International Journal of Advanced Technology in Engineering and Science
Vol. No.6, Issue No. 05, May 2018
www.ijates.com
ijates
ISSN 2348 - 7550

Fusion Based Multimodal Biometrics System

Dr. Snehlata Barde

Mats School of Information Technology, MATS University, Raipur,India

ABSTRACT

Person identification and verification is the most requirement of our society at any stage like examination of school, college or any other competitive entrance exam, employee attendance, registry of house etc. last decade people used admit card, ID card, key or some authenticate paper which is used to recognition the person but it has many drawbacks such as can be lost, stolen, and easily duplicated.

The biometrics provide great solution to improve a security using Biometric technologies each and every field. Basic need of the multimodal biometrics system being able to recognize people for various purpose to increase security widely. In this paper we work on three modalities face, ear and foot and used fusion technique to find the result in the term FAR, FRR, EER, Matching score.

Keywords*— *Biometric, Fusion Technique, Multimodal Biometrics,

I INTRODUCTION

A biometrics is "any automatically measurable, robust and distinctive physical characteristic or personal trait that can be used to identify an individual or verify the claimed identity of an individual". Biometric technologies are developed on the basis of recognizing the characteristics of person. Conventional biometrics or person authentication system usually uses two mechanisms for verification and identification. Verification deals with one-to-one matching whereas identification ensures one-to-many matching. Biometrics is very useful technology used in numerous applications such as biometrics include face recognition, fingerprint matching, DNA matching, iris recognition, gait recognition etc. The biometrics provides great solution to security technologies. The need for a system being able to recognize people for various purposes is increasing widely.

Multiple sources of biometric information are combined for overcoming some of the limitations mentioned in unimodal biometric system. The term "multimodal" is used to combine two or more different biometric sources of a person like face, ear and foot sensed by different sensors.

Multimodal biometrics system involves various levels of fusion namely sensor level, feature level, matching score level, decision level and rank level .The main aim of using fusion is to determine the best set of experts in a problem domain and devise an appropriate function that could combine the decisions of individual experts at optimum level. These are categorized as:

1.1 Prior to matching:

Fusion schemes prior to matching are used to integrate the evidence before matching. Sensor level and feature level fusion are important fusion schemes under this category.

1.2 After matching:

Fusion schemes after matching are used to combine pieces of evidence after matching. Identity management system is challenging task in providing authorized user with secure and easy access to information and services across a wide verity of networked system.

2. RELATED WORKS

Multimodal biometrics is preferred in authentication based image processing applications. Ross et al.(2004) introduced the main objective of a multimodal biometric system is to improve the recognition performance of the system. Barde S. et al. (2016) proposed a biometric systems based on PCA using Ear Modalities. At decision level matching score calculated.

Automatic person authentication using biometric traits has been a research area for biometric scientists and researchers for last many years. Bigun et al. (2005) introduced recognizing person utilizing multiple biometric traits and has significant advantages such as better recognition accuracy and higher robustness, that is; resistance to sub-system failures, increased recognition performance. Tumer et al. (1999) summarized information fusion as necessary step to utilize multiple biometrics for decision making in a single modality system. Initially, neural networks were used for information fusion. Barde S. et al. (2014) developed a multimodal biometric system which combines ear and foot modalities at decision level. In this work, features were extracted by using eigen image classifier for ear and Modified Harr energy for foot and concatenated after normalization process to obtain matching score.

Ross et al. (2003) introduced biometric fusion in multimodal system which is performed at three fusion levels: feature level, matching score level and decision level. Out of these fusion schemes, feature-level fusion could keep the identity information to its most and is expected to perform better.

Abate et al. (2007) proposed a hybrid face/ear recognition system based on IFS (Iterated Function System) theory, which largely used image compression and indexing Yao et al. (2007) proposed a multimodal biometric system using face and palm print at feature level. Gabor features of face and palm prints were used individually. Extracted Gabor features are then analyzed using linear projection scheme such as principal component analysis (PCA) to obtain the dominant principal components of face and palm print separately.

Barde S. et al. (2014) proposed a PCA based multi modal biometric systems using Ear and Face Modalities. Feature extracted, normalized and calculated Euclidian distance for matching score to identify genuine and imposter using multimodal biometrics. Barde S. et al. (2015) developed a multimodal biometric system which combines face and foot modalities at decision level using PCA classifier for face and wavelet transformer for foot and concatenated after normalization process to obtain matching score.

3. METHODOLOGY

Multimodal biometric system can be designed by integrating several modalities using different fusion schemes. The main goal of fusion is to determine the best set of expert values that can optimally combine the decisions rendered by the individual experts. The brief description of the fusion methods is presented here Figure1 Shown fusion scheme.

Sensor Level: The raw data obtained as different modalities from sensors are fused. Since sensor level

Figure fusion combines the information from different sensor, it requires some pre-processing such as sensor calibration and data registration before performing the fusion.

Feature Extraction Level: Feature level fusion consolidates the features obtained from different modalities using suitable methods of feature extraction .This approach also introduces a curse of dimensionality and hence either feature transformation or feature selection can be applied to reduce the dimensionality of the fused feature set.

Matching Score Level: Match score is a measure of the similarity between the input and template biometric feature vector. Since scores obtained from different matchers are not homogeneous, score normalization technique maps the scores obtained from different matcher on to a same range.

Rank Level and Decision Level: Decision level fusion involves the fusion of decisions obtained using different modalities. Since decision level fusion holds binary value it is also called as abstract level fusion.

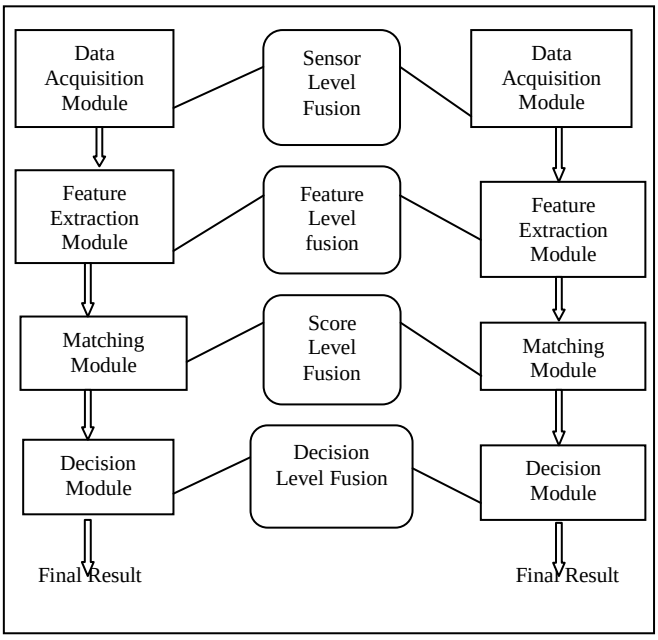

Fig.1: Fusion Scheme at four level.

A decision made by a biometric system is either a "genuine" type of decision or an "impostor" type of decision. For each type of decision, there are two possible outcomes, true or false. Therefore, there are a total of four possible outcomes: a genuine individual is accepted or a genuine match occurred, a genuine individual is

rejected or a false rejection occurred, an impostor is rejected or a genuine rejection occurred and an impostor is accepted or a false match occurred. In present work, we have used the fusion technique at matching level for multimodal biometric system. All the biometric traits (face, ear and foot) were acquired and subjected to the biometrics. The genuine score, impostor score, False Accept Rate (FAR), False Reject rate (FRR) were calculated. The ERR/ROC (error/region of convergence) curve was plotted against FAR at various values of threshold. We also normalized all traits and combined them and calculate matching score for all possible combinations of three biometric modalities.

For this we use digital camera to capture face, ear and foot the images of 200 persons at sensor level. All colour images are converted in to gray scale and resize. The features are extracted by using PCA algorithm. At matching level we calculate the following terms:

False accept rate (FAR): False accept rate is defined as the probability of an impostor being accepted as a genuine individual. The FAR is computed as the rate of number of people is falsely accepted with respect to the total number of enrolled people.

.

$$FAR = \frac{IM}{Th} \quad (1)$$

False reject rate (FRR): False reject rate is defined as the probability of a genuine individual being rejected as an impostor. This is computed as the rate of number of

people is falsely rejected with respect to the total number of enrolled people.

$$FRR = \frac{Gu}{Th} \quad (2)$$

Relative Operating Characteristic (ROC): The values of FAR and FRR can have trade off against each other by changing some parameters. The ROC plotted as a graph against the values of FAR and FRR, changing the variables implicitly.

Equal Error Rate (EER): The rate at which both accept and reject errors are equal is called as EER. When quick comparison of two systems is required, the ERR is commonly used. This is obtained from the ROC at a point where FAR and FRR have the same value. The lower the EER, the more accurate the system.

Weight of biometric traits: The fusion technique used in the experiment is based on the different weight assignment to each biometric trait. The weight for ith trait, Wi is calculated as:

$$W_i = \frac{1}{EER_i} \quad (3)$$

Normalized score: The match score of the individual trait may not be homogeneous and the match scores at the output of different traits may follow different statistical distribution.

Therefore, Min-Max normalization technique is used to calculate normalized score of each trait. The weight of particular trait of all biometric traits is calculated as normalized score:

$$W_i = \frac{\frac{1}{EER_i}}{\sum_{j=1}^{n} \frac{1}{EER_j}} \quad (4)$$

where EERj is equal error rate for jth trait and 'n' is the number of traits.

Score after fusion: The sum rule based fusion is used in the work. The score after fusion is calculated as:

$$S = \sum_{j=1}^{n} (W_j S_j) \quad (5)$$

where Sj is match score and Wj is the weight of jth trait respectively.

4. ANALYSIS OF EXAM RESULTS

Figure 2 shows the training set of face, ear and foot images in which we take the color picture of face, ear and foot of 200 person then convert into gray scale and resize them using Matlab software.

Fig.2: Data set of face, ear and foot

Table 1 shows the genuine score, Imposter sore and threshold value which is calculated using PCA algorithm and find out Euclidian distance from input image(test image) to database (training set image) and set the threshold value. the value which is less then threshold value is known as genuine score and greater value is known as imposter score.

Table 1: Genuine Score and Imposter Score for face, ear and foot images

Trait	Genuine Score	Imposter Score	Threshold Value
Face	1.5470E+04	1.8119E+04	1.5510E+04
Ear	1.5282E+04	1.6488E+04	1.5370E+04
Foot	2.2277E+04	2.6613E+04	2.2325E+04

Table 2 shows False accept rate (FAR) and False reject rate (FRR) for Individual Traits. Value of EER of each modality has been mentioned.

Table2: FAR and FRR

Traits	FAR	FRR
Faces	1.1682E+00	9.9742E-01
Ear	1.0727E+00	9.9427E-01
Foot	1.1921E+00	9.9785E-01

Table 3 shows EER for face, ear and foot modalities.

Table 3: EER for Individual Trait

Traits	EER
Face	1.171
Ear	1.078
Foot	1.194

Figure 3 show the graph of Equal Error Rate which is define between FAR to FRR for face ear and foot modalities.

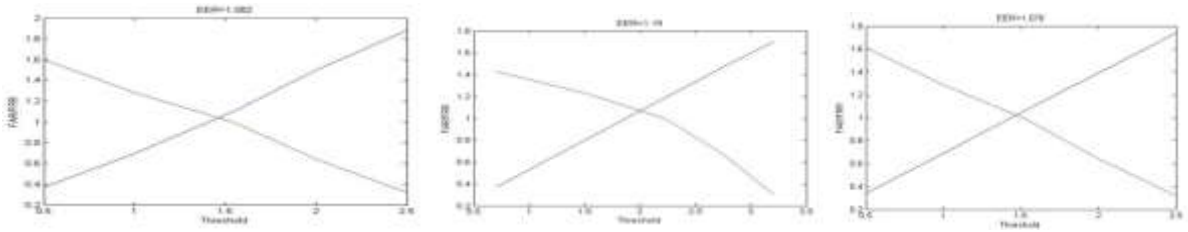

Fig. 3: EER (FAR/FRR) curves for various traits

The weight of all individual face, ear and foot modalities was calculated as 1/EER, shown in table 4.

Table 4: Weight for all Modalities

Traits	Weight
Faces	0.85
Ear	0.92
Foot	0.83

The weights assigned to each traits in all possible fusion of two and three possible combinations of three modalities in table 5 and table 6.

Table 5 : Weight for each Trait in all possible Fusion of two Traits

Traits	Face	Ear	Foot
Faces + Ear	0.479	0.520	-
Face+ foot	0.504	-	0.495
Ear+ Foot	-	0.525	0.474

Table 6: Weight for each Trait in all possible Fusion of three Traits

Traits	Face	Ear	Foot
Face + Foot+ Ear	0.326	0.354	0.319

Face recognition and ear recognition produced similar scores and foot recognition algorithms produced dissimilarity scores. The Min-Max normalization technique was used to convert all dissimilar data into similar data shown in table7

Table 7: Normalized Score

Traits	Normalized Score
Face	0.35
Ear	0.15
Foot	0.07

Matching score was calculated for all combinations using weight of modalities and normalized score shown in table 8 and table 9.

Table8: Matching Score of combination of two Traits.

Traits	Score
Face + Ear	0.248
Face + Foot	0.211
Ear + Foot	0.113

Table 9: Matching Score of combination of three Traits.

Traits	Score
Face + Ear + Foot	0.191

5. CONCLUSION

Multimodal biometric system used face, ear and foot biometric traits. The weight of each biometric trait was calculated applied to PCA classifier approaches. The information was combined after normalization. The sum rule fusion apply to all possible combinations of modalities and the highest matching score was found as 0.11 when two modalities ear and foot were combined. 0.19 score was obtained when three modalities face, ear and foot were combined.

REFERENCES

[1] Ross, A., and Jain, A. K.,"Multimodal biometrics: An overview". *In proc. of 12th European Signal Processing Conference (EUSIPCO),* Vienna, Austria :1221–1224,2004.

[2]Bigun, J., Fierrez-Aguilar, J.,"Combining biometric evidence for person authentication." *LNCS3161*:1–18,2005.

[3]Barde,S," Ear and Foot Biometrics Best for Identification." *International Journal of Novel Research in Computer Science and Software Engineering, 1(1),* pp: 11-19,2014.

[4]Tumer, K., and Ghosh, J.,"Linear and order statistics combiners for pattern classification. In Combining artificial neural nets: Ensemble and modular multi-net systems," *A.J.C. Sharkey (Ed.). London: Springer-Verlag*: 127-161 ,1999.

[5]Ross, A., Jain, A.K., "Information fusion in biometrics." *Pattern Recognition Letters,* 24:2115 –2125, 2003.

[6] Barde,S.," Ear and Foot Biometrics Best for Identification." *International Journal of Novel Research in Computer Science and Software Engineering, 1 (1),* pp: 11-19, 2014.

[7]Abate, A.F. and Nappi, M. D.,"RBS : a robust bimodal system for face recognition." *International Journal of Software Engineering and Knowledge Engineering.,17(4),* pp: 497-513,2007.

[8]Yao, Y., Jing, X. and Wong, H.,"Face and palmprint feature level fusion for single sample biometric recognition." *Nerocomputing. ,70(7),* pp :1582 –1586,2007.

[9]Barde,S.," Person Identification using Face and Foot Modalities." *International Journal of Advanced Engineering Research and Studies (IJAERS), 4(2),* pp: 160-163,2015.

[10]Barde,S.,"PCA based Multimodal Biometrics using Ear and Face Modalities." *International Journal of Information Technology and Computer Science(IJITCS*), 6(5), pp: 43-49,2014.

[11]Barde,S,"Person Identification using Ear Modalities." *International Journal of Modern Trends in Engineering and Research (IJMTER),3(5),* pp:8-13,2016.