frac{2N+1}{2N}\pi k\right), 0 \le k \le N-1$$

and

$$x_n = \sum_{n=0}^{N-1} c_k \cos\left(\frac{2\pi+1}{2N}\pi k\right), 0 \le n \le N-1$$

where

$$\text{w(k)}=\frac{1}{\sqrt{2}} \text{for } k = 0 \text{and } w(k) for 1 \le k \le N-1$$

4. Li Ma

In Li Ma's work [6] an efficient algorithm for iris recognition by characterizing key local variations. The basic idea used is that local sharp variation points. These are the points that denoting the appearing or vanishing of an important image structure are utilized to represent the characteristics of the iris. The mainly two steps for feature extraction are defined. In the first step, the one-dimensional intensity signals set are constructed to effectively characterize the most important information of the original two-dimensional image. In the second step, a position sequence of local sharp variation points in such signals is recorded as features used by a particular class of wavelets.

`This method also presents a fast matching scheme based on exclusive OR operation to compute the similarity between a pair of position sequences. Using wavelet analysis, the position of local sharp variation points in each intensity signal were recorded as features. Directly matching a pair of position sequences is also very time-consuming. Here, a fast matching scheme based on the exclusive OR operation was adopted to solve this problem.

5. Boles and Boashash

In Boles's work [5] Iris recognition system is designed to handle noisy conditions as well as possible variations in illumination and distance between the camera and the face. The characteristics of the irises, They will only deal with samples of the grey-level profiles to construct a representation. Input images are pre-processed to extract the portion containing the iris. Then proceed to extract a set of one dimensional (1-D) signals and obtain the zero-crossing representations of these signals. To represent the features of the iris by fine-to-coarse approximations at different resolution levels based on the WT zero crossing representation. The representation can be build by, a set of sampled data is collected, followed by constructing the zero-crossing representation based on its dyadic WT.

$$D^{(p)} = \sum_{j=k}^{L} \frac{d_j^p(f,g)}{Q}$$

The feature extraction in this extracted information from any of the virtual Circles must be normalized to have the same number of data points. A normalization value N, which is selected as a power-of-two Integer value. The main reason for this selection is to enable the extraction of the whole information available in the iris signature by applying the dyadic wavelet transform.

The accuracy of the classification process can be adjusted by changing the normalization constant. The information of iris signature is analyzed in more detail. by applying large value of N results in decomposing the iris signature to a large number of levels. This implies that the classification is more accurate. In contrast, a small normalization value N results in reducing the accuracy of the classification but increases the speed of the whole process. a zero-crossing representation from the normalized iris signature f(n); n 2 Z. A closed ring represented by normalized iris recognition and the wavelet coefficients are periodic by the help of zero crossing representation. Where p = 1; 2 refers to one of the dissimilarity functions defined above.

Discussion and conclusion

The most robust way was considered iris identification to identify different human. It provides enough accuracy and safe recognition. The most unique and data rich physical structure on the human body is iris. This system has been also work when people wear sunglasses or contact lenses. The image is decomposed by 2-D Gabor Phase Coefficients and Wavelets is applied on it. The frequency components of various bands are used to extract feature vectors suitable for robust recognition. The main problems of scaling, illumination, rotation in vision drawbacks had to be solved were the reflections of the eye to the light source. and in our research we wil use combination of DCT and wavelet, which gives more efficiency to the recognition system. The cost of designing and manufacturing of such a system is very high, so its cost gives disadvantage to the system.

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