# Performance Assessment of Color Spaces in Multimodal Biometric Identification with Iris and Palmprint using Thepade's Sorted Ternary Block Truncation Coding

Rupali K.Bhondave
Department of Computer Engg.
Pimpri Chinchwad College of Engineering,
Savitribai Phule Pune University
India

Dr. Sudeep D.Thepade
Department of Computer Engg.
Pimpri Chinchwad College of Engineering,
Savitribai Phule Pune University
India

Rejo Mathews
Asst.Professor
MPSTME
SVKMS NMIMS
Mumbai,India

***Abstract-Biometrics refers to the automatic identification of an individual based on his/her physiological and behavioral traits. Multimodal person authentication system is more effective and more challenging. The fusion of multiple biometric traits helps to minimize the system error rate. 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 (TSTBTC) using level 2 is taken here to reduce the feature vector size of biometric traits. Iris and Palmprint are together taken here to improve accuracy in terms of genuine acceptance ratio (GAR) in Multimodal Biometric identification. The test beds of 60 pairs of Iris and Palmprint samples of 10 person (6 per person of iris as well as Palmprint) are used as test bed for experimentation. In this Paper different color spaces are considered on iris images for improvement in genuine acceptance ratio (GAR). Experimental results consider different matching score proportion of Iris: Palmprint. Using propose techniques with Iris: Palmprint Score 1:3 using TSTBTC Level2 given better performance as indicated by higher GAR values than all other considers scores. RGB color spaces for multimodal fusion of iris: palmprint gives high GAR than all other color spaces like YCgCb, YIQ, YCbCr, YIQ, and KLUV.***

***Keyword-Multimodal Biometric, Matching Score level fusion, GAR, TSTBTC.***

## I. INTRODUCTION

Biometrics is personal identification system .It is an effective method for automatically recognizing person based on their biometric impression with a high confidence. Earlier system such as token based and password system are hacked. Biometric system is more secure than token based system.

A multimodal biometric system consolidates the evidence presented by multiple biometric sensors. Multimodal is better recognition performance compare to system based on a single biometric modality.[1] Multimodal system also provides anti-spoofing measures by making it difficult for an intruder to spoof multiple biometric traits simultaneously[1]. However, an integration scheme is required to fuse the information presented by the individual modalities.

In multimodal system the fusion of various biometric modalities is considered 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.[2]

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.[2]

## II. LITERATURE REVIEW

In original BTC the image is divided into R, B, and G components and compute the inter band average image (IBAI) which is the average of all the components(R, G, and B) and mean of interband average image is taken as threshold. But the disadvantage of this method is that if one of the component is prominent than the other component then that component dominates the threshold value, reducing the effect of other component.

A more general approach is by using three independent R, G and B components of color images to calculate three different thresholds and then apply BTC to each individual R, G and B planes.[3]

### *A. Thepades's Sorted Ternary Block Truncation Coding (TSBTC)*

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 [4]. 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. Ternary BTC level 2 outperforms other variations of BTC [6, 7]

Consider the image of size $p \times q$dimensions and having red, green and blue planes respectively same for other color spaces also. So threshold can be computed for red plane as given in following equations [1] [2][3].

$$Lower = (\frac{3}{p \times q}) \times \sum_{i=1}^{\frac{p \times q}{3}} sortedR \quad (1)$$

$$Middle = (\frac{3}{p \times q}) \times \sum_{i=(p \times q)/3+1}^{\frac{2 \times p \times q}{3}} sortedR \quad (2)$$

$$Higher = (\frac{3}{p \times q}) \times \sum_{i=(2 \times p \times q)/3+1}^{\frac{p \times q}{3}} sortedR \quad (3)$$

*B. RGB Color Space*

RGB is most common color space used to represent color in standard form. It was developed with CRT as an additive color space.

*C. YCgCb Color Space*

In this color space Y stands for luminance and Cg and Cb stands for chromaticity values.[6]

*D. YIQ Color Space*

Color video standard NTSC uses this color space. 'I' show phase and 'Q' use as qudrature. This color spaces is Bandwidth efficient color space than other Color space.

*E. YCbCr Color Space*

It is an additive color space .In this color space Y stands for Luminance and Cb and Cr signify the chromaticity values of a color image.

*F. Kekre's LUV Color Space*

Kekre's LUV color Space is a special case of Kekre Transforms. Here L stands for luminance where as U and V represents chromaticity values for color image.[6]

## III. MUTLIMODAL 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*

Here the features of biometric traits images are extracted for all the images to be registered in database of identification system.

Step i. Read both Iris and Palmprint image.

Step ii.Convert RGB image with respective color spaces like in, YCgCb, YIQ, YCbCb, and KLUV.

Step iii. Apply TSTBTC level 2 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*

For identification of person, the query of multiple modes of biometric traits is formed & matched with the multimodal biometric database with help of feature of TSTBTC on iris & palmprint images.

Step i. Read both Iris as well as Palmprint image.

Step ii.Convert RGB Iris image into respective color space

Step iii. Apply TSTBTC Level 2 on both images and sort the feature in acceding order.

Step iv. Extract the feature same as mention in feature extraction module.

Step v. Generate query feature vector.

Step vi. Compare query feature vector with feature vector store in template database using similarity measurement criteria as mean square error (MSE).

Step vii. Find out matching Score.

Step viii. Fuse the matching scores of Iris and Palmprint together.

Step ix. Different Score proportions to be considered are Score1 (1:1), Score2 (1:2), Score3 (1:3), Score4 (1:4) and Score 5(1:9) respectively.

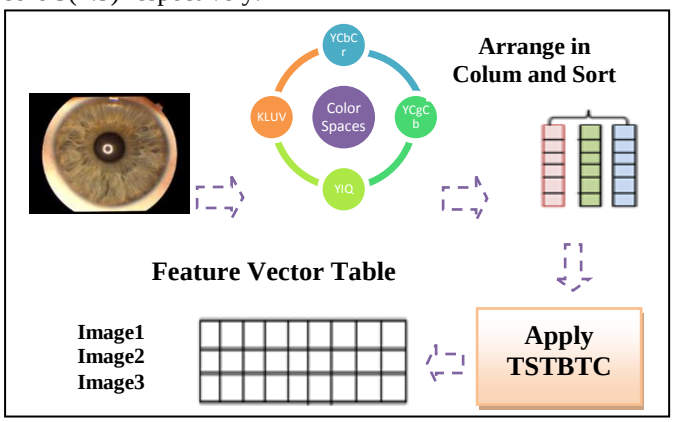


Fig.1.Iris Feature Extraction in Proposed System

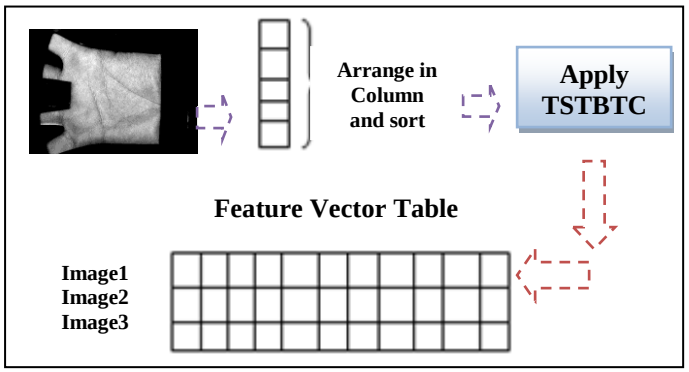


Fig.2.Palmprint Feature Extraction in Proposed System

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

$$MSE = \frac{1}{N}\sum_{i=1}^{N} A_i - B_i \qquad (4)$$

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

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,

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

## 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 [11].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.

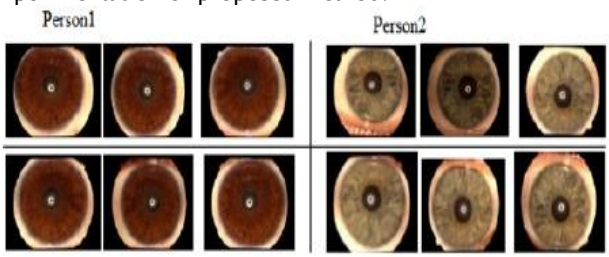


Fig.3.Sample images of Iris Database

The Palmprint database created at Hong Kong University (**PolyU**). [10]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.

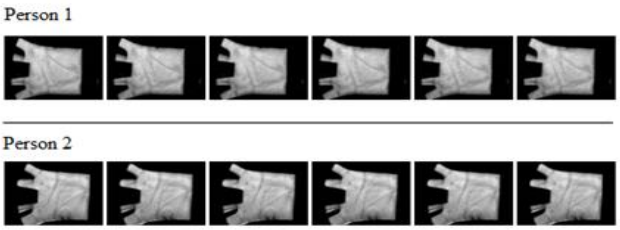


Fig.4.Sample images of Palmprint Database

## 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 level 2 with different color spaces on iris image. Different matching score of Iris: Palmprint are considers for identification. Multimodal fusion with Iris: Palmprint using TSTBTC gives better results than individual iris and individual palmprint based biometric identification methods.

In experimentation TSTBTC level 2 gives better performance than TSTBTC level 1. Here in experimentation it is observe that among all color space RGB color space will give better performance than YCgCb, YCbCr, KLUV and YIQ. After that the YCbCr color space given better performance than YCgCb, YIQ and KLUV.

Among the matching score proportions tested, The Iris: palmprint of score (1:3) gives best performance in terms of high GAR value as 57.6%.

RGB color space is given best performance with Iris: Palmprint fusion of Score (1:3).after that YCbCr with Score (1:9) gives better performance than YIQ, YCgCb and YIQ.

Use of KLUV Color space with Iris: Palmprint fusion gives poor performance in all respective color space.

TABLE I. GAR OF RESPECTIVE COLOR SPACES USING TSTBTC LEVEL 2 WITH DIFFERENT MATCHING SCORE PROPORTIONS IN PROPOSED TECHNIQUES.

| Color Spaces | Iris: Palm 1:1 | Iris: Palm 1:2 | Iris: Palm 1:3 | Iris: Palm 1:4 | Iris: Palm 1:9 | Avg GAR |
|---|---|---|---|---|---|---|
| YCbCg | 41.6 | 45.4 | 46.6 | 47.2 | 50.6 | 46.2 |
| YIQ | 39 | 43 | 43.3 | 44. | 47 | 43.4 |
| YCbCr | 41.2 | 44.4 | 45.4 | 50 | 51 | 46.4 |
| KLUV | 34.6 | 36.6 | 38.6 | 39 | 42 | 38.6 |
| RGB | 55.4 | 57.2 | 57.6 | 57.4 | 57.2 | 56.9 |

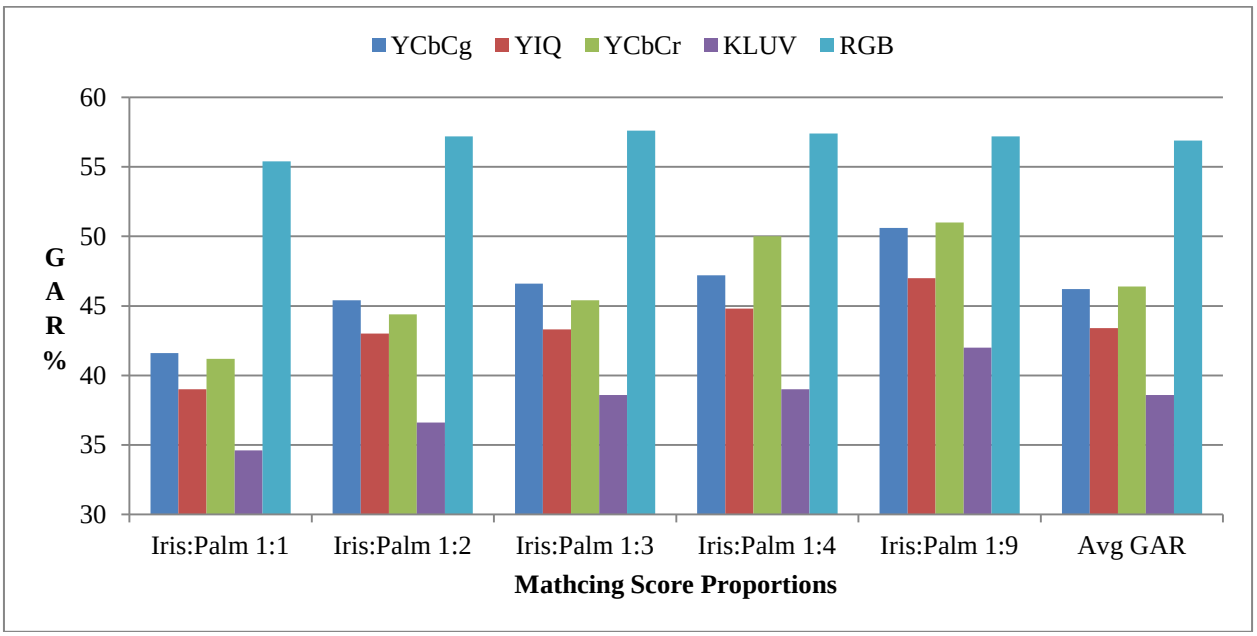


Fig .5. Performance comparison of different Matching Scores (Iris: Palmprint proportions) with respective color spaces using TSTBTC Level2 in proposed Multimodal Biometric Identification method

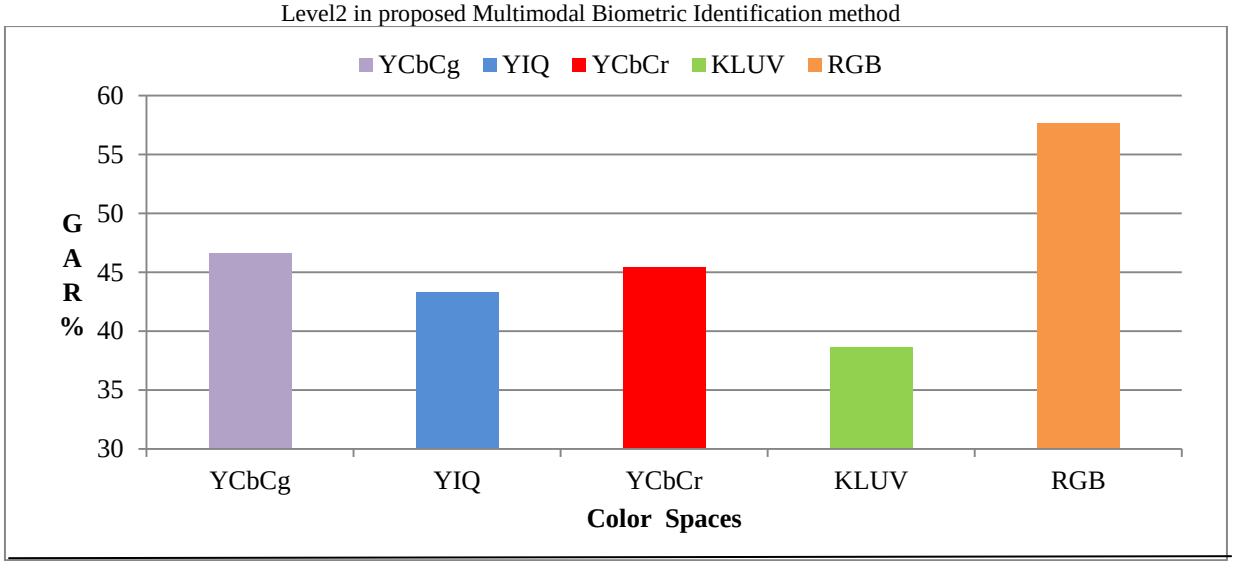


Fig .6. Comparison of different color spaces with reference to Average GAR across all proposed variations of biometric identification

## VI. CONCLUSION

Multimodal Biometric identification is more reliable due to the presence of multiple independent pieces of biometric traits evidences. Use of Thepade's sorted ternary block truncation coding (TSTBTC) Level 2 gives the better performance using multimodal fusion of iris & palmprint traits. In this Paper the TSTBTC with different Color Spaces with matching based multimodal biometric identification method score proportions is proposed. TSTBTC with Level 2 using score level fusion produces higher GAR than individual iris and palmprint traits. Iris: palmprint with matching score 1:3 given best results than other considered score proportions. In Experimentation different color spaces like RGB, YCgCb, YIQ, YCbCr, KLUV and YIQ are used. Among these color spaces, RGB color space with matching score of Iris: Palmprint 1:3 gives high GAR (57.6%).. Here KLUV color space for multimodal fusion of iris: palmprint gives poor performance among the considered.

## REFERENCES

[1] Dr.Sudeep D.Thepade, Rupali K.Bhondave," Bimodal Biometric Identification with Palmprint and Iris Traits

using Fractiona coefficients of Walsh, Haar and Kekre Transforms." 2015 International Conference on Communication, Information & Computing Technology (ICCICT), Jan. 16-17, Mumbai, India.

[2] Dr.Sudeep D.Thepade, Rupali K.Bhondave," Novel Multimodal Identification Technique using Iris & Palmprint traits with Various Matching Score Level Proportions using BTC of Bit Plane Slices".2015 International Conference on Pervasive Computing(ICPC),Jan 9-10,Pune,India.

[3] H.B.Kekre, Sudeep D. Thepade, "Image Retrieval using Augmented Block Truncation Coding Techniques", ACM International Conference on Advances in Computing, Communication and Control (ICAC3- 2009), pp. 384-390, 23-24 Jan 2009, Fr. Concepcion Rodrigous College of Engg., Mumbai. Uploaded on online ACM portal.

[4] H. B. Kekre, Sudeep Thepade, Rik Kamal Kumar Das, Saurav Ghosh," Performance Boost of Block Truncation Coding based Image Classification using Bit Plane Slicing", International Journal of Computer Applications Volume 47– No.15, June 2012.

[5] Dr.Sudeep D.Thepade, Rupali K.Bhondave," Novel Multimodal Identification Technique using Iris & Palmprint traits with Various Matching Score Level Proportions using BTC of Bit Plane Slices".2015 International Conference on Pervasive Computing(ICPC),Jan 9-10,Pune,India.

[6] Dr.Sudeep D.Thepade, Pritam H. Patil," Novel Visual Content Summarization in Videos using Keyframe Extraction with Thepade's Sorted Ternary Block Truncation Coding and Assorted Similarity Measures".2015 International Conference on Communication, Information & Computing Technology (ICCICT), Jan. 16-17, Mumbai, India.

[7] Dr.Sudeep D.Thepade, Nalini B.Yadav," Assessment of Similarity Measurement Criteria in Thepade's Sorted Ternary Block Truncation Coding(TSTBTC) for Content Based Video Retrieval".2015 International Conference on Communication, Information & Computing Technology (ICCICT), Jan. 16-17, Mumbai, India.

[8] Dr. Sudeep D. Thepade, Pushpa R. Mandal," Energy Compaction based Novel Iris Recognition Techniques using Partial Energies of Transformed Iris Images with Cosine, Walsh, Haar, Kekre, Hartley Transforms and their Wavelet Transforms" 2014 Annual IEEE India Conference (INDICON)

[9] Dr.Sudeep D.Thepade, Rupali K.Bhondave," Novel Weighted Score Level Fusion in Multimodal Biometric Identification using Iris & Palmprint Traits",1st International Conference on Futuristic Trends in Computational Analysis and Knowledge Management Feb 25-27,2015.

[10] The Hong Kong Polytechnic University (PolyU) FKP Database:www4.comp.polyu.edu.hk~biometrics/2D_3D_Palm print.html.

[11] Palacky university iris database: "http://www.advancedsourcecode.com/irisdatabase.asp

[12] H B Kekre, S D Thepade, J Jain, N Agrawal "Iris Recognition using Texture Features Extracted from Walshlet Pyramid",International Conference and Workshop on Emerging Trends in Technology (ICWET 2011) – TCET, Mumbai, India

[13] Dr. Sudeep Thepade, Pushpa R. Mandal," Novel Iris Recognition
Technique using Fractional Energies of Transformed Iris Images using Haar and Kekre Transforms." International Journal of Scientific & Engineering Research, Volume 5, Issue 4, April-2014