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Iris and Fingerprint Recognition using Multiple Transformation

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Abstract **– A wide variety of systems requires reliable personal recognition schemes to confirm or determine the identity of an individual requesting their services. Fingerprint and Iris Recognition using Multiple Transformation provides easiest way of security and faster processing. It ensures data security and protection of system from unauthorized users as well. This paper focuses on Iris and Fingerprint features. In the first part, Iris template is generated from Iris image. Then Iris features are generated by applying Discrete Wavelet Transformation (DWT) and Discrete Cosine Transformation (DCT) on Iris Template. Second part focus on fingerprints; the Fingerprint is preprocessed to get Region of Interest. Using DWT and Fast Fourier Transformation (FFT), features of Fingerprints are obtained. Finally, both the Iris and Fingerprint features are concatenated to obtain final set of features. The final feature is compared with stored database using Euclidean distance matching to obtain exact match. We check False Acceptance Rate (FAR) and False Rejection Rate (FRR) at different threshold level.**

Keywords **– Fingerprint, Iris, DWT, DCT, FFT, Euclidean Distance, FAR, FRR.**

I. Introduction

Recognition using single biometric trait is not sufficient. These system performs better for certain assumptions but fails when the biometric data available is noisy, also fails in case of unavailability of biometric template. Limitations of unimodal biometric systems can be overcome by using multimodal biometric systems which refers to the use of a combination of two or more biometric modalities in verification / identification system [6].

The most widely used method for recognition for person is fingerprint and iris. The reason for chosen these two biometric are (1) Iris has high degree of randomness as no two iris are alike and remains stable throughout person's life [1]. (2) Fingerprint developed at fetal stage and remain same throughout person's life. Fingerprint consist pattern of ridges and valley. Ridges are dark colored and can be used for identification [2]. Valley is the region between two adjacent ridges. Multimodal biometric systems often provide promising results than any single biometric system [8].The access to the secured area can be made by the use of ID numbers or password which amounts to knowledge based security. But such information can easily be accessed by intruders and they can breach the doors of security. This happens in case of net banking and highly secured information zone. Thus to overcome the above mentioned issue multimodal biometric traits are used.

Contribution- In this paper we generate iris template after preprocessing where image is converted to grey. Image features are information extraction from images where DCT coefficients are features from Iris. DWT and DCT are used to generate iris features. The DWT and FFT are used to generate features of fingerprint. Finally iris and fingerprint features are concatenated and generate final features for matching.

II. Existing Approaches

Arun Ross and Anil K Jain [3] introduced various scenarios that are possible in multimodal biometric systems, the levels of fusion that are plausible and the integration strategies that can be adopted to consolidate information.

Mahdi S Hosseini and Hamid Soltanian-Zadeh [4] introduced an algorithm that encodes the pattern of pigment melanin in the Visible Light (VL) image, independent of textures in the Near-Infrared (NIR) image. It also extracts invariant features from VL and NIR images, whose fusion leads to higher classification accuracy.

S.Prabhakar, A. K. Jain, and J.Wang [2] presented a unimodal fingerprint verification and classification system. The system is based on a feedback path for the feature-extraction stage, followed by a feature-refinement stage to improve the matching performance.

N. K. Ratha, R. M. Bolle, V. D. Pandit, and V. Vaish[9] proposed a unimodal distortion-tolerant fingerprint authentication technique based on graph representation. Using the fingerprint minutiae features, a weighted graph of minutiae is constructed for both the query fingerprint and the reference fingerprint. The proposed algorithm has been tested on a large private database with the use of an optical sensor.

III. Levels of Fusion

Fusion levels define how fusion is performed [10]. Levels of Fusion

1. Fusion at feature extraction level: The information extracted from different modalities is stored in vectors and these feature vectors are combined to create a joint feature

vector which is used for matching and recognition process.
2. Fusion at matching score level: In this approach the score generated from different modalities.
3. Fusion at decision level: In this approach feature extraction, matching and recognition processes are completed by each biometric system. Output of this is majority decision among all subsystem.

From above fusion levels, fusion feature extraction level is expected provide better recognition results.

IV. Background

DWT: It is wavelet transformation. The advantage of DWT is it captures both frequency and time. At each level DWT is decomposed into low frequency and high frequency band. DCT: Just as Fourier transform uses sine and cosine waves to represent a signal, DCT uses only cosine waves. The cosine is more efficient than sine functions.

FFT: The FFT algorithm is used to reduce the computation time. It provides a path to transform current image from spatial space into frequency space. FFT is used to remove noise from image.

V. Model

In this section the definitions of performance parameters, proposed system and fingerprint, iris matching is discussed.

A. Definitions:

(i) False acceptance rate (FAR): The probability that the system incorrectly matches the input pattern to a non-matching template in the database.

$$FAR = \frac{\text{No. of incorrect matches}}{\text{No. of images out of database}} \quad (1)$$

(ii) False rejection rate (FRR): The probability that the system fails to detect a match between the input pattern and a matching template in the database.

$$FRR = \frac{\text{No. of Falsely rejected images}}{\text{No. of images in the database}} \quad (2)$$

(iii) Equal Error Rate (EER): Rate at which both accept and reject errors is equal.

(iv) Euclidean Distance: It is the straight line distance between two pixels. If p and q are two pixels with coordinates (x1, y1) and (x2, y2), then

$$D_E = \left[(x_1 - x_2)^2 + (y_1 - y_2)^2 \right]^{1/2} \quad (3)$$

B. Proposed System

Discrete wavelet transformation and discrete cosine transformation are used to generate features of iris and DWT and FFT are used to generate features of fingerprint.

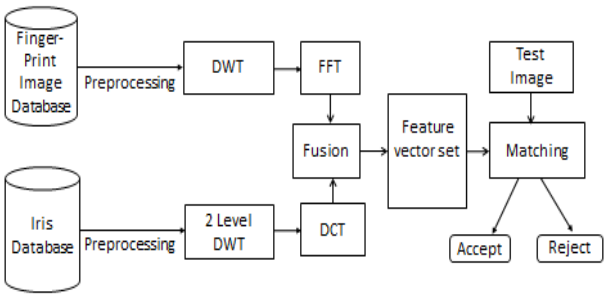
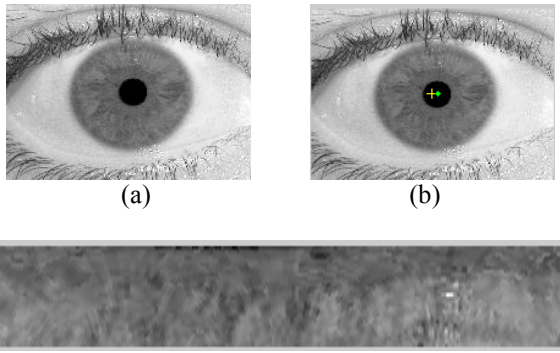


Fig.1. The block diagram of proposed model

(i) Iris Database- Iris images are taken from Chinese Academy Science Institute of Automation (CASIA V1.0).The database considering 10 persons, 5 sample per person taken at different timing. Out of 50 images, for each person first 3 samples are used in database. The 2 samples of each person are considered as test image to compute to FRR.

(ii) Iris Preprocessing - The iris image must be preprocessed before using it for the feature extraction purpose.

Pupil detection: To find the boundary between the pupil and iris, it must detect the location (centre coordinates and radius) of the pupil. The rectangular area technique is applied in order to localize pupil and detect the inner circle of iris. The pupil is a dark circular area in an eye image.



(a) (b)

(c)

Fig.2. (a) Iris image (b) Center of pupil (c) Normalized iris

Besides the pupil, eyelids and eyelashes are also characterized by black colour. The following formula is used to find the centre coordinates (xp, yp) of the pupil.

Xp = (X3+X4)/2, Yp=(y3+y4)/2 (4)

(iii) Fingerprint Database- The fingerprint images are taken from FVC2004. The database considering 10 persons, 5 sample per person taken at different timing. Out of 50 images and for each person first 3 samples are used in database. The 2 samples of each person are considered as test image to compute FRR.

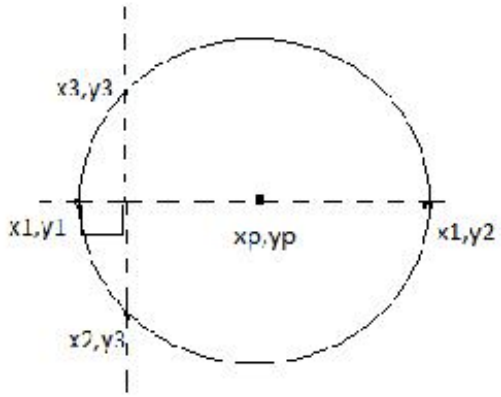


Fig.3. Finding centre of pupil

(iv) Fingerprint Preprocessing- Fingerprint image is preprose- ssed to extract the ROI (Region of interest)[7].

(a) (b)

Fig.4. (a) Orignal fingerprint imag (b) Cropped image

(v) Iris Features- To generate iris features two level Discrete wavelet Transformation (DWT) is applied on iris template and then DCT is applied on approximation band of second level DWT.The DCT Equation is given as

$$y(k) = w(k) \sum_{n=1}^{N} \mathrm{x(n)} \cos \frac{\pi(2n-1)(k-1)}{2N}$$

For k = 1…….. N (5)

$$\text{Where w(k)=} \begin{cases} \frac{1}{\sqrt{N}} & k = 1 \\ \sqrt{\frac{2}{N}} & 2 \le k \le N \end{cases}$$

(vi) Fusion- No any individual trait can gives 100% accuracy. Thus in proposed system the features of iris and fingerprint are fused using concatenation and generate extracted feature vector set to recognition of person.

(vii) Euclidean distance matching - Extracted features are compared with database features by using Euclidean distance for matching.

VI. ALGORITHM

The proposed algorithm is used for recognition of person effectively by fusion of iris and fingerprint.

The objectives are –
i) The value of FAR bereduced.
ii) The value of FRR be reduced

Table 1: Proposed Algorithm

Input: Iris and Fingerprint database
Output: Recognition of person
1. Read iris and fingerprint images
2. Preprocessed iris image
3. Preprocessed fingerprint image
4. 2- level DWT and DCT is applied on iris template
5. Preprocessed fingerprint image
6. DWT is applied on fingerprint
7. FFT is applied on approximation band
8. Features of iris and fingerprint are fused by concatenation
9. Repeat 1 to 8 steps to test iris and fingerprint
10. Test features are compared with data base features using Euclidean distance

In this paper we introduced identification system based on iris and fingerprint traits. In enrollment process we can find pupil centre. From the centre of pupil we can calculate radius of the pupil. Then apply 2 level DWT on iris template.

After preprocessing on fingerprint image, ridges in fingerprint are darked with black colour and furrows with white colour. Then fingerprint imges is cropped to obtain region of interest.

VII. RESULT

After processing the input image, we get the correct output that is person recognition correctly. If we enter different iris and fingerprint images of different person from the database we get the output as not recognized.

Following table shows the value of FRR decreases from 100% to 40% and the value of FAR is 0% for all threshold values.

Table 2: FRR, FAR variation with threshold for fusion

Threshold	FRR (%)	FAR (%)
10	100	0
20	100	0
30	95	0
40	90	0
50	85	0
60	65	0
70	55	0
80	45	0
90	40	0
100	40	0

VIII. CONCLUSION

The paper presents person recognition system by combining iris and fingerprint features. Here we preprocessed iris image and obtain centre and radius of pupil. On preprocessed iris template two level DWT is applied and applying DCT on low frequency band iris. The fingerprint image is preprocessed to obtain ROI then applied DWT and FFT to generate features of fingerprint. The experimental results achieve better result. The features of iris and fingerprint are concatenated to generate feature vector set. By using Euclidean distance on test feature vector and feature vector set, final decision of recognition is made.

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