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Thepade's Sorted Ternary Block Truncation Coding with Score level fusion for Multimodal Biometric Identification using Iris &Palmprint

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Abstract— The fusion of multiple biometric traits helps to increase accuracy in terms of genuine acceptance ratio (GAR). Here Iris and Palmprint fusion at Matching Score level is performed. The feature extraction in spatial domain using Thepade's sorted ternary block truncation coding is taken here to reduce the feature vector size of image. Iris and Palmprint are together taken here for identification. The test beds of 60 pairs of Iris and Palmprint samples of 10 persons (6 per person of iris as well as Palmprint) are used as test bed for experimentation. Experimental result in matching score proportion of Iris: Palmprint (1:4) using TSTBTC given better performance as indicated by higher GAR values than all other scores for matching score level fusion of proposed multimodal biometric identification using TSTBTC.

Keywords— Multimodal Biometric, Matching Score level fusion, GAR, TSTBTC.

I. INTRODUCTION

Deployment in biometric systems have several benefits depending on the type of application such as increase in security, reducing fraud, improving service and increase accountability, more user convenience [1].

Multimodal biometric systems consolidate the data coming from different biometric sources. These sources may be multiple sensors to the same biometric modality; multiple snapshots capture of the same biometric modality, multiple representations the same biometric modality, several biometric modalities [1].

In multimodal system here various biometric modalities are considered the fusion at different levels is possible. Fusion at feature level, fusion done at score level and fusion at decision level. In feature level fusion, feature vector coming from different modality are fused together so it takes more space. The data from multiple sources are incompatible so this type of fusion.

Score level fusion and decision level fusion is relatively easy as compare to feature level fusion. In score level fusion score from different modality are found out and fused together to produce a single score. But the score is limited information so sometimes this type of fusion is less used.

II. LITERATURE REVIEW

Features may be considered as color, shape, texture of an biometric image. Averaging and Histogram techniques are used realize the color facet of an image. Texture can be obtained by using transforms or vector quantization. Shape aspects are achieved with gradient operator or morphological operator. Earlier approaches have studied as Block Truncation Coding (BTC) and color moments to classify images into various categories.[2]

A. Block Truncation Coding(BTC)

Block Truncation Coding (BTC) was first developed in 1979 for grayscale image. Block Truncation coding is a simple compression algorithm which segments the image .In this method first divides the image into small non-overlapping blocks. The small blocks are coded one at a time. For each block, the original pixels within the block are coded using a binary bit-map and two mean pixel values [3].
It is an efficient image coding algorithm. The algorithm involves an image to be segmented primarily into (n×n) non overlapping blocks of image. Coding of small image blocks are done one at a time. RGB space is most use color space possibly considered as most familiar color space [4].

A binary bitmap of the same size of block is formed for single bitmap BTC of color image. An Inter Band Average Image (IBAI) is first created to form a binary bitmap in the RGB space and threshold value is computed. The pixels in the IBAI are compared with the threshold value to create the bitmap.

Block truncation coding produces two colors mean one for the pixels greater than or equal to the threshold and ,other for the pixels smaller than the threshold are calculated. Size of feature vector is six that is ft=[uR,uG,uB,lR,lG,lB],'uR' as upper for red plane and 'lR' as lower for red plane same for green and blue.

B. Thepade's sorted ternary block truncation coding(TSTBTC)

In the Ternary BTC will contain three non overlapping regions. Three distinguished regions of pixels are formed with help of multimodal characteristic of pixel intensity values [5]. Color BTC works on individual color planes. Image features are generated from the individual Red, Green and Blue planes of an image. Ternary BTC can be static or dynamic based on the level decided at runtime. There are multiple variations for BTC depending on levels and color spaces.

Considers the image is size dimensions and having red, green and blue planes respectively. So the threshold can computed for red plane as given in following equations [1][2][3]. Same equations for green and blue plane respectively.

$$LR = \left(\frac{3}{r \times c}\right) \times \sum_{i=1}^{\frac{r \times c}{3}} sortedRED \quad (1)$$

$$MR = \left(\frac{3}{r \times c}\right) \times \sum_{i=(r \times c)/3+1}^{\frac{2 \times r \times c}{3}} sortedRED \quad (2)$$

$$HR = \left(\frac{3}{r \times c}\right) \times \sum_{i=(2 \times r \times c)/3+1}^{\frac{r \times c}{3}} sortedRED \quad (3)$$

In TSTBTC the feature vector is produces as considering the upper, middle and lower. Size of feature vector is nine that is ft= [LR, MR, HR, LG, MG, HG, LB, MB, HB].LR is lower red, MR is middle red, HR is higher red same for green and blue plane.

III. MULTIMODAL BIOMETRIC IDENTIFICATION

The system based on proposed multimodal identification has two modules. First Module is Feature extraction and Second Module is Query execution.

A. Feature Extraction

Step i. Read both Iris and Palmprint image.
Step ii. Apply TSTBTC on iris as well as palmprint image and sort the feature in acceding order.
Step ii. Generate feature vector and stored it into the database individually.

B. Query Execution

Step i. Read both Iris as well as Palmprint image.
Step ii. Apply TSTBTC on both images and sort the feature in acceding order.
Step ii. Extract the feature same as mention in feature extraction module.
Step iv. Generate query feature vector.
Step v. Compare query feature vector with feature vector store in template database using similarity measurement criteria as mean square error (MSE).
Step vi. Find out matching Score.
Step vii. Fused the matching score of Iris and Palmprint into single score.
Step viii. Different Score proportions considers as Score1 (1:1), Score2 (1:2), Score3 (1:3), Score4 (1:4) and Score 5(1:9) respectively.

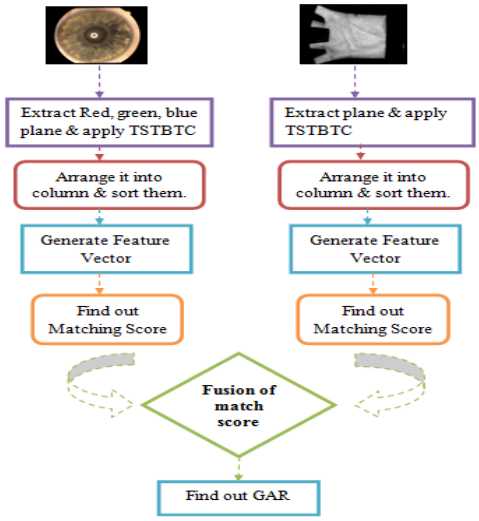

Fig.1.Fusion of iris and palmprint in proposed multimodal identification

Mean Square error is calculated for two feature vectors x and y as given in equation 4,

$$MSE = \frac{1}{N}\sum_{i=1}^{N=1} x_i - y_i \quad (4) \quad (4)$$

Where, N is the size of the vectors. Low MSE indicates higher similarity between the feature vectors x and y.

Here the genuine acceptance rate (GAR) [5] is considered as performance measurement Criteria. In biometric security system GAR will correctly accept an access of attempt an authorized user. A systems GAR typically is stated as,

$$GAR = \frac{Number\ of\ Correct\ Acceptance}{Number\ of\ Identification\ Attempts} \quad (5)$$

IV. EXPERIMENTATION ENVIRONMENT

The Experimentation performed on, Intel Core TMi5 CPU with Matlab. Proposed techniques are tested on Iris & Palmprint Database having 60 images each.

The Iris database created at Palacky University [8].This database has 3x64 right eye and 3x64 left eye images, corresponding to 64 persons .From this 60 iris images belonging to 10 persons are considered for experimentation of proposed method.

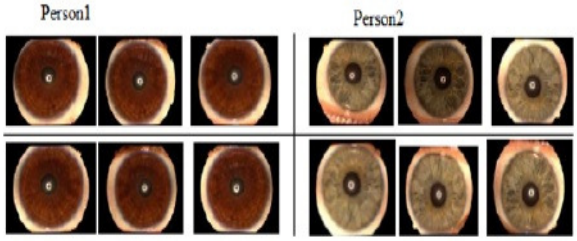

Fig.2.Sample images of Iris Database

The Palmprint database created at **Hong Kong University (PolyU). [9]**Palmprint image were Collected from 250 volunteers. These samples were collected in two separate sessions. Age distributed in 20 to 60 years old. In each Session, the subject was asked to provide 6 images for each palm. From this data base 60 Palmprint images are considered for 10 persons for experimentation of proposed techniques.

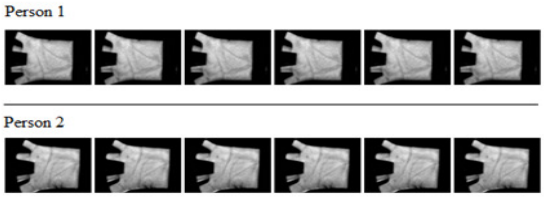

Fig.3.Sample images of Palmprint Database

V. RESULTS AND DISCUSSION

To test the performance of the proposed Multimodal biometric identification techniques, 60 queries of iris and 60 queries of Palmprint. Were fired on the database containing 60 iris images and 60 Palmprint images in 60 pairs of Multimodal biometric traits.

Matching Scores of 'Iris', 'Palmprint' and 'Iris: Palmprint' are computed for identification using TSTBTC of iris and palmprint images. Their Matching Score Proportions are given in following Table I, and plotted in fig.4.

Here Experimentation has been done using TSTBTC of with different matching score Iris: Palmprint proportions. Fusion with Iris: Palmprint of using TSTBTC gives better results than individual iris and individual palmprint based biometric identification methods.

The Iris: Palmprint with matching score (1:1) gives better performance in term of high GAR value as 53% than alone iris and palmprint. Among the matching score proportions tested, The Iris: palmprint of score (1:4) gives best performance in terms of high GAR value as 56.4%.

TABLE I. GAR OF SCORE LEVEL FUISON USING TSTBTC IN PROPOSED TECHNIQUES.

Techniques	Only Iris	Only Palmprint	Score Iris:Palm (1:1)	Score Iris:Palm (1:2)	Score Iris:Palm (1:3)	Score Iris:Palm (1:4)	Score Iris:Palm (1:9)
TSTBTC	49	45.4	53	55.6	55.4	56.4	55.4

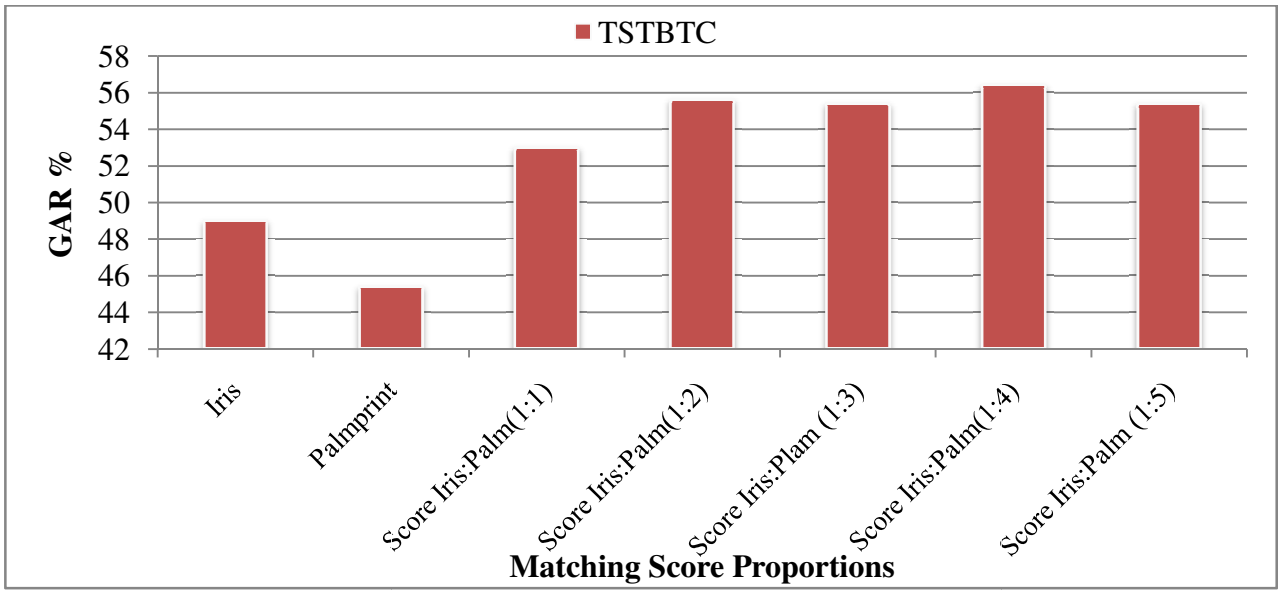

Fig .4. Performance comparison of different Matching Scores for respective TSTBTC in proposed Multimodal Biometric Identification method

VI. CONCLUSION

Multimodal Biometric identification more reliable due to the presence of multiple independent pieces of biometric traits evidences. Use of Thepade's sorted ternary block truncation coding (TSTBTC) gives the better performance using multimodal fusion of iris & palmprint traits. In this Paper TSTBTC with different matching score proportions is proposed to be used in multiple biometric identification. TSTBTC with score level fusion produces higher GAR than individual iris and palmprint traits. Iris: palmprint with matching score (1:4) given best results than other considered score proportions.

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