WELCOME

To Presentation

Hand Geometry based Person Verification System

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Content

A look at our presentation agenda

1. Introduction
2. Literature Review
3. Proposed Methodology
4. Experimental Results
5. Conclusions
6. Questions & Answers

Objectives

- To extract the geometrical features from the hand image
- To verify the unique person based on the hand geometric features

The main aim of this proposed system is to reduce the feature and database size and improve the performance of the system

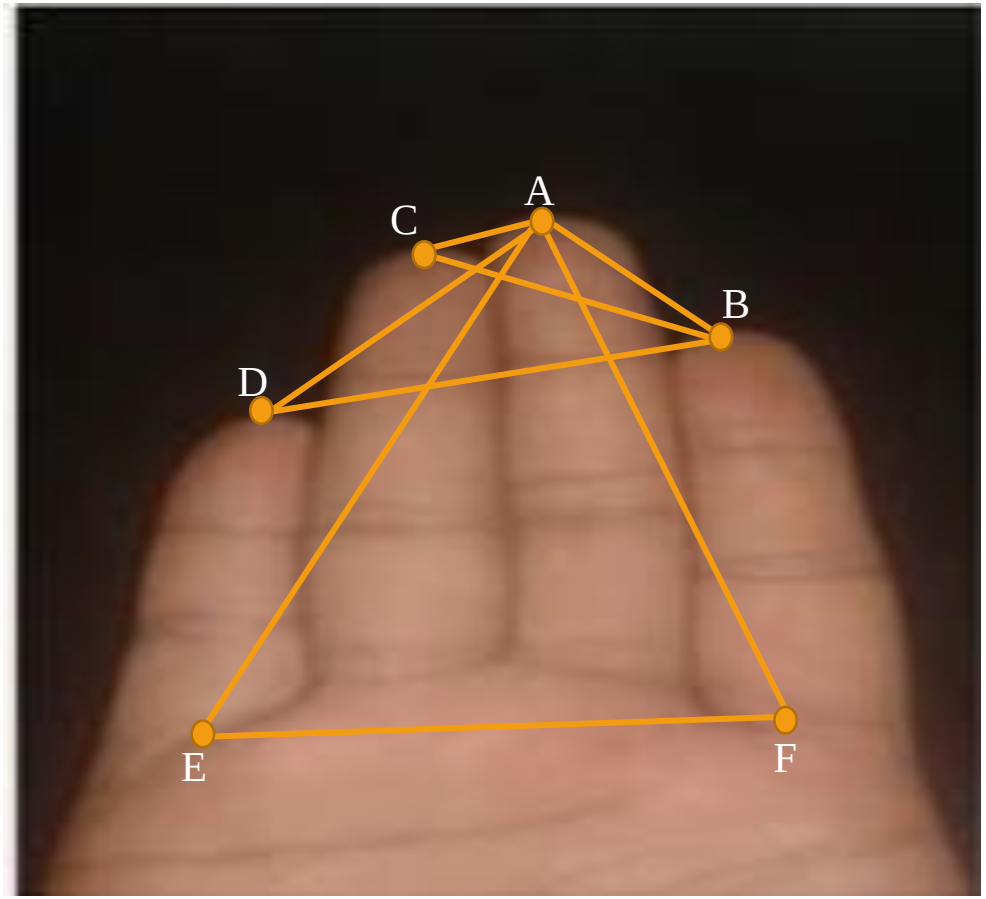
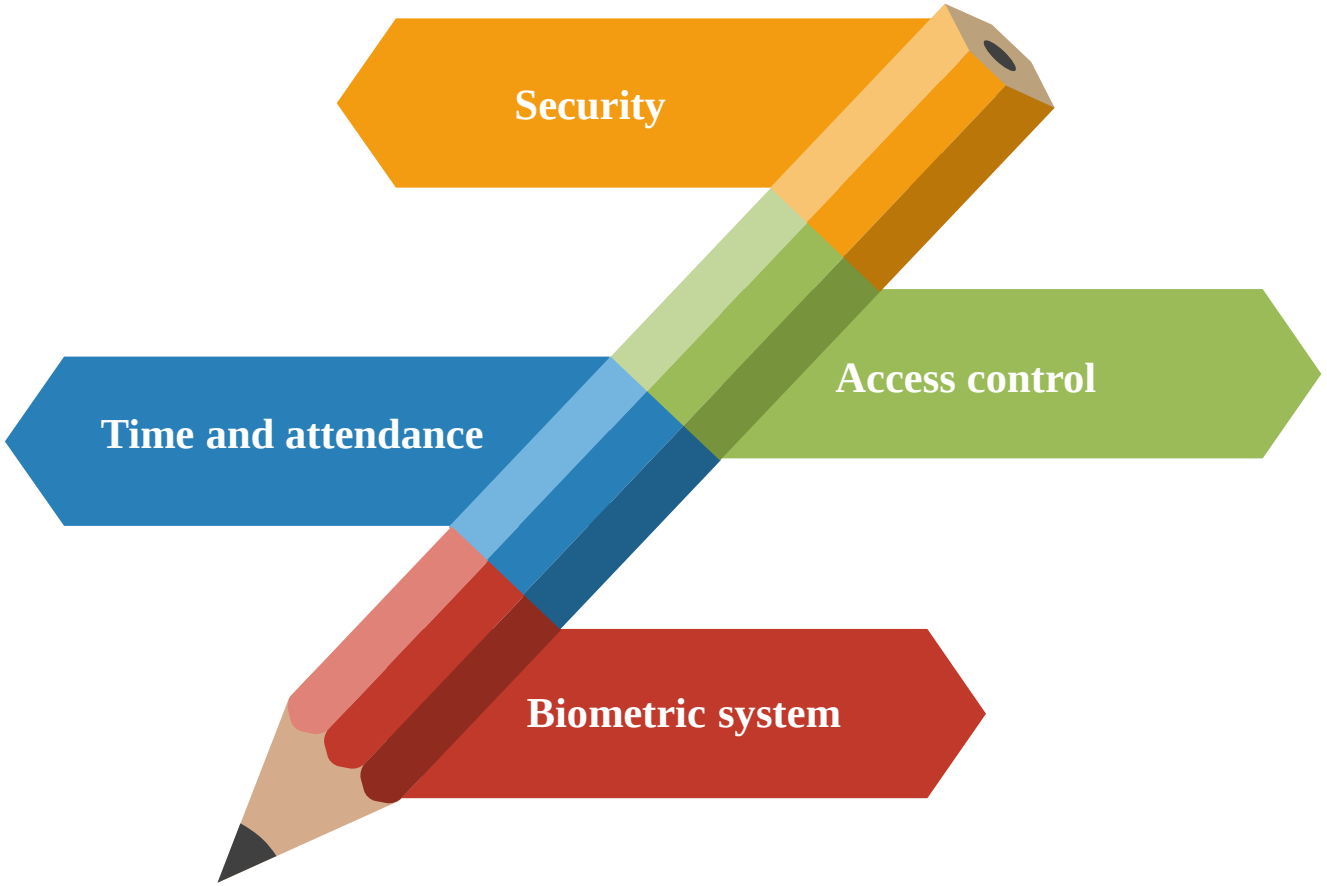


Fig. 1. Geometrical feature of a hand.

Motivations

1. The biometric system is fluently used in the field of immigration, criminal investigation, and border control
2. Good frictional skin is required for fingerprint, and a special illumination setup is needed for iris or retina-based identification systems
3. Environmental factors such as dry weather or individual anomalies do not appear to have any negative effects on the verification of hand geometry based systems
4. As the special illumination setup is required for maximum of the traits, for low cost and easily access the hand geometry image is used for person verification
5. Hand geometry is basically used the physical property of user's hand and fingers

Applications



Related Research

In [4], a novel hand tracking approach is proposed to automatically detect and capture the geometrical features of the hand from low-resolution video stream

- Several algorithm are used to track the location of the finger
- Equal error rate of 4.2% is reported using the proposed approach

Demerits:

- High computational cost

In [5], authors proposed an approach to identify the person uniquely through the features of four fingertips of right hand

- This approach is based on the edge detection method
- Distance is measured based on the Euclidian distance algorithm

Demerits:

- The size of feature is high

Related Research

A hand geometry based person verification system is introduced in [6]

- Hand features are extracted through the image processing
- The recognition is performed by using the distance based nearest neighbor algorithm

Demerits:

- Low accuracy

A Hand geometry feature based person identification method is introduced in [7]

- Here, 15 features are extracted from the hand
- Distance is measured based on the absolute and Euclidean distance

Demerits:

- Feature size is high

Challenges

- Different oriented hand image
- Long nail fingers
- Gaps between the fingers

Proposed Method

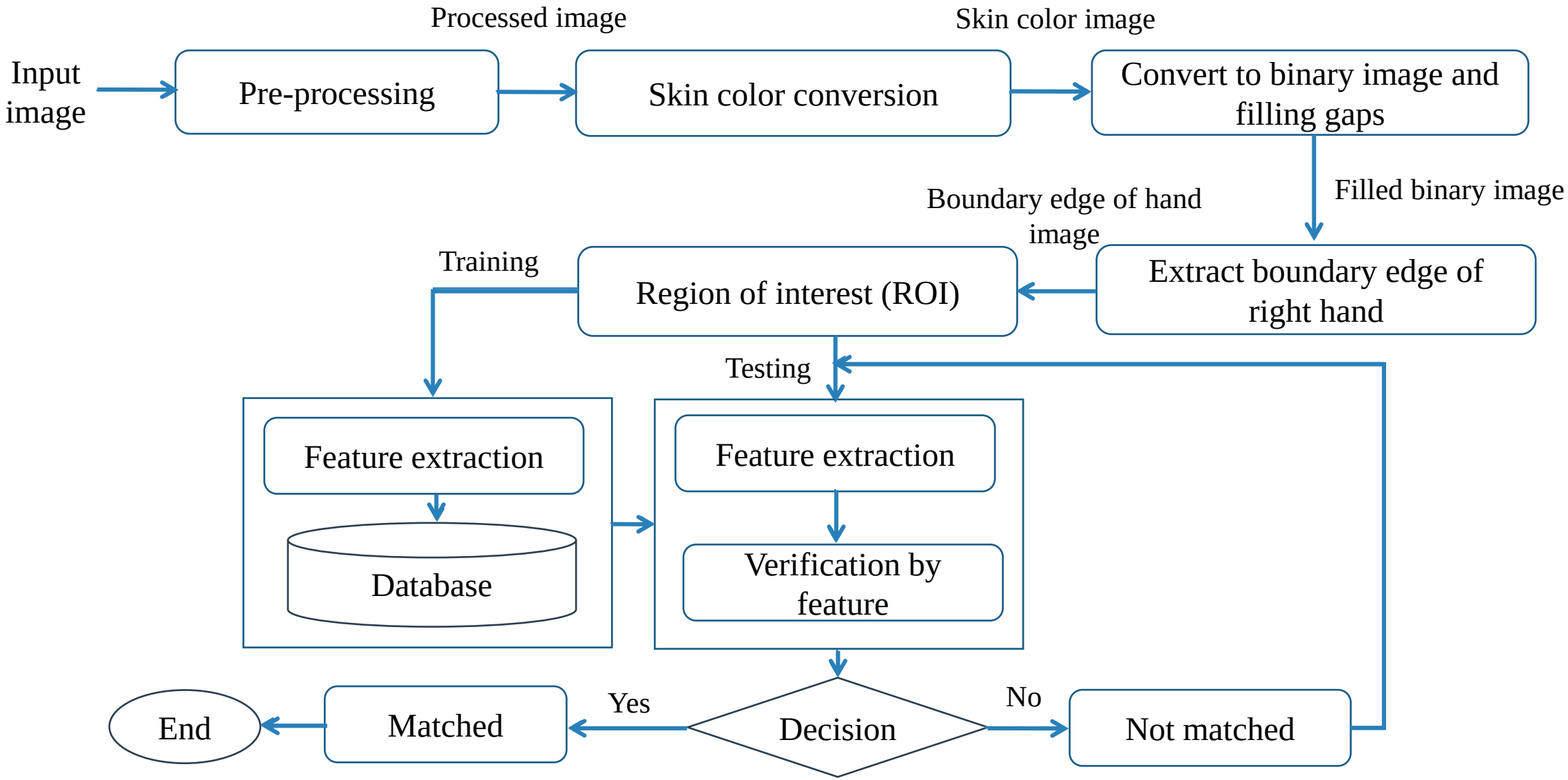


Image Acquisition and Pre-processing

- The image is captured such a way that the right hand fingers except thumb finger are located adjacent of each other
- For that, user's hand should be placed on the surface of the scanner from where the hand image will be captured

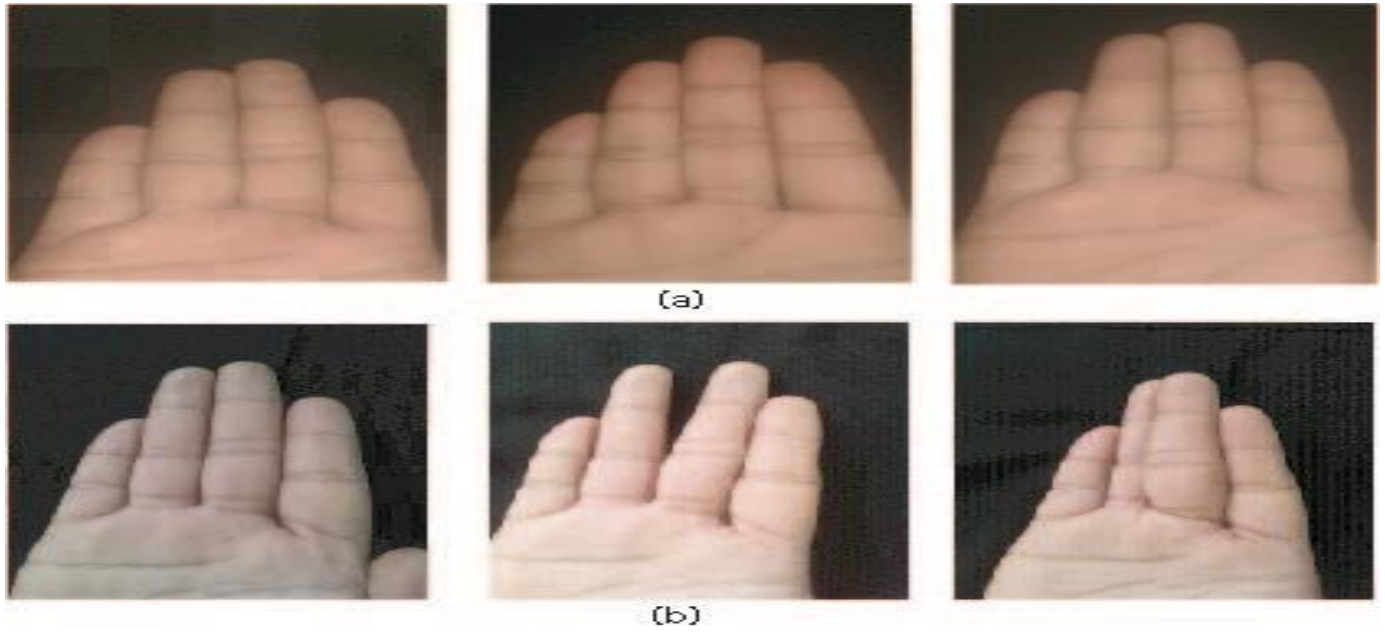


Fig. 3. Sample image: a) right hand positive sample images, and b) right hand negative sample image.

Skin Color Conversion

- The RGB image is converted into the YCbCr image as the RGB image is more sensitive to illumination

- RGB is more **sensitive** to illumination variation
- YCbCr color space is a **linear** luminance color space

Y	= Luminance
Cb	= Chromaticity of **Blue**
Cr	= Chromaticity of **Red**

RGB to YCbCr conversion formula

$$Y = 16 + (65.481 * R + 128.553 * G + 24.966 * B) \quad (1)$$

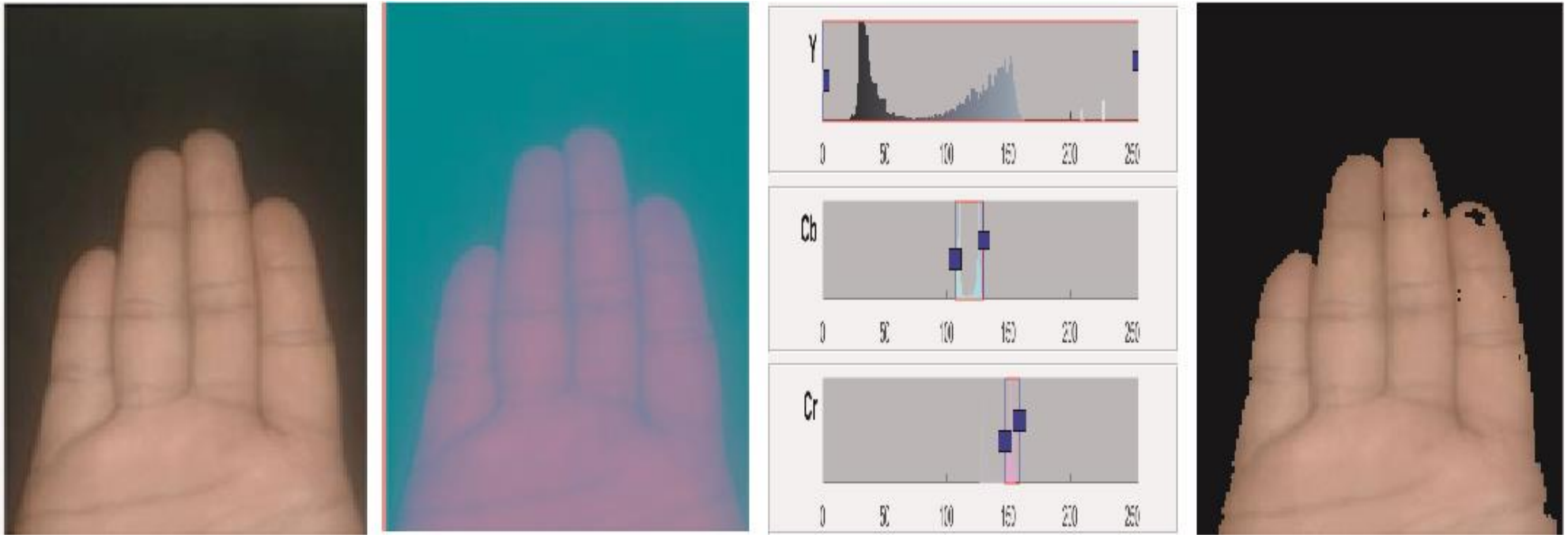
$$Cb = 128 + (-37.797 * R - 74.203 * G + 112 * B) \quad (2)$$

$$Cr = 128 + (112 * R + 93.786 * G + 18.214 * B) \quad (3)$$

Information Range

Y =	16 to 235
Cb =	16 to 240
Cr=	16 to 240

Processing Examples

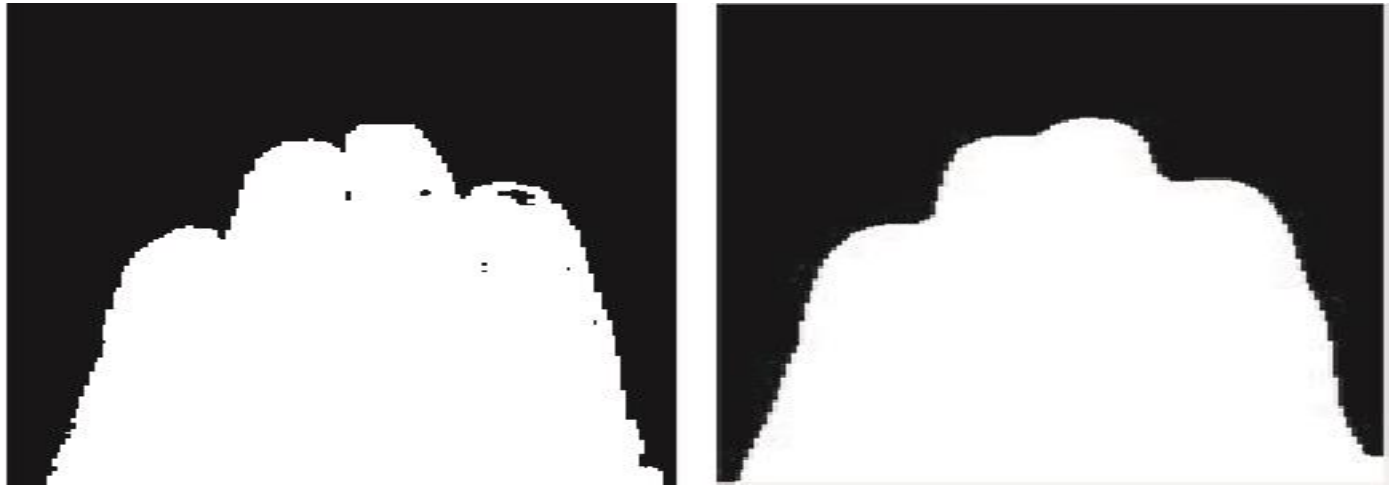


(a) (b) (c) (d)

Fig. 4. The process of skin color conversion: a) original RGB image, b) YCbCr image, c) Y, Cb, and Cr value, and d) final skin color image with Cb and Cr threshold value.

Convert to the Binary Image and Filling the Gaps

- To extracting the shape of the right hand the skin color image is converted into the binary image
- From the binary image the shape of the hand image will be extracted
- However, the binary image has some gaps for various reasons.
- The morphological operation is performed on the binary image to fill up the gaps

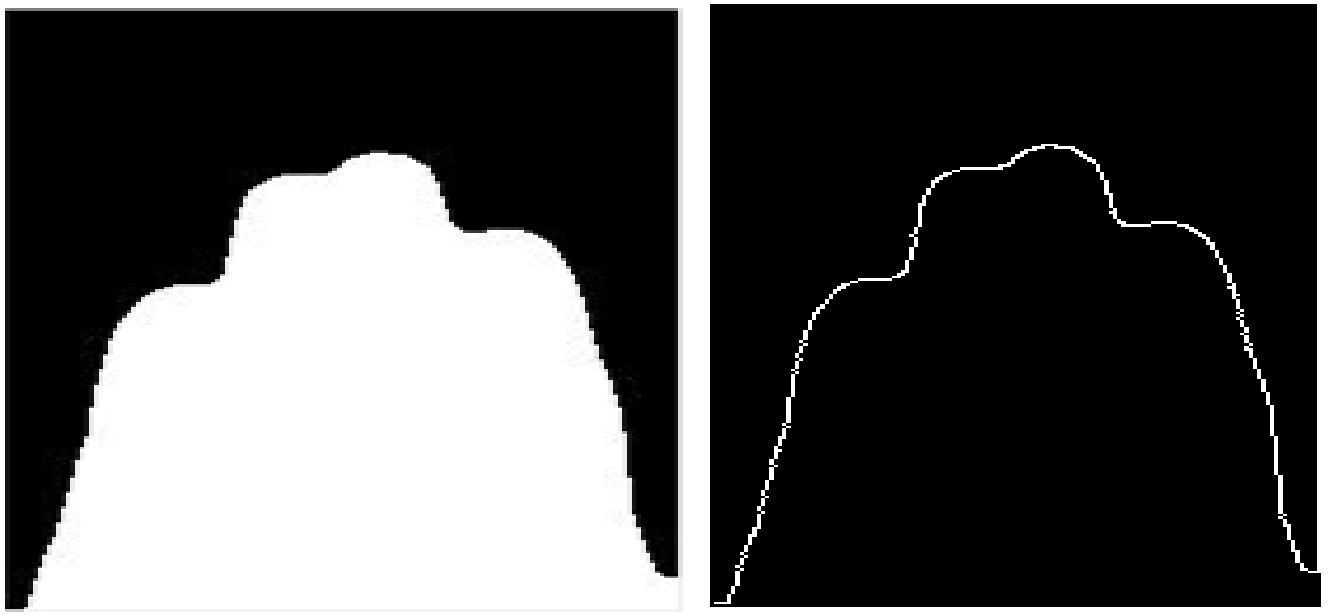


(a) (b)

Fig. 5. Binary image: a) binary image from skin color image, and b) binary image after morphological operation.

Extract the Boundary of Right Hand and Detect ROI

- From the extracted binary image, the boundary edge of the right hand finger's image is extracted through the Canny edge detection method



(a) (b)

Fig. 6. Binary image: a) binary image after morphological operation, and b) Canny edge image.

Feature Extraction

- The six feature point are detected from the acquired and preprocessed image
- Among the six points four points of them are the top points of the index finger, middle finger, ring finger and little finger i.e., A, B, C, D.
- The rest of the two points among the six points are the corner valley points of the four fingers i.e., E, F.

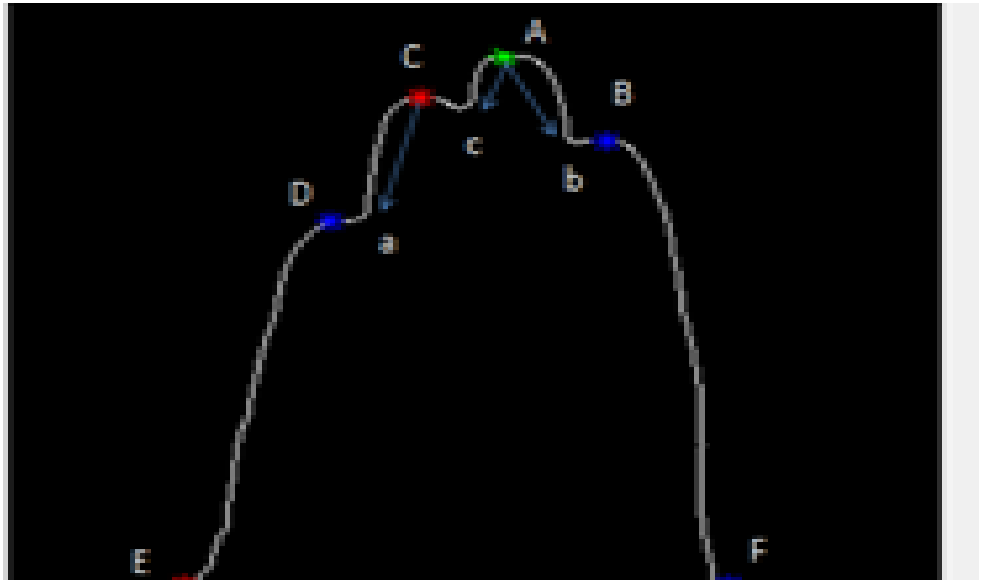


Fig. 7. Geometric feature point at the edge image.

Processing Examples

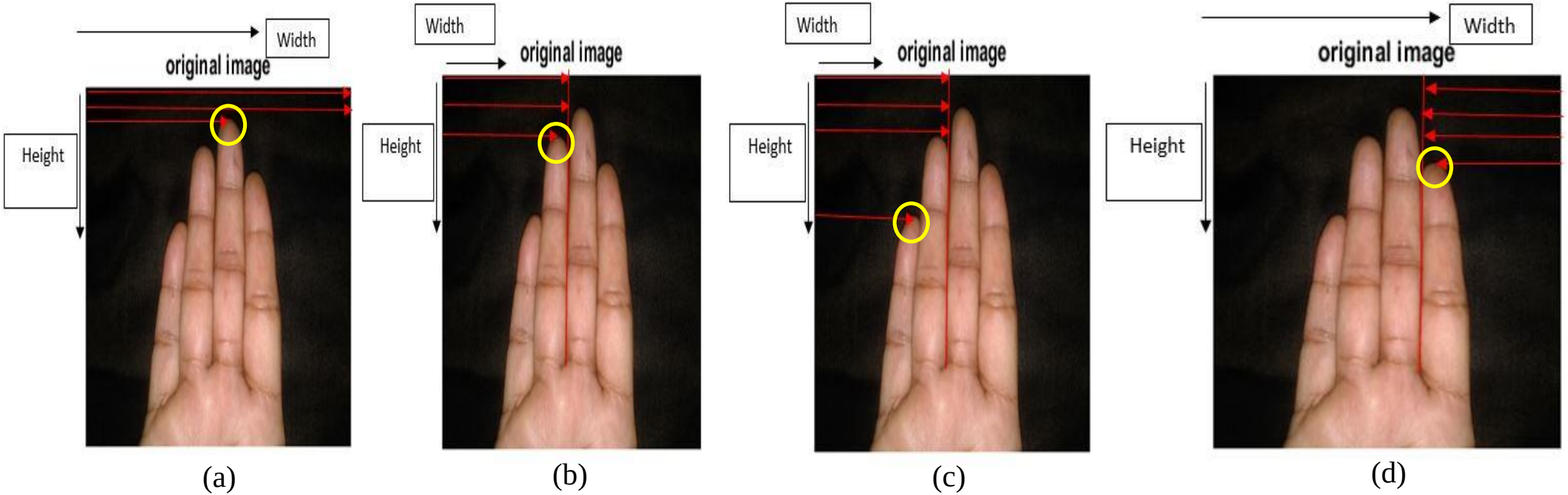


Fig. 8. Fingertip points feature extraction process: a) middle fingertip point, b) ring fingertip point, c) little fingertip point, and d) index fingertip point.

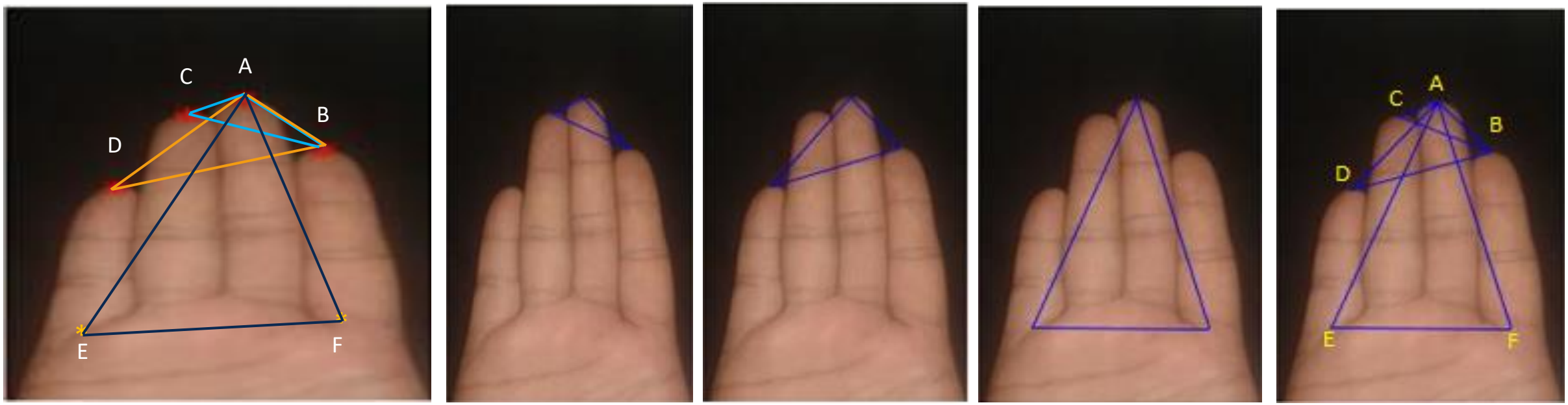
Processing Examples

(a) (b) (c)

Fig. 9. Right hand finger's feature points: a) top fingertip points, b) and c) corner valley points.

Processing Examples

- The distance edges are AB, AC, AD, AE, AF, BC, BD, BE, BF, CD, CE, CF, DE, and DF
- For reducing the computational cost, three distinct triangles are considered using the six points
- These triangles are ΔACB, ΔADB, and ΔAEF



(a) (b) (c) (d)

Fig. 10. Triangle features: a) ΔACB triangle formed from AB, AC, and BC, b) ΔADB triangle formed from AD, AB, and BD, c) ΔAEF triangle formed from AE, AF, and EF, and d) all triangles at the same image.

Feature Database

- If the feature vector is authentic and its size is low, then the performance of the verification system will be high
- The features used in this work are three triangles area value
- The database is generated by the five snapshot of every person
- From these five snapshots, initially, calculates the individual triangles and estimate the mean of the each triangle from the five snapshots
- These triangles mean's values will be used for person verification

The database format for each person will be:

$$\text{Database entity for single person } D = (TA_1, TA_2, \ldots\ldots\ldots, TA_i)$$

Where, TA_i is the mean value of individual triangle area. And i= 1, 2, 3 total number of features

Matching

- Matching is the process of identifying the feature entities stored in the database with the current claimed entity
- For matching, snapshot of the claimed right hand image is taken and generate the feature vector based on the area of the triangles
- The claimed feature vector is compared with the previously stored database feature vector
- The satisfactory of the comparison is depended on the match score
- The test image feature vector is compared with previously stored database feature vector
- The comparison is acceptable that is positive, if the match score of the test image feature vector (T) and previously stored database feature vector (P) is less than a threshold value
- In this work, the match score is estimated through Euclidian distance

The Euclidian distance is measures by (4).

$$\sqrt{\sum_{i=1}^{n}(P_i - T_i)^2} < \epsilon_\theta \qquad (4)$$

Where, ϵ_θ is the threshold value for Euclidian distance metric

Experimental Results

- In the experiments, the dataset is collected from 250 different peoples, each person having at least 5 images at various environments i.e. total image will be 1250

  For estimating Euclidian distance, the FRR is 1% and FAR is 2% for the propose identification system where the threshold value is 7.

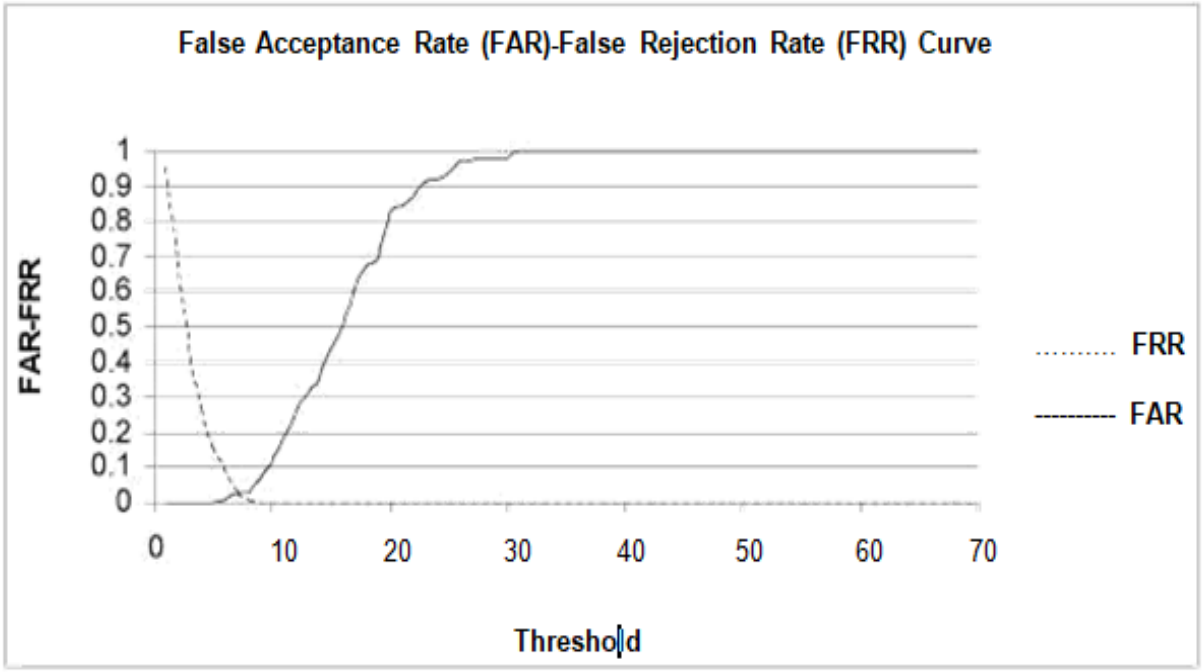


Fig. 11. FRR-FAR curve for Euclidian distance.

Experimental Results

Table I. Recognition Rate in Different Environment Condition

Condition	Image provided	Correctly recognized image	Recognized rate	Avg. recognition rate
Normal	450	450	100%	97.88%
Noisy	425	415	97.65%	
Uneven elimination	375	360	96.00%	

Table II. Comparison Among Proposed Method and Existing Methods

Method	No. of feature	Techniques for verification	Recognition rate (Normal condition)
[6]	15	Distance Based Nearest Neighbor (DBNN)	99.11%
[5]	6	Euclidean Distance	99.96%
Proposed System	3	Euclidean Distance	100%

Conclusion & Future Work

- This paper has presented a biometric verification system based on the small size hand geometry features
- To reduce the computational cost and improve the system performance, the proposed system used small size feature vector i.e., three features that are stored in the database

Low feature size	Low computation cost	100% accuracy at normal condition	Hand orientation problem	Gap between the fingers
Merits	Merits	Merits	Demerits	Demerits

- Future work: correct the orientation and finger's gap

References

[1] A. K. Jain, A. Ross, and S. Prabhakar, ” An introduction to biometric recognition,” IEEE Transactions on circuits and systems for video technology, 14(1), pp.4-20.

[2] H. Pedro, and M. C. Proenca, “Towards Non-Cooperative Biometric Iris Recognition”, P.hd thesis, University of Beira Interior Department of Computer Science, October 2011.

[3] N. K. Ratha, A. Senior, and R. M. Bolle, J. Thomas, "Automated biometrics." In International Conference on Advances in Pattern Recognition, pp. 447-455. Springer, Berlin, Heidelberg, 2001.

[4] G. K. O. Michael, T. Connie, and L. S. Hoe "Locating geometrical descriptors for hand biometrics in a contactless environment." In Information Technology (ITSim), 2010 International Symposium in, vol. 1, pp. 1-6. IEEE, 2010.

[5] M. A. Rahman, M. Mahiuddin, and N. Hoque, “A Fingertip based Recognition System”, IEEE/OSA/IAPR International Conference on Informatics, Electronics and Vision (ICIEV), 2012.

[6] M. A. Rahman, F. Anwar, and M. S. Azad, "A Simple and Effective Technique for Human Verification with Hand Geometry", In International Conference on Computer and Communication Engineering, pp.1177-1180, 2008.

[7] B. Aghili, and H. Sadjedi, "Personal authentication using hand geometry." In Computational Intelligence and Software Engineering, 2009. CiSE 2009. International Conference on, pp. 1-4. IEEE, 2009.

[8] H. Yan, and D. Long. "A novel bimodal identification approach based on hand-print." In Image and Signal Processing, 2008. CISP'08. Congress on, vol. 4, pp. 506-510. IEEE, 2008.

References

[9] S. Selvarajan, V.Palanisamy, and B.Mathivanan ," Human Identification and Recognition System using More Significant Hand Attributes" In International Conference on Computer and Communication Engineering(lCCCE), Vol.3, pp. 1211 - 1216, 2008.

[10] P. Varchol, D. Levicky," Using of Hand Geometry in Biometrics Security Systems", Radio Engineering, Vol. 16, NO. 4, 2007.

[11] A. Kumar, and D. Zhang, "Integrating shape and texture for hand verification", International Journal of Image and Graphics, Vol. 6, No. 01, pp. 101-113, 2006.

[12] V. Kanhangad, A. Kumar, and D. Zhang, "Combining 2D and 3D hand geometry features for biometric verification," In IEEE Computer Society Conference on Computer Vision and Pattern Recognition, CVPR Workshops 2009, pp. 39-44, IEEE, 2009.

[13] S. Ribaric, and I. Fratric,"A Biometric Identification System Based on Eigen Palm and Eigen Finger Features", IEEE Transaction on pattern analysis and machine intelligence, Vol. 27, No.11, pp 1698-1709, 2005.

[14] A. Kumar, D. C. Wong, H. C. Shen, and A. K. Jain, "Personal Authentication Using Hand Images", Pattern Recognition Letters, Vol. 27, No. 13, pp. 1478–1486, 2006.

[15] A. Mostayed, M. E. Kabir, S. Z. Khan, and M. M. G. Mazumder, "Biometric Authentication from Low Resolution Hand Images Using Radon Transform", Proc. of 12th International Conference on Computer and Information Technology (ICCIT), pp. 587-592, IEEE, 2009.

Thank You

Any Question(s) ?

Appendix - 1

The FAR is defined as the ratio of number of false user accepted by the identification system to the number of identification trial made.

The FRR is the ratio of number of original user rejected by the identification system to the number of identification trial made

The applicable threshold value is measured from the match point of FRR and FAR, which is the EER

The EER is the point in which both ERR and FAR indicates the minimum error