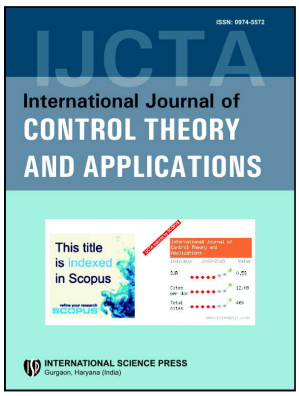

International Journal of Control Theory and Applications

ISSN : 0974-5572

Volume 10 • Number 15 • 2017

A survey on triple level Biometric Fusion for human authentication

Rohit Srivastava[1] and Prateek Srivastava[2]

[1] Dept. of Computer Science and Engineering, School of Engineering Parul University Vadodara, Gujrat, India, Email: rts080185@gmail.com
[2] Assistant Professor, Dept. of Computer Science and Engineering, School of Engineering Sir Padampat Singhania University Udaipur,Rajasthan, India, Email: prateek.srivastava@spsu.ac.in

Abstract: Biometric identification process is used for recogniting and identifying a person for various applications. The process can be done by using single Biometric feature or a combination of Biometric features. If the identification is done by using a single Biometric feature (face iris finger , palm etc) then the system is called as Unimodal and if a combnation of Biometric is used then it is called as Multimodal. In multimodal system various drawbacks of Unimodal system (Noisy Data , Multiple vectors etc) are removed. The main goal of the proposed work is to design a framework that will provide authentication based upon three level authentication for a person. Earlier works in this field are explained in different statistical models based on different authentication schemes. They tried to estimate the predictable output values with known historic data. In those procedures, they tried to authenticate with the help of transformations and analysis.In the proposed method a mechanism is developed in which if one biometric trait gets failed then the other biometic traits can be used for authentication.

Keywords: Principal Component Analysis, Face Recognition, Fingerprint Recognition, Miniutae Matchnig, Score Fusion, Palmprint Recognition

1. INTRODUCTION

A biometric system refers to a pattern recognition system that have ability to acquire biometric data from an individual [1]. The requirements of enhanced security in biometric based upon the authentication of a person has led us to an interesting area. Those biometrics systems that are based on single information source are called "Uni-modal Systems" [2]. Unimodal biometrics have many implicit problems in their applications. The major difficulty with uni-modal biometric technology is that it is not perfect suited for all applications [3]. Limitations of uni-modal biometric systems even though these systems offers a reliable solution for secured verification and it is commonly used in numerous commercial systems in practice; it suffers from following limitations: Sensed data noise, intra-class variation, intra-class similarities, spoof attacks and non-universality [4]. Hence, it is not possible to achieve desired performance by single biometric system. One of the methods to solve these problems which are encountered in single biometric system is to make use of multi-modal authentication biometric systems. This model combines information from multiple modalities to dictate a decision [2].

This paper presents the review of multimodal biometrics. This includes a brief introduction about multimodal biometrics. In this paper, various fusion techniques of multi-modal biometrics have been discussed. In this paper a fusion technique is proposed based on face,fingerprint and palmprint biometric traits. After capturing features preprocessing is done and features are extracted for feature level fusion . Biometric Fusion is classified into 5 categories:

(a) Sensor Level Fusion: This is also referred to as image level or pixel level fusion. This is possible only if multiple samples are fused that are taken using the same sensor. If multiple sensors are used then the data from different sources must be compatible. The raw data contains a lot of information but at the same time it is corrupted by noise.

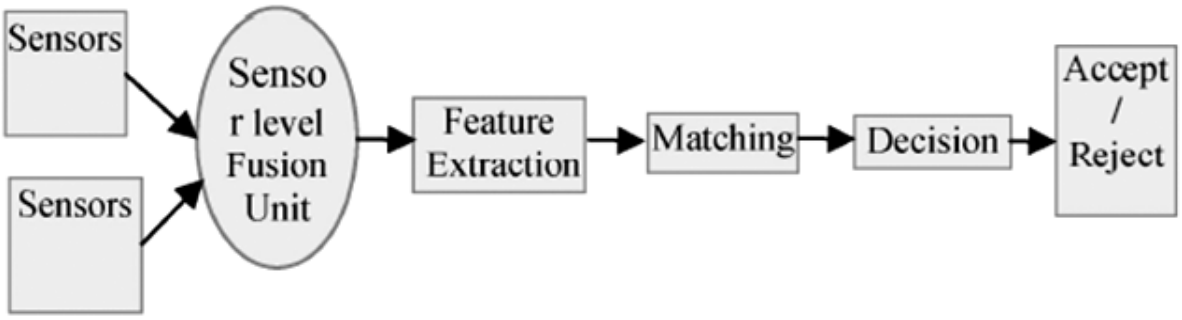

Figure 1: Sensor Level Fusion [3]

(b) Feature Level Fusion: In this fusion the data from different sources are separately processed, features are extracted and a joint feature vector is computed for matching against the stored template. The fusion can be easily accomplished if the features are extracted using same algorithm otherwise it becomes tedious.

(c) Score level fusion: Score level fusion is merging scores matched from the output of the individual matcher. These matching scores indicate the approximation of identification of sample image form the database. The matching score is rich in information next to the feature vector.

(d) Rank Level Fusion: Rank level fusion is based on ranking of the output of the enrolled identities. Ranks gives a clear information regarding the decision-making process compared to just identify, but they give less info as compared to score level. Just like score match the ranking outputs are comparable so, normalization process is not required.

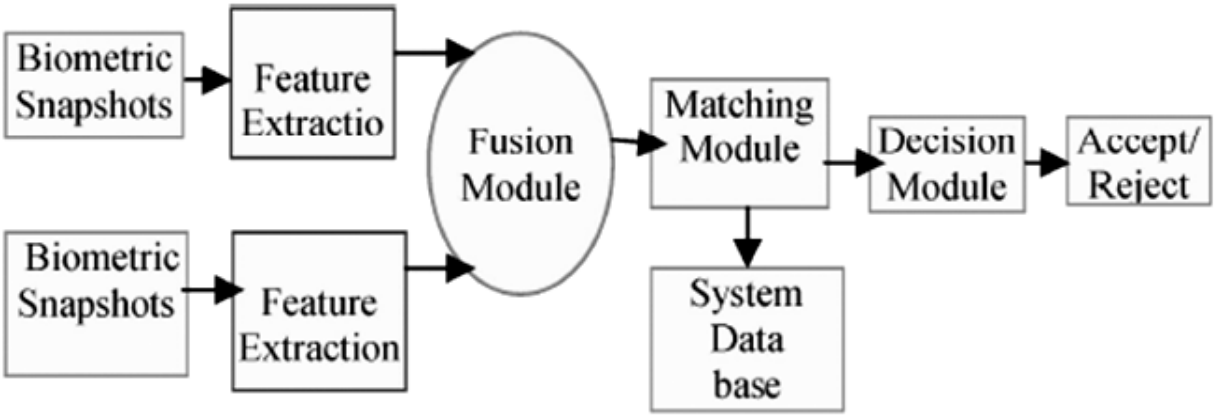

Figure 2: Feature Level Fusion [3]

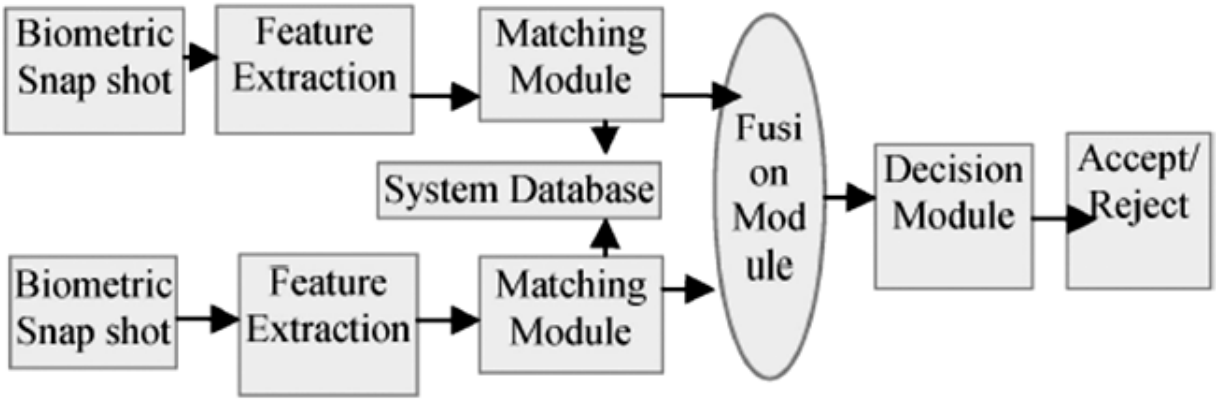

Figure 3: Score Level Fusion [3]

(e) Decision level fusion: The decision level or abstract level fusion is possible only when the output from individual biometric matchers is available. The output from the different matchers are fused using the "AND" and "OR "rules. The output of the "AND" rule is a "match" only when the input test sample is matched with the stored templates at the output of each matcher. Whereas, the "OR" rule outputs a "match" decision even if one of the matcher+ decides that the input test sample matches with the stored templates.

Artificial Neural Networks (ANN) has been are having a great usage in authentication systems and also provides automation to the system.. The advantages of these models of the neural network are to be seen in increase in approximation and cost reduction. Artificial Neural Networks takes part as an important task in support of the analysis of the big data sets in various forms of authentication.

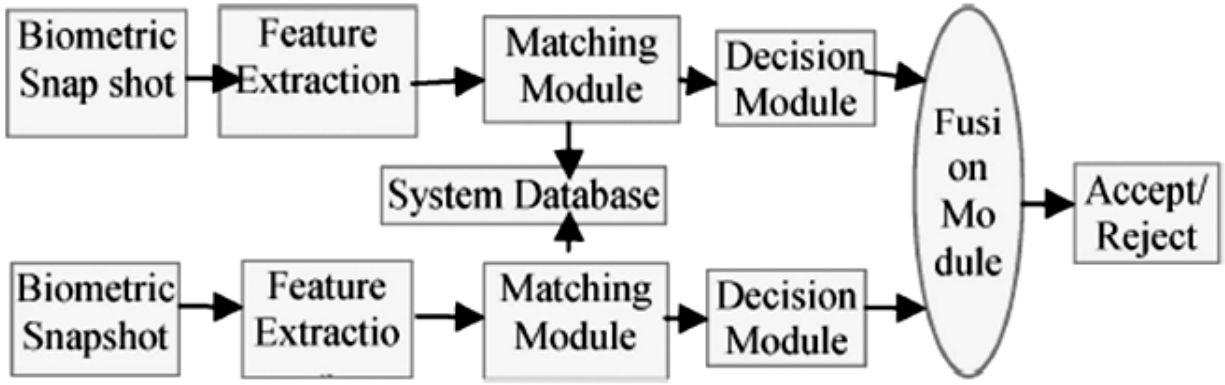

Figure 4: Decision Level Fusion[7]

2. SYSTEM BLOCK DIAGRAM

3. PROPOSED METHODOLOGY

3.1. Fingerprint Identification (Minutiae matching):

Minitutae matching is performed by processing fingerprint image captured through fingerprint sensor. The captured image is processed for ridges and valleys and then converted digital ones and zeroes. This processing results in the identification of fingerprint characteristics known as minutiae. This is further used for verification and identification. The face vector module also uses the features computed by fingerprint module to define the feature values for face vector typically for defining the miniutae points present in every fingerprint image.

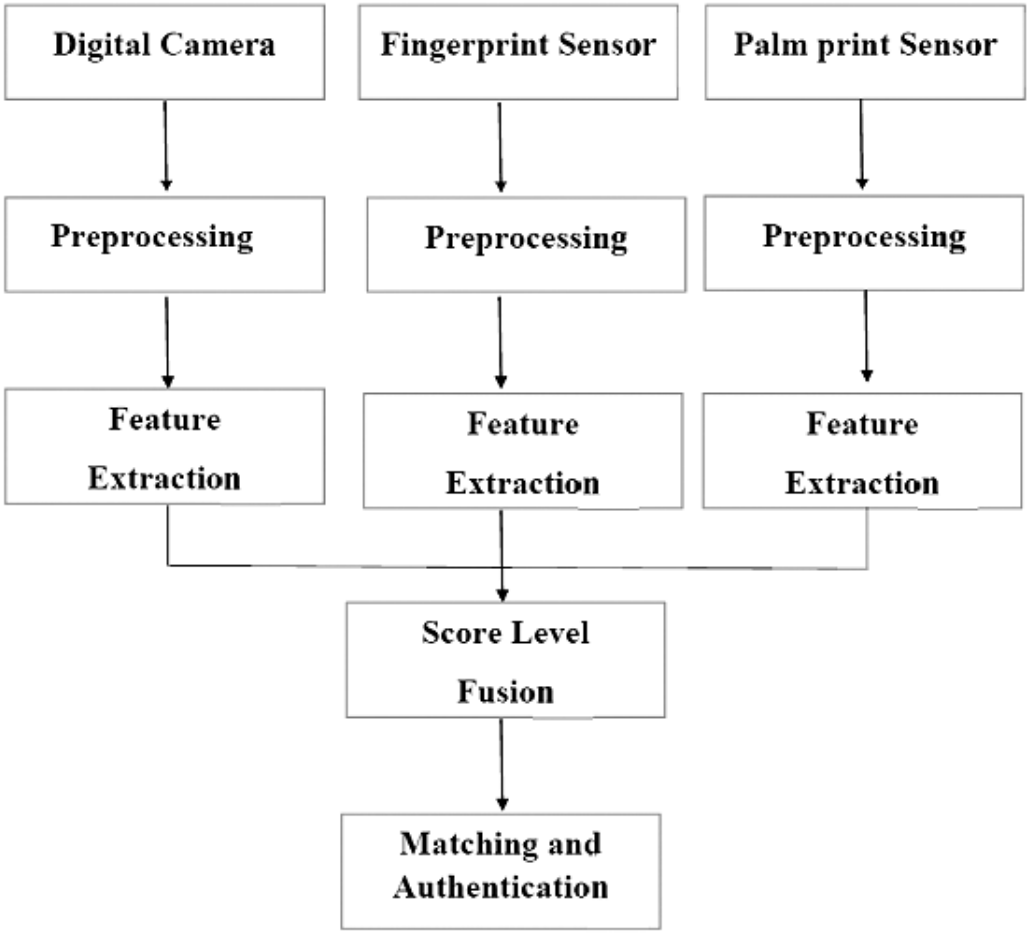

Figure 5: A Fingerprint Image[4]

In the fingerprint processing the captured images are preprocessed and filtered for detecting minutiae points[21], after which the matching of fingerprint images is performed. The matching of fingerprint is performed with the Euclidean Distance matcher. Suppose A and B be the collection of sample points extracted from fingerprint database and query databases respectively ,where orientation and coordinates are defined by x,y and 8 respectively.

$$sd = sqrt[\ (xj\text{-}xi)2 + (yj - yi)2 \leq r0 \quad (1)$$

$$dd = \min(\theta j - \theta i\ |, 360 - |\ \theta j - \theta i\ |) \leq \theta 0 \quad (2)$$

A and B are matched successfully if the value of sd is less than a specific Tolerance value and the direction of the

Coordinates is less than an angular tolerance. Through this processing a similarity score is generated which is further used in decision module. [23].

3.2. Fingerprint Verification (Gabor Filter approach)

For identifying details in a fingerprint image Gabor filters are to be used. Matching of two fingerprint images is done on the basis of Euclidean Distance. The matching of two images can be enhanced for performance by the combination of score decisions based on different fingerprint features. [21]

3.3. Face Identification (PCA)

Face recognition is highly used biometrics technique for identification. In this paper PCA (Principle Component analysis) technique is used for identification using face.

3.3.1. Principal component analysis (PCA)

PCA is most effective technique for face detection. In PCA the face image is identified by splicing the image into smaller parts and then correlating the pixel values generated for each sample space. For identification of a face image coordinate system and dimensionality reduction is used. If the dimensions of face image are higher then principal components of face distribution or eigenvectors of matrix for set of images is used and image is treated as a vector[18] [19] [20] .Suppose there are x number of patterns and each pattern has y number of training images of m x n configuration . For this a matrix is generated in which each column represents an image. Now a covariance matrix is computed with help of eigenvalues and eigenvectors for computing the feature vecors. This feature vector is the representation of image. Now for classification of Image Euclidean Distance is used and a score is generated which is further normalized for Score level fusion

3.4. Palmprint Identification

For this a combination of both palmprint images has been used. For the proposed methodology a framework for fusing left both palmprint images is developed. For this framework to successfully identify palmprint image a fusion of three kinds of score is required. Two scores can be generated by using left and right palmprint image whereas for third score a specific algorithm is proposed.

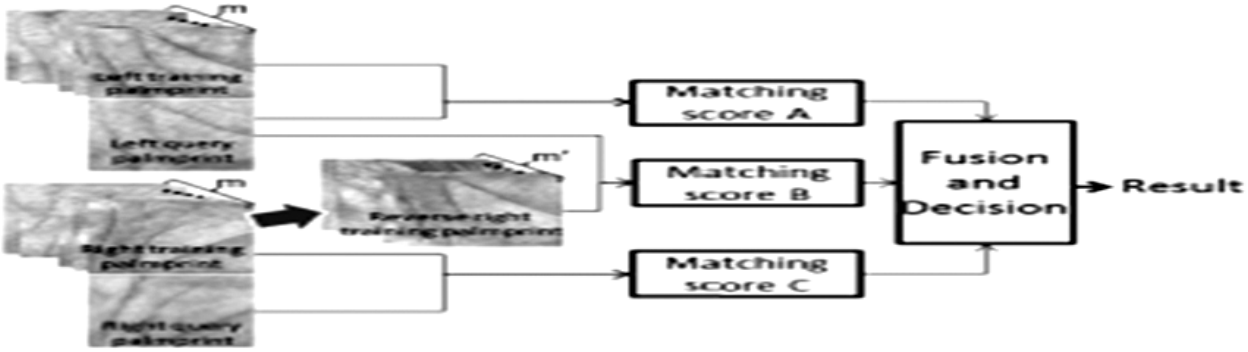

Figure 6: Procedure for Palmprint fusion[7]

3.4.1. Corelation Between both Palmprints

Both palmprint images are similar to each other. In Fig. 7 palmprint images of four different subjects is taken. Again the right palmprint image and reverse palmprint image is also taken in the figure [Fig 7] As depicted from the figure it is inferred that palmprint image and it's reverse image of the same subject are similar in nature.

Fig. 8 shows the principal lines images of images shown in Fig. 7. According to the figure [Fig. 8 (i)-(l)] we can see that principal lines of palmprint image for a same subject are almost similar in shape and position but for different persons is different[Fig. 8 (m)-(p)]. So according to this result it can be concluded that the this feature of palprint images can be deployed for palmprint verification.

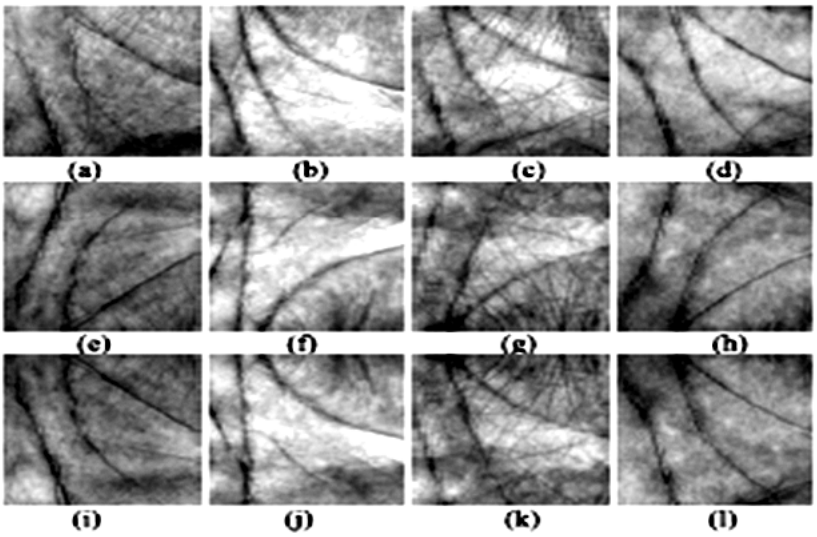

Figure 7: Palmprint images

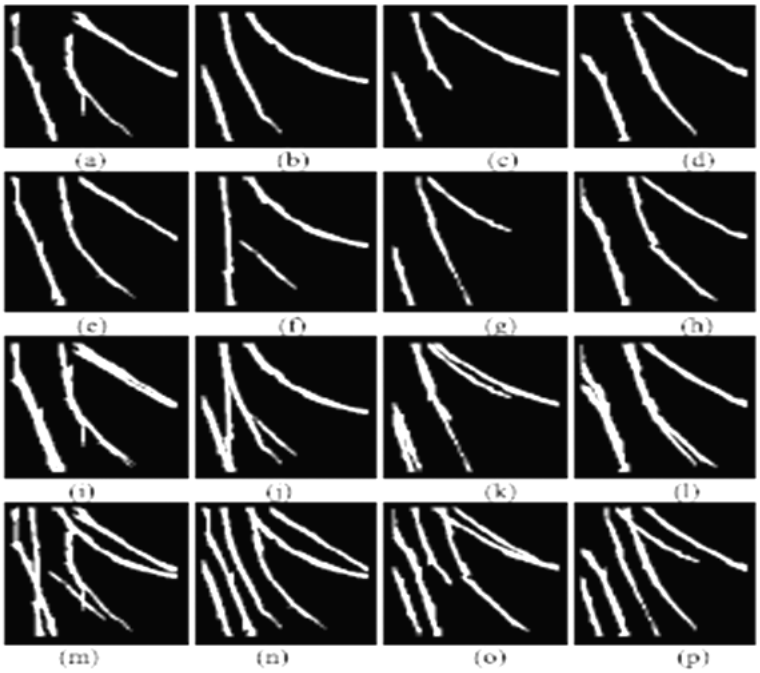

Figure 8: Principal lines images.

In the proposed framework firstly left palmprint images and then right palmprint images are used for score calculation for each sample class After the matching score generation for each class is generated final fusion is performed for to obtain the identification result.

After obtaining all three scores final matching score is generated. Depending on the all the three matching scores, final matching score is generated. After obtaining first and second score the third score is generated by performing cross match between both the images. For an ith matcher wi , where i is the weight for ith matcher, score can be generated for corresponding matchers.

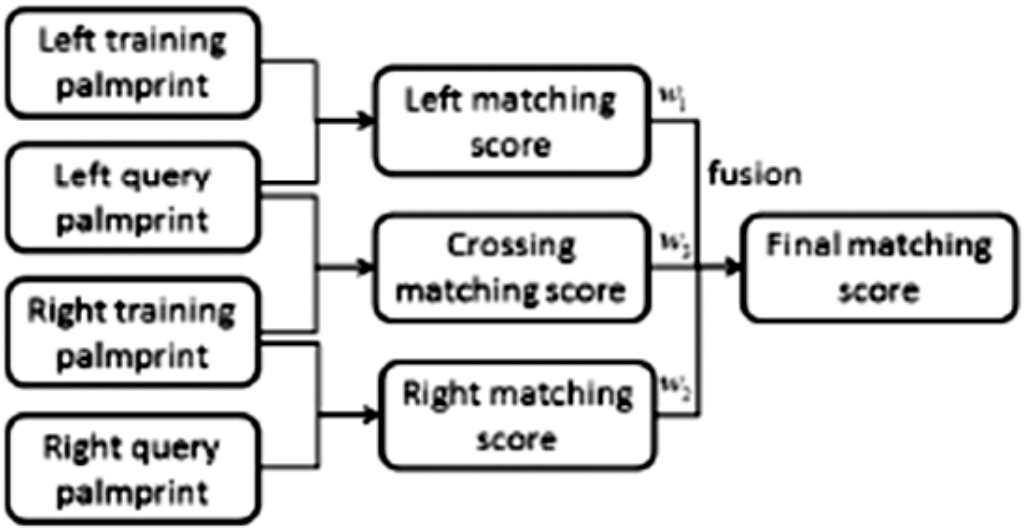

Figure 9: Fusion at the matching score level[4]

In the proposed method a strategy is introduced in which cross match score is used for fusion methodology. When w3 = 0, the proposed method is comparable to the conventional score level fusion. Thus a performance enhancement is there for the proposed method compared to conventional methods .

4. FUSION PROCEDURE FOR BIOMETRIC FEATURES

4.1. Score Normalization

For resizing the matching scores to a criterion between 0 and 1 Normalization is done. For both the scores normalization is done by:

$$N_{face} = MS_{face}\text{-}min_{face} / max_{face} - min_{face} \quad (3)$$

$$N_{fingerl} = MS_{fingerl}\text{-}min_{fingerl} / max_{fingerl}\text{-}min_{fingerl} \quad (4)$$

$$N_{finger2} = MS_{finger2}rmin_{finger2} / max_{finger2}rmin_{finger2} \quad (5)$$

$$N_{palm} = MS_{palm}\text{-}min_{palm} / max_{palm}\text{-}min_{palm} \quad (6)$$

Where min_{face} and max_{face} are the minimum and maximum scores for Face recognition and $min_{finger1}$ and $max_{finger1}$ are the resultset values obtained from applying minutiae matching over fingerprint image. $min_{finger2}$ and $max_{finger2}$ are the resultset values obtained from applying Gabor filter over fingerprint image and min_{palm} and max_{palm} are the corresponding values obtained from palmprint image .

4.2. Fusion

The normalized values from finger, face and palm print images are fused using sum rule as -

$$MS = m*N_{face} + n*N_{finger1} + p*N_{finger2} + q*N_{palm} \quad (7)$$

where m, n, p and q are four weight values that are assigned using the feature vector. If the value of matching score is less than the actual score it can be easily misleaded. So the value value of weight is assigned linearly.

5. CONCLUSION

As per the current proposed system accuracy rate in multimodal biometric system is greater than single biometric system. After experimentation it can be seen that the accuracy of system would increase on combination of multiple biometric features. The Genuine Acceptance Rate is also improved using multibiometric recognition and Neural Network approach. Also the system can be developed using five level biometric traits in future.

ACKNOWLEDGMENT

I take immense pleasure in expressing my humble note of gratitude to my guide Dr. Prateek Srivastava, Assistant Professor, Department of Computer Science and Engineering, SPSU, Udaipur, Rajasthan, India for his remarkable guidance and technical suggestions.

REFERENCES

[1] Aizi K., Ouslim M.and Sabri A., "Remote Multimodal Biometric Identification Based on the Fusion of the Iris and the Fingerprint", IEEE transactions on Information and Forensics, 12(6), 2015.

[2] Lee T. and Bong D., "Face And Palmprint Multimodal Biometric System Based on Bit-Plane Decomposition Approach", In Proc. International Conference on Consumer Electronics-Taiwan, 114(21), 2016.

[3] Telgad R., Deshmukh P. and Siddiqui A. , "Combination Approach to Score Level Fusion for Multimodal Biometric System By Using Face and Fingerprint" , In Proc. International Conference on Recent Advances and Innovations in Engineering (ICRAIE-2014), May 09-11, 2014, Jaipur, India.

[4] Yong D., Bhowmik S., Magnago F.,"An effective Power Quality classifier using Wavelet Transform and Support Vector Machines", Expert Systems with Applications, 42(15), 2015, pp 6075.

[5] N. Radha, A Kavitha," Rank Level Fusion Using Fingerprint and Iris Biometric", Indian Journal of Computer Science and Engineering (UCSE) ISSN: 0976-5166 Vo!. 2 NO. 6 Dec 201 I-Jan 2012.

[6] Jian-Gang Wang , Kar-Ann Toh, Eric Sung , Wei-Yun Yau, "A Featurelevel Fusion of Appearance and Passive Depth Information for Face Recognition", Source: Face Recognition, Book edited by:Kresimir Delac and Mislav Grgic, ISBN978-3-902613-03-5, pp.558, I-Tech, Vienna, Austria, June2007.

[7] Muhammad Imran Razzak, Muhammad Khurram Khan Khaled Alghathbar,Rubiyah Yusof, "Multimodal Biometric Recognition Based on Fusion of Low Resolution Face and Finger Veins" , International ournal of Innovative Computing, Information and Control ICIC International 2011 ISSN 1349-4198 Volume 7, Number 8, August 2011 pp.4679{4689}

[8] Y. Xu, Q. Zhu, D. Zhang, and J. Y. Yang, "Combine crossing matching scores with conventional matching scores for bimodal biometrics and face and palmprint recognition experiments," Neurocomputing, vol. 74, no. 18, pp. 3946– 3952, Nov. 2011.

[9] A. K. Jain and J. Feng, "Latent palmprint matching," IEEE Trans. Pattern Anal. Mach. Intell., vol. 31, no. 6, pp. 1032– 1047, Jun. 2009.

[10] A. K. Jain, A. Ross, and S. Prabhakar, "An introduction to biometric recognition," IEEE Trans. Circuits Syst. Video Technol., vol. 14, no. 1, pp. 4–20, Jan. 2004.

[11] Y. Xu, Q. Zhu, D. Zhang, and J. Y. Yang, "Combine crossing matching scores with conventional matching scores for bimodal biometrics and face and palmprint recognition experiments," Neurocomputing, vol. 74, no. 18, pp. 3946–3952, Nov. 2011.

[12] R.L. Telgad,Dr. P.DDeshmukh,"Computer Aided Technique for Finger Print Image Enhancement and Minutiae Extraction "U.C.A Volume 75, Number 17, August 2013.

[13] Ajay Kumar, Senior Member, IEEE, Sumit Shekhar," Personal Identification Using Multibiometrics Rank-Level Fusion", IEEE Transactions On Systems, Man, And Cybernetics-PART C: Applications And Reviews.

[14] F. Besbes, H. Trichili, and B. Solaiman, -Multimodal biometric system based on Fingerprint identification and Iris recognition,1I in Proc. 3rd Int. IEEE Conf. Inf. Commun. Techno!.: From Theory to Applications (ICTTA 2008), pp. 1-5. DOl: 10.1109/ ICTT A2008.4530129.

[15] A Rattani, D. R. Kisku, M. Bicego, Member, IEEE and M. Tistarelli," Feature level fusion of face and finger Biometric".

[16] N. Radha, A Kavitha," Rank Level Fusion Using Fingerprint and Iris Biometric", Indian Journal of Computer Science and Engineering (UCSE) ISSN: 0976-5166 Vo!. 2 NO. 6 Dec 201 I-Jan 2012.

[17] Jian-Gang Wang , Kar-Ann Toh, Eric Sung , Wei-Yun Yau, "A Feature level Fusion of Appearance and Passive Depth Information for Face Recognition", Source: Face Recognition.

[18] Muhammad Imran Razzak, Muhammad Khurram Khan Khaled Alghathbar,Rubiyah Yusof, "Multimodal Biometric Recognition Based on Fusion of Low Resolution Face and Finger Veins" , International ournal of Innovative Computing, Information and Control ICIC International 2011 ISSN 1349-4198 Volume 7, Number 8, August 2011 pp.4679{4689}.

[19] Anil K. Jain,Fellow,IEEE, Salil Prabhakar,Lin Hong, and Sharath Pankanti,"Filterbank-Based Fingerprint Matching",IEEE transactions on Image processing,VOL.9 No. 5 May 2000.

[20] Jian Wang, Jian Cheng, "FACE RECOGNITION BASED ON FUSION OF GABOR AND 2DPCA FEATURES", IN International Symposium on Intelligent Signal Processing and Communication Systems, December 2010, pp. 1-4.

[21] P. 1. B. Hancock, Y. Bruce and A M. Burton ,"Testing Principal Component Representations for Faces", Proc. of 4th Neural Computation and Psychology Workshop, 1997.

[22] Jonathon Shlens, "A Tutorial on Principal Component Analysis", Systems Neurobiology Laboratory, Ver.2, 2005

[23] Zhujie, Y.L.Y., 1994. Face recognition with Eigen faces. Proc.IEEE Int!. Conf. Industrial Techno!. Pp: 434-438.