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DCT (Discrete Cosine Transform) Coefficient based Iris Recognition System

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Abstract

For achieving high security in varied areas, biometric system has become common analysis space over past decades. Biometric system provides machine-controlled personal identification supported distinctive features of an individual. Biometric system depends on distinguishing every individual on the premise of their physiological options (face, finger print, palm print, retina, iris) still as behavioral options (signature, key stroke, voice). Security will primarily be achieved by three factors: password or pin, sensible token or access card, biometric technology. Out of those three ways, biometric system is best as a result of user ought not to remember (password or pin) or keep something (smart token or access card) for identification or verification. In this paper present a novel approach iris recognition based on DCT Matrix coefficient and significant recognition rate as well as speed is achieved.

Keywords: *DCT, image, recognition system, iris*

1. Introduction

Comparison of some biometric methods with iris recognition is given as:

1.1 Finger Print Vs Iris Recognition

Both biometric strategies have some common characteristics and each is reliable and correct however iris recognition system is healthier than fingerprint because of some advantages: 1) iris recognition system (1 in 131,000) has low error rate as compared to the finger print (1 in 500+). 2) there's a lot of risk of forgery in finger print as compared to iris system as a result of harm to iris isn't the maximum amount straight forward as finger. 3) Finger print needs physical contact with device whereas in iris recognition system [1, 2, 3] no physical contact is needed to make iris example.

1.2 Voice Recognition Vs Iris Recognition

Voice recognition is a smaller amount correct than iris recognition system owing to terribly high error rate(1 in 50) as compared to the error rate(1 in 131,000) of iris recognition system. Voice recognition is straightforward to use, low cost and non-intrusive however occurrence of errors during this system is high because of cold and a few external factors like cold. Voice recognition system is barely used for verification whereas iris recognition system is employed for each identification and verification.

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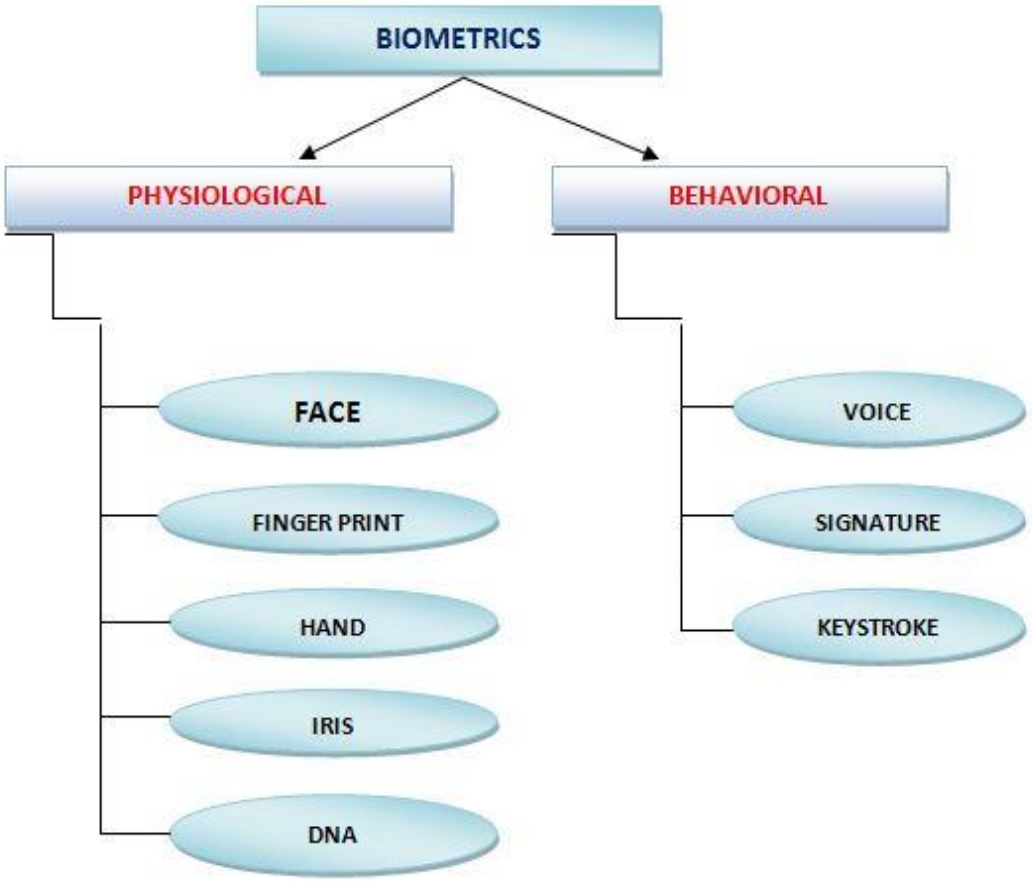

Figure 1. Types of Biometrics

1.3 Face Recognition Vs Iris Recognition

Face recognition is additionally non-intrusive like iris recognition however less reliable than iris recognition because of low level of stability in face (as face changes with time as compared to the iris that remains same when eight months older throughout life). Each technologies disagree in terms of False acceptance rate (FAR) as way of face recognition is 1:100 whereas 1:1.2 million for iris recognition.

1.4 Hand Pure Mathematics Vs Iris Recognition

Hand pure mathematics is straightforward to use and cheaper however less correct than iris recognition system as a result of error rate of hand pure mathematics is one in five hundred that is incredibly high as compared to iris recognition system (1 in 131,000). It produces false negative simply as a result of hand options aren't distinctive thus this method isn't the maximum amount reliable as iris recognition (iris has important property of singularity i.e. no 2 twins have same iris, even it differs in left and right eye of person).

2. Proposed Scheme

For feature extraction of the normalized iris image, ***Discrete Cosine Transform*** **(DCT)** [4-6] matrix is used. The DCT matrix is given by:

$$\mathbf{T_{ij}} = \begin{Bmatrix} \frac{\mathbf{1}}{\sqrt{\mathbf{n}}} \mathbf{if i} = \mathbf{0} \\ \sqrt{\frac{\mathbf{2}}{\mathbf{n}}} \mathbf{cos}\left[\frac{(\mathbf{2j}+\mathbf{1})\mathbf{i\pi}}{\mathbf{2n}}\right] \mathbf{if i} > 0 \end{Bmatrix}$$

For a 4x4 block, the following results are observed and these are shown in the matrix below:

$$T = \begin{bmatrix} 0.5000 & 0.5000 & 0.5000 & 0.5000 \\ 0.6533 & 0.2706 & -0.2706 & -0.6533 \\ 0.5000 & -0.5000 & -0.5000 & 0.5000 \\ 0.2706 & -0.6533 & 0.6533 & -0.2706 \end{bmatrix}$$

Where the first row i=1 has all entries equal to $1/\sqrt{4}$(as defined in the equation above), the column of T form an orthonormal set so T here, represents an orthonormal matrix. The DCT matrix is more efficient and faster as compared to two dimensional DCT which is used for square input images. DCT is used in many images compressing technique [20]. In this case, the input images are divided into a set of 4-by-4 blocks and thereafter the two dimensional DCT is employed to each block for obtaining the DCT coefficients. The obtained DCT coefficients are then binarized to form the templates of the image. Now to reduce the size of template, the most discriminating coefficients of DCT matrix are extracted and binarized. For binarization, the value of positive coefficient is assumed as one and the value of negative coefficient is discarded.

2.1. Matching

For comparing the two iris codes, the hamming distance algorithm is employed. Since the iris region contains features with very high degrees of freedom, and each iris produces bit-pattern which is autonomous to that produced by another iris, whereas the codes produced by the same iris would be similar. If two bits patterns are completely independent, then the ideal Hamming distance between the two patterns will be equal to 0.5. It happens because independent bit pattern are completely random. Therefore, fifty percent bits may agree and else will not agree with these patterns. Daugman had employed hamming distance for checking the tables. This technique is applicable to only bits of real iris area. The Hamming distance will be defined as follows:

$$HD = \frac{1}{N}\sum_{j=1}^{N} X_j \oplus Y_j$$

Where X_j and Y_j are the two bit wise template to compare and N is the number of bits represented by each templates. The Hamming distance can be computed using the elementary

logical operator XOR (Exclusive-OR) and thus can be completed very quickly. In the present case, the HD is 0.445 which signifies that if the hamming distance between the two templates is below 0.445 than both the irises are of same eye and if the HD value falls above 0.445, it signifies that both the irises are from different eye.

3. Simulations Results

To evaluate the performance of the proposed method, the iris images are collected from the largest available UBIRIS database version4.1. Almost 990 images of 198 different persons are taken. The entire testing is done on the ***Matlab*** 7.5 platform and the laptop of 1.85GHz processor and 1GB RAM is used to run our prototype model.

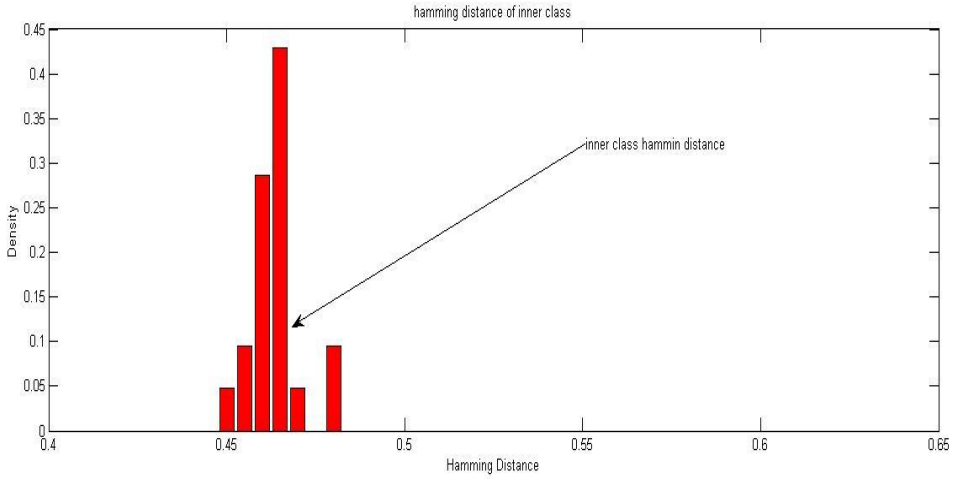

Figure 2. Hamming Distance of Inner Class

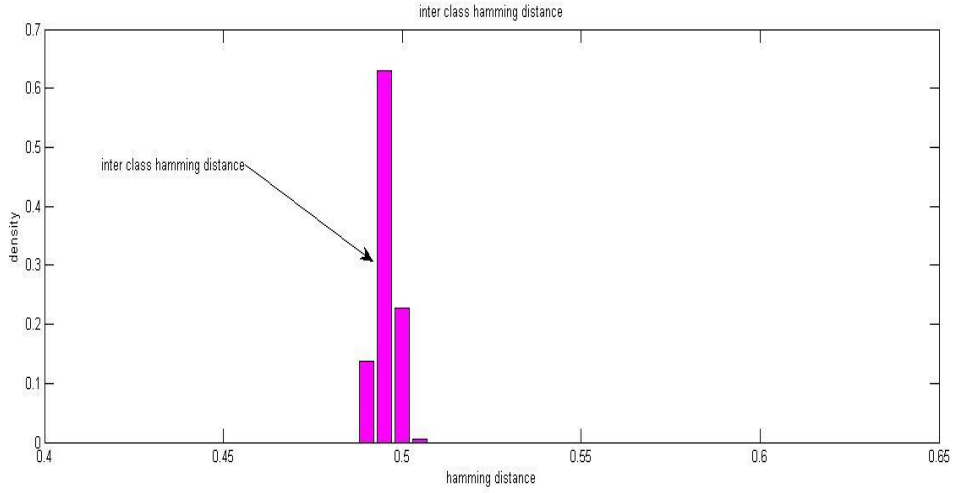

Figure 3. Inner Class Hamming Distance

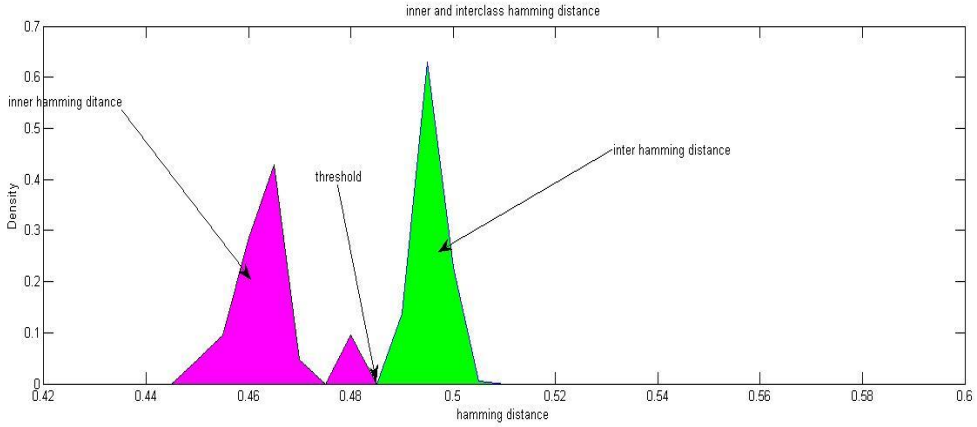

Figure 4. Inner and Inter Class Hamming Distance

Table 1. FAR and FRR

	HD	**FAR**	**FRR**
Proposed Method	0.445	0.19%	0.26%

Where the **False Acceptance Rate** (FAR) and **the False Rejection Rate** (FRR), defined as the accepting of a false person and rejecting of a genuine person for a given value of hamming distance respectively

The performance evolution of any iris recognition system is done on the basis of **Recognition Rate** (RR) and **Equal Error Rate**(EER), defined as the number of the correct recognition and the point where the FAR and FRR both are equal in value respectively. In this case, the value of RR is 99.84% and EER is 0.11%. The Table 2 shows the comparison of existing and well-known iris recognition and Table 3 shows the speed comparison between existing systems. Both the tables show that the algorithm which has been proposed here has a higher recognition rate as well as higher speed. Although, Daugman system has high recognition rate than the proposed system, but the Daugman system comparatively has low speed. On the other hand the Boles system offers high speed but it has low recognition rate and higher EER. Therefore when both speed and recognition rate are taking into consideration, the proposed algorithm is far better than the existing ones.

4.1 Conclusion

In this study robust iris recognition system is based on two dimensional DCT coefficients. the DCT coefficient extraction and decomposition is one of the famous technique for image decomposition, as well as it is the one of the fastest technique for image decomposition. The research paper presented here shows that that proposed algorithm is the effective technique for iris recognition based on DCT coefficient extraction in terms of recognition as well as speed consideration.

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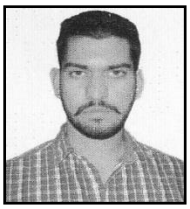
Authors



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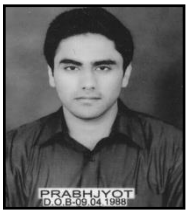

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