IMPLEMENTATION OF IRIS RECOGNITION AND FEATURE EXTRACTION TECHNIQUE BASED ON 2D DCT

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Abstract : Biometric system based on iris is the most secured system comparatively to any other biometrics because of its characteristics that remains unchanged throughout. Here iris feature extraction is implemented, primarily any iris recognition system posses following steps, image acquisition, image pre-process, feature extraction and matching. Circular Hough transform is used for iris localization and then iris image are normalized by using Daugman rubber-sheet model so as to transform the iris region into a fixed dimension. 2D discrete cosine transformation is used for feature encoding. The two databases CASIA V1.0 and IITD databases is used for testing the 2D DCT encoding. A threshold value is applied to distance metric and false rejection and acceptance rate is recorded. An accuracy of 99.3% and 98.4% are recorded on CASIA V1.0 and IITD database respectively.

IndexTerms **- FAR, FRR, DCT, Hamming distance.**

I. INTRODUCTION

Biometric system based on iris is the most secured system comparatively to any other biometrics because of its characteristics that remains unchanged throughout. Iris is the most secured biometric as compared to other biometric traits like fingerprint, knuckle print, voice, palm and gait. Iris is the most secured biometric as compared to other biometric traits like fingerprint, knuckle print, voice, palm and gait. Here iris feature extraction is implemented, primarily any iris recognition system posses following steps, image acquisition, image pre-process, feature extraction and matching. In feature extraction phase it extracts most distinctive feature from an image where discriminative iris texture feature information are extracted and encoded for the exact comparison and matching of an iris template. There are various algorithms and techniques for iris feature extraction and the time required for feature extraction depends on the complexity of the extraction techniques. Some of the extraction technique is presented here.

II. FEATURE EXTRACTION TECHNIQUES

Daugman is the pioneer of iris recognition system development [1]. Daugman used integro differential equation for finding papillary-iris circle and iris-sclera circle by computing the summation of heavy jump and drop of the pixel intensities over the circle. Then 2D Gabor wavelet coefficients are used for generating feature vector and Hamming distance is used to match these feature vectors. The following are the iris feature extraction methods.

a) **Appearance Based:** in this method of feature extraction technique Gabor Wavelength, Independent Component Analysis (ICA) and Principal Component Analysis (PCA) algorithm is used.

b) **Texture Based Feature Extraction:** in this method of feature extraction technique Gabor Filter and Gaussian Filter algorithms are used. The extracted features are compared with the feature vector stored in the database.

c) **Feature Based Extraction:** in this method of feature extraction technique wavelet transform and multilevel wavelet transform is used.

The block diagram of Iris image processing is given below which possess six steps iris image Acquisition, preprocessing, Iris Segmentation, Normalization, Feature Extraction and Matching.

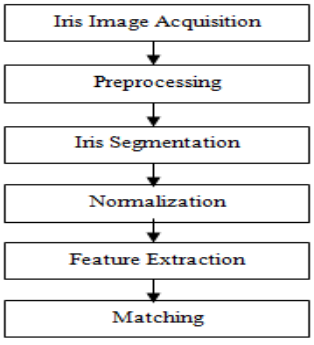


Fig 1: Block Diagram of Iris image processing.

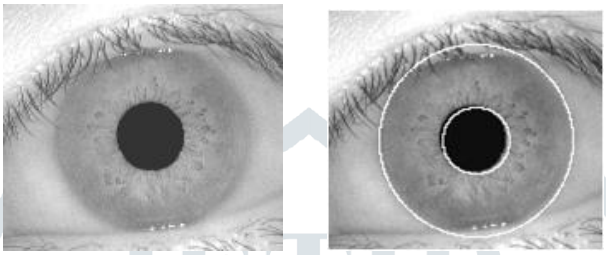
The number of feature extraction techniques is discussed above but the number of bits required to store features are different for different algorithm as tabulated below

Table 1: Algorithm and feature vector [7]

Algorithm	Feature vector(bits)
Wavelet transform	400
Log-Gabor	1024
2D Gabor	2048

III. IRIS LOCALIZATION

Iris is the circular area between pupil and the sclera contains texture information. Iris localization is one of the important steps in feature extraction. For iris feature extraction the region of iris must be identified and it is done with the help of circular Hough transform. Circular Hough transform is capable of identifying circles and lines in the iris image which determines the pupilary circle and the sclera iris circle. The radius and center coordinates are easily found by applying circular Hough transform [2]. Hough transforms works by assuming centre of coordinate and radius those pixels falls on the circumference are set zero when function is executed. In Hough transform a threshold value is set for edge detection, the problem is it deletes some critical edge points which lead to incomplete circle.

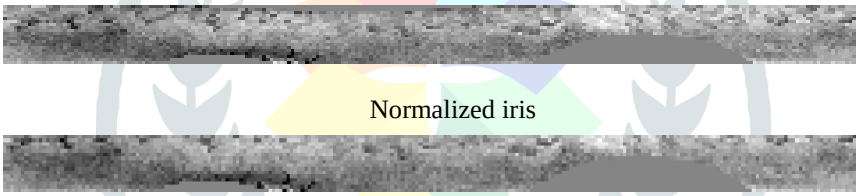


a) Original Eye Image b) Circular Hough

Fig 2: Edge map of original iris image.

IV. NORMALIZATION

In normalization process the image is transformed from polar to Cartesian coordinates. After successful normalization of iris image the iris region is transformed to have fixed dimensions which are shown below. Because of fixed dimension the features remains constant even if different orientation is done. These characteristics make it reliable for feature matching of two images [3, 4].



Normalized iris

Polarcoordianate Iris

Fig 3: Normalization process on CASIA database image

V. FEATURE EXTRACTION WITH 2D- DCT

Most distinct Features are extracted from and image as a feature for matching two iris image. When the large set of data handling become difficult we extract features from it to represent the large set of data and these features are distinct and capable to recognize an individual. From iris image the texture is extracted as a feature. For feature extraction 2D-DCT algorithm is used and these features are encoded to protect information loss of feature.

Fig 4: Feature extracted and encoded

VI. MATCHING

For matching two irises feature matrix are compared using the hamming distance. Humming distance computes the difference between two vectors of features and if the difference is below the threshold value means it is matched and if the difference computed is above the threshold value then the decision made that it is not matched. When two iris vector of same image is compared then it is called intra class comparison and when it is compared with different iris vectors then it is called inter class comparison. The humming distance is the sum of exclusive-or between two vectors.

VII. RESULT ANALYSIS

While implementation selected eye images are considered from the database and at first the uniqueness of iris pattern is checked. The templates generated from different iris are compared to check uniqueness of it, after uniqueness checking the templates are used for comparison for identification of an individual. Hamming distance is calculated between two templates. A threshold value is set to calculate hamming distance if the result of hamming distance is below the threshold value then it is considered that it is matched and if the result is higher than the threshold value then it is considered that it is not matched. The below mentioned table contains different threshold values and their False Acceptance Rate and False Rejection Rate.

Table 2: Threshold values and their corresponding FAR and FRR

Threshold value	FAR	FRR
0.45	0.1023	0.286
0.55	0.1409	0.143
0.65	0.1537	0.139

VIII. RESULT OF 2D DCT APPROACH

Discrete Cosine Transform (DCT) is highly used for image compression, to apply this algorithm on our CASIA and IITD database, 50 classes of CASIA V1.0 and 20 classes of IITD images are considered [5,6]. It gives both low and high frequency components for feature extraction where as the low frequency components are considered and the high frequency components are discarded. Our method is applied on CASIA v1.0 and IITD database and the results are shown below.

Table 3: DCT results

Proposed method	2D DCT
Hamming distance value	0.5
FAR	0.18
FRR	0.27
Recognition rate	99.5
EER	0.09

The recognition rates and number of DCT coefficients are enlisted in the Table-4. In DCT it is observed that it uses very less number of coefficients and that does not affect the accuracy. On the same set of normalized image all comparison for identification and verification are carried out at feature extraction level for fair comparison. DCT approach reduced the computational complexity.

Table 4: Result analysis on different databases

Database	Proposed DCT		Threshold value	Number of bits
	CRR		ERR	
CASIA	99.41	0.09	0.5	120
IITD	98.47	0.16	0.5	120

IX. COMPARISON WITH EXISTING ALGORITHM

Performance of the recognition system analyzed on the basis of recognition rate which includes FAR, FRR, ERR and required number of coefficient for matching templates. A comparison table of this approach is given below [8], [9], [10], [11].

Table 5: Different algorithms and their recognition rates

Researcher	Algorithm	Year	Recognition rate(in percentage)
Libor Masek	1D Log Gabor	2003	98.5
J.Daugman	Gabor filter	2004	100
Chia Te Chu	LPCC	2005	96.8
Viaden Velisaulesevic	Directionlets	2009	97.4
Amir and Hamid	Contourlet transform	2009	94.2
Hui Lui	2D log Gabor	2010	98.5
Tze Wang	Haar wavelet	2010	98.45
S.Hariprasd and S.Venkatsubramian	Wavelet packet	2012	93
Kshamaraj Gulmire and Sanjay Ganorkar	Gabor wavelet	2012	99
Pravin S Patil	Log Gabor	2012	98.4
Yong Zhang and Yan Wo	Fusion of 2D Gabor and 1Dlog-Gabour	2013	98.92
Mah Mond Elgana and Nasser Al Biqami	Wavelet transform	2013	99.5
Mohd. Tariq	1D Gabor	2013	99
Ankush Kumar	1D Wavelet	2013	97.5
Charles O Ukpai	Dual tree complex wavelet transform	2015	98.86
Proposed method	2D DCT	2019	99.5

X. CONCLUSION

Iris is the trait whose features remain unchanged throughout the life and hence it is the most reliable trait for biometric authentication system. Our experiment shown an excellent result of recognition of an individual and hence it could be applied for the biometric authentication system. The 2D-DCT is excellent in terms of the length of the feature vector reduction. It has been observed that the experiment performed on the images of CASIA V1.0 and IITD database given an excellent result. Hence the proposed method can be implemented for the improvement of the recognition rate and accuracy of personal identification in biometric authentication system based on iris.

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