# The Investigation on Multimodal Biometric Recognition

Ai-Li Geng[1,a],Liyang Liu [2]

[1] The electronic commerce department, GuangDong Pharmaceutical University,Guangzhou（510006）, P. R. China

[2] College of Physics, Jilin University, Changchun (130012), P. R. China

[a.] gengaili@126.com

**Keywords:** recognition systems, fingerprint and iris biometry, recognition rate, multimodal biometric systems

**Abstract.** Biometrics is used to identify individual in groups by their characteristics, such as fingerprint, face, iris, voice and behavioral characteristics like hand written signature and keystroke. Normally, a majority of biometrics recognition systems adopt methods by using unique feature to discriminate different individual from groups. But there is some forgery, subjective modifications like making up exiting as usual. A multimodal biometric recognition systemusing multiple biometrics to identify is proposed. In addition, it can support better Equal Error Rate (EER), False Acceptance Rate (FAR) and False Rejection Rate (FRR) by combining two or more physical or behavioral features. With lots of approached have been proposed, experts also pay much attention to the methods mentioned in recent years. The objective of this paper is to support a survey of multimodal biometric recognition system and approach using face, fingerprint recognition and enhanced iris characters that commonly used recently.

## Introduction

Biometric recognition as defined by ISO/IEC is the process of searching against a biometric enrolment database to find and return the biometric reference identifier(s) matching a submitted biometric sample of a single individual [1]. Biometric recognition systems are being adopted widely in many applications and security systems requiring high levels of security, for enhancing security for Internet banking, ATM, Airports, Law enforcement applications etc. [2]

But normal biometric systems operate on a single character. Captured sensordata are oftenaffected by noise due to the environmental conditions (insufficientlight, powder, etc.) or due to user physiologicaland physical conditions (cold, cut fingers, etc); not all biometric features havethe same distinctiveness degree (for example, hand-geometrybased biometric systems are less selective thanthe fingerprint-based ones); and all biometric features are universal,but due to the wide variety and complexity of the humanbody, not everyone is endowed with the same physicalfeatures and might not contain all the biometric features[3].

Multimodal biometric systemis a recent approach developedto conquer these problems.It combines more than one co-related biometric features, for e. g. many impressions of a finger, many images of a face and like. It may also combine different features for example finger print and face images, orfinger print, Iris and face images, or finger print and spokenpassword (i. e. voice recognition) [4].Multi-modal biometric system holds in possessionnumerous merits like, improvement in the matching accuracy by impoverishingEqual Error Rate (EER), False Acceptance Rate (FAR) and False Rejection Rate (FRR), vanquishing the problem of non-universalityby supporting for another biometric trait in ease ifa human is rejected to enroll using one trait, better quality ofdata i.e. effectively addresses the problem of noisy data,enhancing security by making tampering task extremelydifficult, supporting to operate even if some of the biometric sources become trustworthy, easy searching in the database[5].

 

## Biometric Modalities

1) Face Recognition Biometrics

Face recognition is one of identification technology adopting automated ways to verify the identity of a person due to his/her physiological characteristics[6], such as location, shape and spatial relationships between facial attributes like eyes, eyebrows, nose, lips and so on[7].Principal Component Analysis (PCA) is one of the best global compact representations,which were used by Kirby and Sirovich for the first time to apply the Karhunen-Loeve expansion to face recognition[8]. PCAgives an s-dimensional vector representation of each face in a training set of images[9]. At the beginning of face recognition, the researchersonly adopted a small quality of features as represent the dataset.Only they had reconstructed the small number of features to form images, they contained the images resembled faces, which owned the name of Eigen images[10]. Then they hope to discover a t-dimensional subspace with basis vectors corresponding to the maximum variance direction in the initial image area. Then, fast PCA is mentioned for improve the computational efficiency, with some limitation mainly about convergence which the images own high resolution and mean square error.

2) Fingerprint Biometrics

It is another common biometric approach for recognition a person. It is obviously that even fingerprint of recognition twins are not unique. It contains ridges and valleys of the surface of a finger. The location and direction of some important points called minutiae points are the object of patching process.

Weizhou Zhao et al. describe a novel approach torecognize finger print based on Frobenius norm. The randommapping result avoids attacking original fingerprint feature.But the FAR and FRR is not perfect. An EER of 0.21 % is reported with FVC2002 database[11].Yang and Ma used fingerprint, palm print, and hand geometryto implement personal identity verification[12]. Compare with other multimodal biometric systems, these three biometric characters can be got from the same image. They deal with matchingscorefusion at different levels to establish identity, besides, it performsa fast fusion of the fingerprint and palm-print character successively,a matching-score fusion withinthe palm-geometry uni-modal system andthe multimodal system.Therefore, it improves the system more stability.

3) Iris Biometrics

Iris is a thin circular diaphragm, and locates amount the pupil and the sclera. It has a unique epigenetic pattern throughout adult life. This feature makes it very obvious that iris catches much attractive tobe used as a biometric for separate individuals with each other.

Yogendra Narain Singh et al. explain different vitalitydetection techniques for biometric features like fingerprint,face and iris techniques. The result reviews that the result ofFingerprint techniques Image power spectrum (EER=0.6%-6.3%), Perspiration Pattern (Classification Accuracy=90%),Fingertip morphology (EER is N/R), Skin Deformation(EER= 11.24%-19.63%) arereported. In Face recognition techniques Face Spatial features(Classification error rate=0.75%, Movement of eyes are achieved. It alsoreports results of multimodal vitality detection techniques.The voice with Face (EER=I%-5.1%), Audio-Visual(EER=17%-32%) is obtained. [13]

## Discussions and Conclusion

An important investigation of literature existing mainly on biometric recognition system incorporating face recognition, fingerprint recognition and iris matching have been introduce and analysis in this paper.Inside, uni-model biometric system can only deal with unique character of the subject, and the consequence is partial, thenmultimodal isproposed for optimal EER, FAR and FRR indexes improving system dependability.

The pursuits of knowledge on the diverse biometricsystems envisage single biometric feature is not sufficient toprovide strong authentication. This dictates the importance ofmulti-modal biometrics. A few multi-modal biometric related works have been reported. But, the most of the multimodaltechniques are lacking in security aspects. Table 2 showsexperimental comparative

analysis of different biometric traitsand technologies with respect to the parameters listed in Table 1. In general, the consequence of fingerprint is better than other two biometric recognition under these parameters mentioned before.The summary ofour experimentaldedicates that the fingerprint, face recognition andiris are having edge over other biometric traits.

Table 1biometric parameters

| Number | Parameters | Details |
|---|---|---|
| 1 | Universality | Each person should have the characteristic |
| 2 | Uniqueness | Is how well the biometric separates individuals from another |
| 3 | Performance | Accuracy, speed and robustness of technology used |

Table 2 comparison of biometric parameters and technolgies

| Biometrics | Face | Fingerprint | Iris |
|---|---|---|---|
| Universality | High | Med | High |
| Uniqueness | Low | High | High |
| Performance | Low | High | High |
| EER | NA | High | Low |
| FAR | Med | High | Low |
| FRR | High | Med | Low |

## Reference


[1] Standing document 2, harmonized biometric vocabulary, version 8, Aug.22, 2007.

[2] Vincenzo Conti, Carmelo Militello, Filippo Sorbello, and Salvatore Vitabile, A Frequency-based Approach for Features Fusionin Fingerprint and Iris Multimodal BiometricIdentification Systems

[3] Debnath Bhattacharyya, Rahul Ranjan, Farkhod Alisherov A, MinkyuChoi, Biometrie Authentication: A Review, International Journal of u- ande- Service, Science and Technology, Vol. 2, No. 3, Page 13-27,September 2009.

[4] Ashraf ADarwish, Walaa M.Zaki, Omar M.Saad, Nadia M.Nassar,Gerald Schaefer, Human Authentication using Face and FingerprintBiometrics, Second International Conference on ComputationalIntelligence, Communication Systems and Networks, ISBN: 978-0-7695-4158-7/1O$26.00@2010 IEEE, Page 274-278, 2010.

[5] Naveena Marupudi, Eugene. John, Fred Hudson, FingerprintVerification in Multimodal Biometrics, ISBN: 1-4244-0359-6/06/$20.00@2006 IEEE, Page 130-136,2006.

[6] Yea-Shuan Huang,Chu-Yung Li, An effective illumination compensation method for face recognition,Journal of Marine Science and Technology, DOI: 10.6119/JMST-012-0829-4

[7] Debnath Bhattacharyya, Rahul Ranjan, Farkhod Alisherov A, MinkyuChoi, Biometric Authentication: A Review, International Journal of u- ande-Service, Science and Technology, Vol. 2, No. 3, Page 13-27,September 2009.

[8] M. Kirby and L. Sirovich, Application of the Karhunen-Loeve procedure for the characterizationof human faces, IEEE Trans. Pattern Anal. Mach. Intel. 12(1) (1990)103-108.

[9] Gagandeep Kaur, Gurpreet Singh, Vineet Kumar, A Review on Biometric Recognition, International Journal of Bio-Science and Bio-TechnologyVol.6, No.4 (2014), pp.69-76.

[10] M. Parisa Beham, S. Mohamed Mansoor Roomi, A Reviewof Face Recognition Methods, International Journal of Pattern Recognitionand Artificial IntelligenceVol. 27, No. 4 (2013) 1356005 (35 pages)

[11] Weizhou Zhao, Hui Zhang, Secure Fingerprint Recognition Based onFrobenius Norm, International Conference on Computer Science andElectronics Engineering, ISBN: 978-0-7695-4647-6/12$26.00@2012IEEE, Page 388-391,2012.

[12] Zin Mar Win, Myint Myint Sein, Fingerprint recognition system forlow Quality Images, SICE Annual Conference, Waseda University,Tokyo, Japan, PROOOIl1ll0000-1133#400@2011 SICE, Page 1133-1137,13-18 September 2011.

[13] Yogendra Narain Singh, Sanjay Kumar Singh, Vitality Detection fromBiometrics: State-of-the-Art, World Congress on Information andCommunication Technologies, ISBN: 978-1-4673-0126-8/11/@2011 IEEE, Page 106-111,2011.