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A Survey on Fusion Techniques for Multimodal Biometric Identification

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ABSTRACT: Biometric is the science and technology of measuring and analyzing biological data of human body, extracting a feature set from the acquired data and comparing this set against to the template set in the database. Biometric systems based on single source of information are called unimodal biometric system. The performance of unimodal system is affected by noisy sensor data and non-universality [1]. Problems arised in the unimodal system can be resolved using multimodal biometric. Multimodal biometrics can be achieved through a fusion of two or more images, where the resultant fused image will be more secured. This paper discusses various fusion techniques that are used in multimodal biometrics.

KEY WORDS: Fusion, Biometrics, Multimodal, Unimodal,Accuracy.

I. INTRODUCTION

Biometric systems automatically determine or verify a person's identity based on his anatomical and behavioral characteristics such as fingerprint, palm print, vein pattern, face and iris. A method of identifying or verifying the identity of an individual person or subject based on the physiological and behavioral characteristics is biometric recognition. Multimodal biometrics increase accuracy by considering other highly specific biological traits to limit the number of applicant for an identity. Multimodal biometric systems utilize more than one physiological or behavioral characteristic for enrollment, verification and identification. The reason to combine different modalities is to improve recognition rate. The aim of multimodal biometrics is to reduce one (or) more of the following

- False Accept Rate [FAR].
- False Reject Rate [FRR].
- Failure to enroll rate [FTE].

Multimodal biometrics systems take input from single or multiple sensors measuring two or more different modalities of biometric characteristics. The key to multimodal biometrics is the fusion of various biometric modes [2]. A generic multimodal biometric system has four important modules:

1. Sensor level: This fusion strategy requires the raw data to be acquired from multiple sensors which can be further processed and integrated to generate new data from which features can be extracted. Sensor level fusion can be done only if the multiple cues of the same biometric are obtained from multiple compatible sensors.

2. Feature level: The feature set is extracted from the multiple sources of information and is further concatenated into a joint feature vector. This new high dimensional feature vector represents an individual. In case of feature level fusion some reduction technique must be used in order to select only useful features.

3. Match score level: Match score is a measure of the similarity between the input biometric and template biometric feature vectors. Based on the similarity of feature vector and the template, each subsystem calculates its own match score value. These individual scores are finally combined to obtain a total score, which is then passed to the decision module, after which recognition is performed.

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4. Rank level: Rank level fusion is generally adopted for the identification of the person rather than verification. Thus, fusion entails consolidating the multiple ranks associated with an identity and determining a new rank that would aid in establishing the final decision.

5. Decision level: In a multi biometric system, fusion is carried out at this level when only the decisions output by the individual biometric matchers are available. Here, a separate authentication decision is computed for each biometric trait which is then combined to result in a final vote. Different strategies are available to combine the distinct decisions of individual modality to a final authentication decision. Fusion at this level is considered to be rigid compared to the other fusion schemes due to the availability of limited information.

II.BACKGROUND STUDY

The fusion can be achieved in two different ways. The first is the fusion prior to matching and the second is the fusion after matching. The prior works of research in multimodal biometric systems are reviewed. Fusion at the match score, rank, feature and decision levels has been extensively studied in the literature.

- Muhammed Razzak et. al [3] combined the face and finger veins in which multilevel score fusion is performed to increase the robustness of the authentication system. The score level fusion of client specific linear discriminant analysis (CSLDA) for fusion of face and finger veins result is performed. The score of face and finger veins are combined using weighted fuzzy fusion. This system is efficiency in reducing the FAR 0.05, FRR 0.23 and the accuracy of the system is 95%.

- Mohammed soltane et. al [4] proposed a human recognition method combined face and speech information in order to improve the problem of single biometric authentication. Gaussian Mixture modal(GMM) is the main tool used in text-independent speaker recognition, in which it can be trained using the expectation maximization(EM) and Figuieredo-Jain algorithms for score level data fusion is proposed. Extracted face and extracted audio is fused to achieve recognition rate of 96%. Face speech biometric FAR is reduced to 0.087 and FRR is 0.67 and accuracy is 96%.

- Dhanashree vaidhya et. al [5] performed experiments with two modalities: palmprint and palm vein in which feature level fusion is used based on the Entropy technique. The system performance is 99% with FAR 0.02929%, FRR of 1.00 % and accuracy of 99%.

- Rattani et. al [6] combined the face and fingerprints in which feature level fusion is performed to enhance the performance of the face and fingerprint modalities alone by 5.05% and 0.82 % respectively. The feature level fusion outperforms the score level fusion by 0.67%. The system performance is FRR of 1.98 %, FAR of 3.18 % and the system accuracy is 98 %.

- Bhagat et. al [7] proposed a multimodal biometric by combining palm vein and face biometric, in which feature level fusion is performed. The overall accuracy of the system is more than 95%, FAR of 0.5%, FRR of 1.0% and accuracy of 98.3%.

- Feifei et. al [8] combined the fingerprint and finger vein in which score level fusion is performed. The overall accuracy of the system before fusion fingerprint accuracy is 95.3%, finger vein is 93.72% but after fusion the accuracy of the system is 98.74% with FAR of 1.2%, FRR of 0.75%.

- Krishneswari et. al [9] combined the fingerprint and palm print in which feature level fusion were used using wavelet based image fusion techniques with min-min approximation. Features were extracted using information Gain (IG). The average verification accuracy obtained was 98.34% and the FAR of 1.02%, FRR of 0.9% and accuracy of 98%.

- Nazmeen et. al [10] combined face and ear images in which images are passed to a quality module in order to reduce false rejection rate. Improvement in recognition result is obtained when ear biometric is fused with face

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biometric. The fusion is done at decision level, achieving a recognition rate of 96% showing an improvement in accuracy with FAR of 0% and FRR of 4%.

- Nageshkumar et. al [11] combined the palm print and face image in which score level fusion were used and the results are found to be very encouraging and promoting for the research in the field. The overall accuracy of the system is more than 97%, FAR 2.4%, FRR 0.8%

- Krzyszof et. al [12] combined the face and speech in which decision level fusion is performed. The system performance is FAR of 3.0%, FRR of 1.1% and the accuracy of 87%.

- Mohamad et. al [13] performed multimodal biometrics by fusing the fingerprint and iris in which decision level fusion is used. A fuzzy logic method is used for fusion which is given better performance and accuracy of 98% with FAR of 2%, FRR of 2% and accuracy of 98%.

- Lin Hong et. al [14] combined the palm print and face image in which decision level fusion is performed. Decision fusion formulated in the system enables performance improvements by fusing the extracted features of face and fingerprints are fused to achieve the recognition rate of 92%, FAR 1%, FRR is 1.8%.

- Gayatri Bokade et. al [15] presented a feature level fusion system of face and palm print traits using a simple fusion algorithm. Since feature set contains relevant and richer information about the captured biometric evidence, fusion at feature level is expected to provide more accurate results as compared to other fusion methods. The GAR using palm images only is found to be 81.48%. The GAR using face images is found to be 88.88%. The fusion results indicate substantial increase in system to be 95%, FAR of 0.5%, FRR of 1.2%.

- Mitul Dhameliya et. al [16] combined the two biometric palmprint and fingerprint at feature level fusion to develop a multimodal biometric system. Features are extracted using Gabor filtering. The average recognition rate obtained was 87% with FAR 0.2% of and FRR of 1.1%.

- Jegadeesan et. al[17] combined the fusion of fingerprint and iris in which feature level fusion is used and the images are preprocessed. The system performance is 91% with FAR of 10% and FRR of 5.3%.

Figure 1: Accuracy of fusion techniques

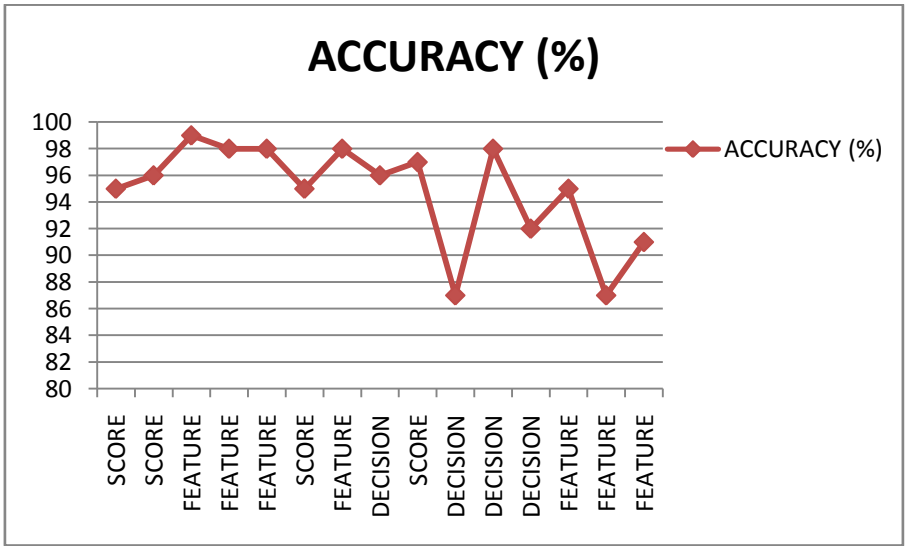

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TABLE 1: Comparison of fusion techniques and its dataset, FAR, FRR and accuracy rate by various authors

AUTHOR	FUSION	DATA SET	FAR (%)	FRR (%)	ACCURACY (%)
Muhammed et al.	SCORE	Face, Fingervein	0.05	0.23	95
Mohammed et al.	SCORE	Face, speech	0.087	0.67	96
Dhanashree et al	FEATURE	Palmprint, palm vein	0.029	1.0	99
Rattani et al.	FEATURE	Face, fingerprint	1.98	3.18	98
Bhagat et al	FEATURE	Palmvein, face	0.5	1.0	98
Feifei et al	SCORE	Fingerprint, F.vein	1.2	0.75	95
Krishneswari et al	FEATURE	Fingerprint, palmprint	1.02	0.9	98
Nazmeen et al	DECISION	Face, ear	0	4	96
Nageshkumar et al	SCORE	Palmprint , face	2.4	0.8	97
Krzyszof et al	DECISION	Face, speech	1.1	3.0	87
Mohamed et al	DECISION	Fingerprint, iris	2	2	98
Lin hong et al	DECISION	Palmprint, face	1	1.8	92
Gayatri et al	FEATURE	Face, palmprint.	0.5	1.2	95
Mitul et al	FEATURE	Palmprint, fingerprint	0.2	1.1	87
Jegadeesan et al	FEATURE	Fingerprint, iris	10	5.3	91

III. RESULTS AND CONCLUSION

In this paper various image fusion techniques are studied and their performances are evaluated on three criteria: Score, Decision and feature fusion. While selecting fusion feature for particular application Table 1 is helpful. For fusing multiple images feature fusion technique [5,6,7,9,15,16,17] are better choice when compared to score [3,4,8,11] and decision [10,12,13,14] techniques. The accuracy of the above three techniques are summarized in Figure 1. For proposed work, the feature fusion technique provides a better solution for fusing multiple images. The image transformation and cancelling process can be done with the help of the distortion algorithm. As a result, the combination of feature fusion technique and distortion algorithm provides more accuracy and security for fusing multiple images in multimodal biometrics.

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REFERENCES

1. K.Geetha, V.Radhakrishnan," Multimodal biometric system: A feature level fusion approach", International journal of computer applications Vol.71, No.4, 2013.
2. P.S.Sanjekar, J.B.Patil,"An overview of multimodal biometrics", Signal and image processing: An International journal (SIPIJ) Vol.4, No.1, 2013.
3. Muhammed Imran Razzak, Rubiyah Yuosf and Marzuki Khalid, "Multimodal face and finger veins biometric authentication", Scientific Research and Essays, Vol.5, No.17, pp. 2529-2534, 2010.
4. Mohammed soltane, Noureddine Doghmane,"Face and speech based multimodal biometric authentication", International journal of advance science and technology, Vol 21, No.8, pp 41-46, 2010.
5. Dhanashree vaidhya, sheetal pawar, "Feature level fusion of palmprint and palm vein for personal authentication based on Entrophy technique", International Journal on Electronics and communication Technology, Vol.5, Issue spl-1, 2014.
6. A.Rattani, D.R.Kishu, M.Bicego," Feature level fusion of face and fingerprint Biometrics", Biometrics: Theory, applications and systems, First IEEE International conference, 2007.
7. S.F.Bahgat, S.Ghoniemy, M.Alotabi," Proposed Multimodal palm-veins- face biometric Authentication", International journal of advanced computer science and applications, vol-4, No.6, 2013.
8. Feifei cui, Gongping yang, "Score level fusion of fingerprint and finger vein Recognition", Journal of Computer Information's systems: 16, 5723-5731, 2011.
9. Krishneswari K, Arumugam S," Multimodal Biometrics using feature fusion", Journal of computer science 8(3):431-435, 2012.
10. Nazmeen bibi boodoo, R.K.Subramanian, "Robust multi-biometric recognition using face and ear images", IJCSIS-International journal of computer science and information security, Vol.6, No.2, 2009.
11. Nageshkumar, Mahesh.PK, Shanmuka swami M.N, "A Efficient Multimodal biometric fusion using palmprint and a face image", International Journal of computer science, Vol.2, Issue 3, 2009.
12. Krzyszof, Jonas Richard, Plamen Prodanov, Andrzejn Drygajlo, "Reliability- Based decision fusion in multimodal biometric verification systems", EURASIP Journal on advances in signal processing, Article ID 86572, 9 Pages, 2007.
13. Mohamad Abdolahi, Majid Mohamadi, Mehdi Jafari," Multimodal biometric system fusion using fingerprint and iris with fuzzy logic", International Journal of soft computing and engineering, Vol.2, Issue-6, 2013.
14. Lin Hong, Anil Jain, "Integrating faces and fingerprints for personal identification for personal identification", IEEE Transactions on pattern analysis and machine intelligence, Vol.20, No.12, 2008.
15. Gayathri umakant bokade, ashok M.sapkal, "Feature level fusion of palm and face for secure recognition", International Journal of Computer and Electrical Engineering, Vol.4, No.2, 2012.
16. Mitul D. Dhameliya, Jitendra P.Chaudri," A multimodal biometric recognition system based on fusion of palmprint and fingerprint", International journal of engineering trends, Vol.4, Issue 5, 2013.
17. A.Jagadessan, Dr.K.Duraisamy,"Secured Cryptographic Key Generation from multimodal biometrics: Feature level fusion of fingerprint and Iris", International Journal of computer science and information security, Vol.7, No.2, 2010.
18. Sumeet kaur, Priyanka Sharma," Analysis of multimodal biometrics by feature level fusion: A Review", International journal of advanced research in computer science and software engineering, Vol.3, Issue 7, 2013.
19. DivyaKant T.Meva, C.K. Kumbharana," Comparative Study of Different fusion techniques in multimodal biometric authentication", International Journal of Computer Applications, Vol.66,No.19, 2013,
20. Deepa Kumar Sahu, Parsai M.P, "Different Image Fusion Techniques-A critical Review", International Journal of modern Engineering Research (IJMER) Vol.2, Issue-5, pp 4298-4301, 2012.
21. Dapinder kaur, Ganganpreet kaur," Level of fusion in multimodal biometrics: A Review", International journal of advanced research in computer science and software engineering, Vol.3, Issue 2, 2013.
22. Sakshi Kalra, Anil Lamba," A survey on multimodal biometric", International journal of computer science and information technologies, Vol.5, No.2, pp 2148-2151, 2014.
23. Rupali L.Telgad, Almas M.N.Siddiqui, "Automated biometric verification: A survey on multimodal biometrics", International journal of computer science and business informatics, Vol.6, No.1, 2013.