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Analysis of Fusion Methods for Ear Biometrics

C.Malathy*
Department of Computer Science and Engineering
SRM University, Chennai, India

Annapurani K
Department of Computer Science and Engineering
SRM University, Chennai, India

Dr.M. AbdulKarim Sadiq
Department of Information Technology
College of Applied Sciences, Sohar
Ministry of Higher Education, Oman

Abstract— Personal security has become an important aspect recently in many organizations. To provide a secured authentication, several biometric techniques are used. In all these techniques, details about the physiological or behavioural characteristics of a person are entered in a database. When a person uses the system, the characteristics required for the system are scanned and a template is formed. In this paper, we consider human ear biometrics since ears are the novel biometric with major advantages. Ears tend to maintain their structure and shape over time even with increasing age. The main objectives of this research are to analyse local and global feature extraction of ear using feature level fusion and matching score level fusion, to analyse the performance and to find out which approach best suits for the extraction of features with improved accuracy and security. Pre-processing is an initial step which includes noise removal using median filter, finding standard deviation, converting the input image into greyscale. The next stage involves extracting the features of ear in which first the edges are detected using zero-cross edge detection method and from the detected edge the local and global features are extracted. Thus by using these fusion methods, the performance is analysed with entropy values based on hamming distance matching technique.

Keywords— Ear biometrics, feature level fusion, zero-cross edge detection, entropy, hamming distance approach.

I. INTRODUCTION

Unimodal biometrics system relies on a single biometric for identifying a person. The inter-level and intra-level fusion best describes the fusion at different levels. Inter-level fusion is fusing multiple biometric traits to form a template. Intra-level fusion combines different feature sets of single trait to form a template. In this research, intra-level fusion is performed to analyse the performance of ear biometrics.
The following are some of the biometric fusions [8] at different levels:

- Sensor level
- Feature level
- Matching Score level
- Decision level
- Rank level

a. Sensor level:
Raw data from the sensor(s) are combined at this level. This is referred to as image level or pixel level fusion. Sensor level fusion can benefit multi-sample systems which capture multiple snapshots of the same biometrics.

b. Feature level:
The input data from the sensor(s) is taken and after the extraction of the feature different feature sets [1] are formed. These different feature sets are combined for appropriate match by using matching technique.

c. Matching score level:
After extracting the feature, the scores [4] are being generated from different modules that are combined to produce a single score. Final decision is taken by considering the fused score. Normalization and Similarity/ Dissimilarity Score are used for making final decision.

d. Decision level:
Decision level fusion is the highest level fusion of biometric evidences. It takes the decision based upon the number of matches performed. It also has own threshold and it individually makes its decision.

e. *Rank level:*
For identification, the output is the ranks of enrolled identities. This fusion scheme is used to consolidate the ranks of individual biometric systems to derive a fused rank for each identity. It reveals less information than match scores. Unlike match scores, the ranking output by multiple biometric systems are comparable. Hence the accuracy of biometric systems can be increased by using any of the above fusion methods.

II. METHODOLOGY

The main processes that are performed in this project are described below:

a. Input Acquisition:

Normally image [13] is captured using Digital cameras, Minolta vivid 300 cameras, Minolta vivid 910 cameras can be used to capture ear images. In this project, the input images are taken from existing IIT Delhi Ear database.

b. Ear Image Enhancement:

In any biometric system the first phase is biometric image enhancement. The images of different biometric traits [18] in this case, ear, are needed to be pre-processed before use them for feature extraction. The enhancement process starts with removal of noise. The original image of biometric traits may contain noises. These noises are normally generated at the time of capturing the image. Median filter is used here to remove the noise. Local standard deviation computation is made to enhance the dimension of the output image so that it helps to detect edges clearly.

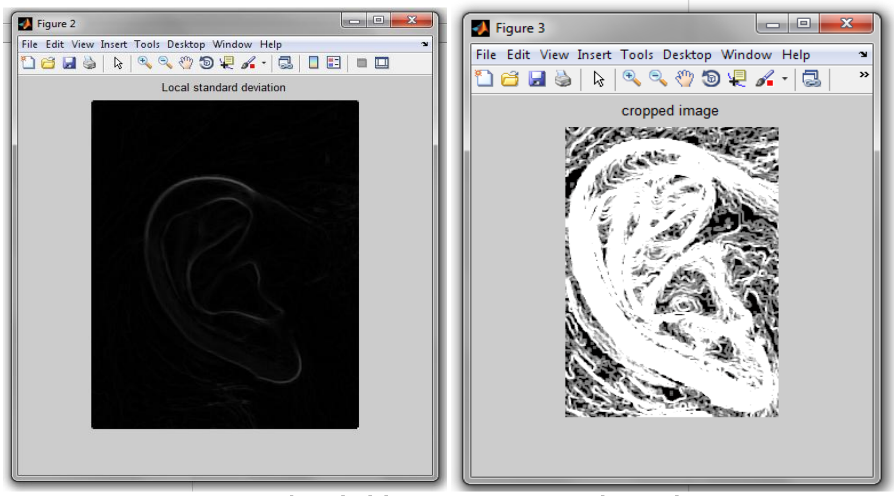

Figure.1. Local standard deviation computation and cropped image

Then automated cropping is made to acquire the needed part of the ear image. Figure 1.shows Local standard deviation computation and cropped image. By using image's histogram, the contrast adjustment is done for cropped image.

c. Edge detection and Feature extraction:

The zero-cross method is used here for finding the edges by looking for zero crossings after filtering image, I with a filter

BW=edge (I)

This method is often combined with the Laplacian of a Gaussian filter, but any filter that approximates the second derivative of the image's data will work. If the filter is not provided, then zero crossing uses the equivalent of this filter:

H=fspecial ('log',13,2)

where fspecial creates a two-dimensional filter 'H' of the specified 'type'.

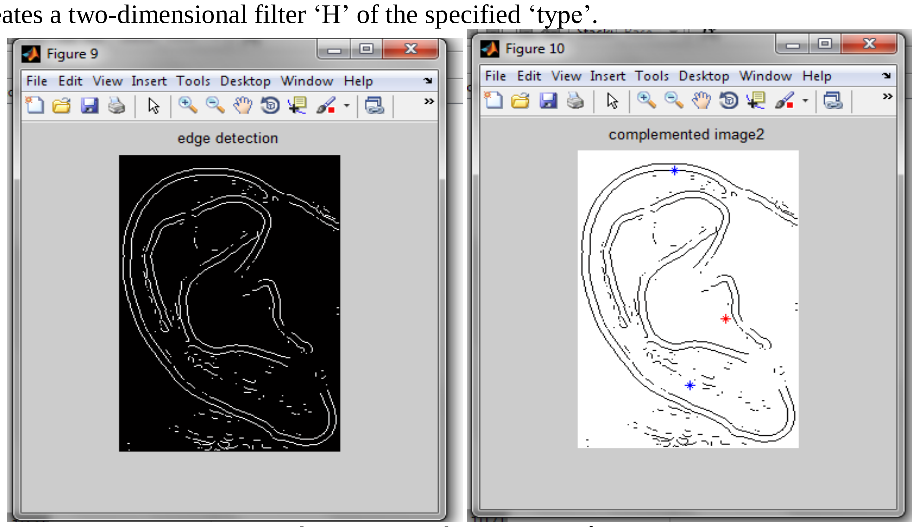

Figure.2: Edge Detection and ROI Detection for input image

Feature extraction [20] is the most important and main part of digital image processing. After completion of both enhancement and ROI selection operation the images are ready for feature extraction.Concha part is taken as the local feature and Outer Helix is taken as the global part of ear image. The rectangular area of radius R is cropped around the selected key points and aligned on its principle axis to extract the desired feature. Since the output of the global feature is less compared to local feature, it is resized to local feature's size for fusion.

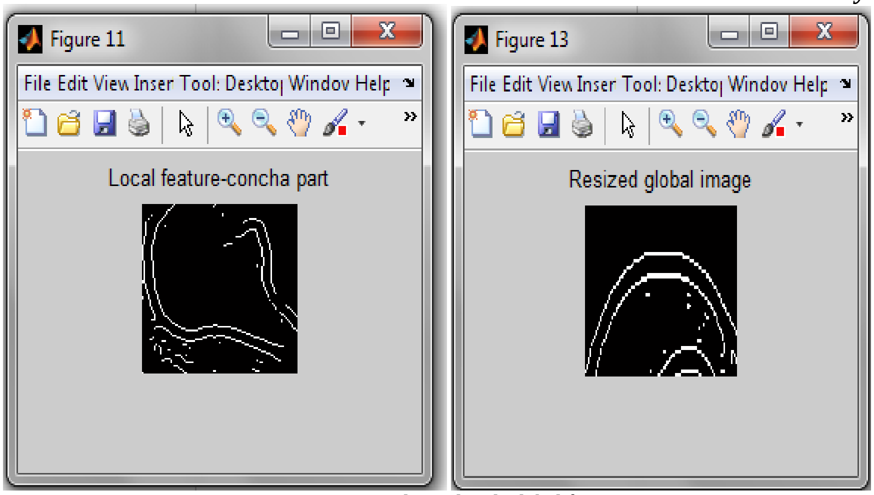

Figure.3: Extracted Local and Global feature

d. Fusion Strategies and matching technique:

Feature level fusion: The feature level fusion is realized by concatenating the feature points obtained from Concha part and Outer Helix part of information .The concatenated feature set has better discrimination power than the individual feature vectors.

Matching score level fusion: By using product rule, the scores are produced and sent to decision module for matching template in the database.

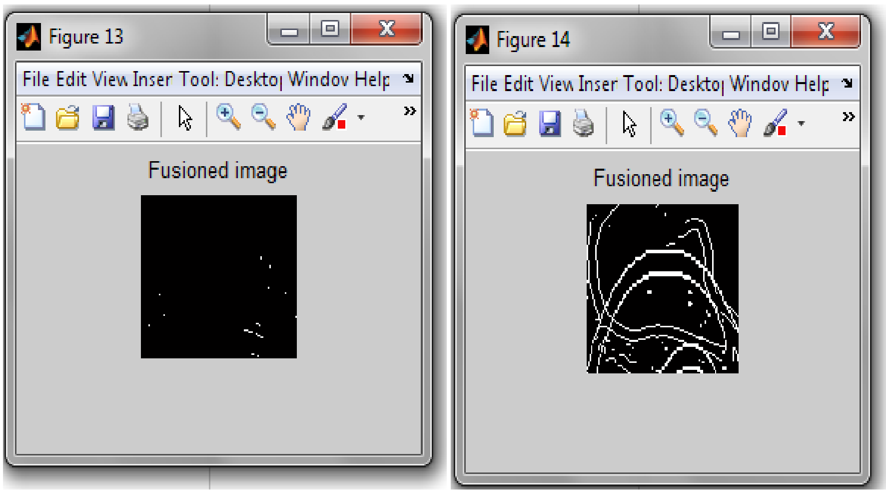

Figure.4: Feature level and Matching score level fusion

Template matching: Hamming distance matching technique is used for both feature level fusion and matching score level fusion to find whether the image is matched to the database or not .This technique is used to find the points that are different in two images that is placed for matching. For eg: Hamming distance for 'roses' and 'toned' is 3.

e. Performance analysis: Entropy is the metric used here for objective assessment which is evaluated as if entropy of fused image contains more information than the other image then fused image is said to have more information. Here entropy value for fused image using feature level fusion and matching score level fusion has been found and the graph has been plotted for analysis.

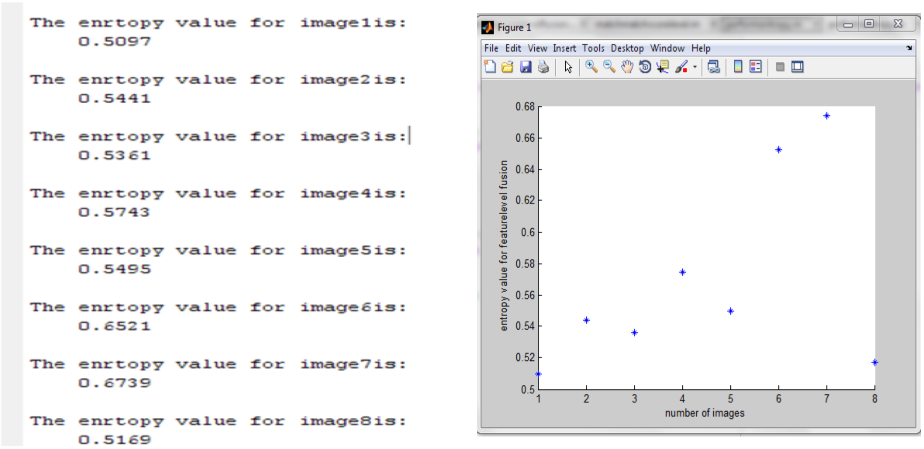

Figure.5: Entropy value and graph for feature level fusion image

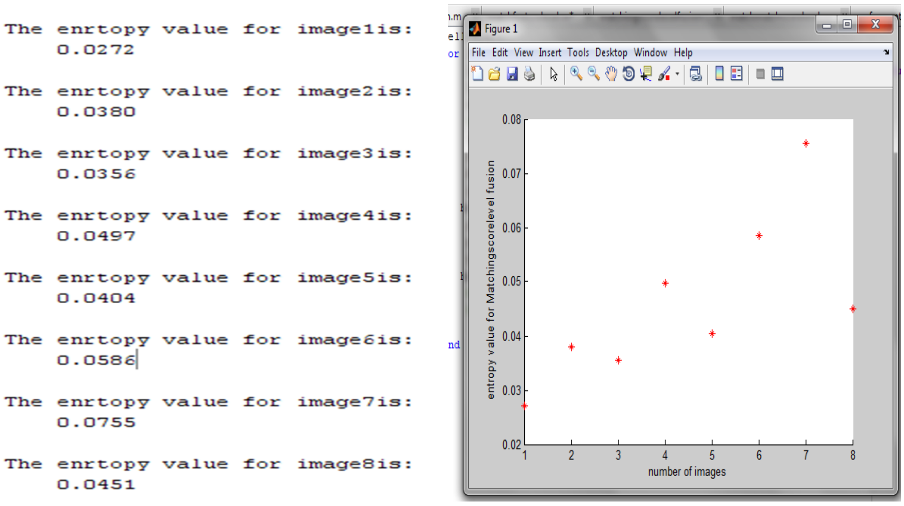

Figure.6: Entropy values and graph for Matching score level fusion image

III. Results

TABLE I

ENTROPY VALUES FOR FEATURE LEVEL FUSION AND MATCHING SCORE LEVEL FUSION

Images / No. of images	1	2	3	4	5	6	7	8
Feature level fusion	0.5097	0.5441	0.5361	0.5743	0.5495	0.6521	0.6739	0.5169
Matching score level fusion	0.0272	0.0380	0.0356	0.0497	0.0404	0.0586	0.0755	0.0451

The above graphs and table shows that the entropy value for feature level fusion is higher than matching score level fusion. Therefore it is concluded that feature level fusion method contains more information than matching score level fusion.

IV. Conclusions

This work is focused on fusion between Outer Helix part and concha part of ear image. The operation gives an efficient result in matching and detecting correct image pairs. When both the feature level fusion and matching score level fusion is used for these images, it results with 100% accuracy. However, in this research, some consideration has been done as listed below:

- The ear images database which is used here contains ear images of very small size that is 300 x 400 pixels. To perform all the operations on the new ear images it must be resized to the above size and this resize operation is based on manipulation of pixel values.
- The ear images which are considered here are good quality images and all have the same angle with the camera. So any other corrective operations are not required here.
- The fusion process done here is with the ear images that are without occlusions.

These limitations are to be overcome in future.

Acknowledgment

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References

[1] Banabfshe Arbab-Zavar, Mark S.Nixon, *"Robust log-Gabor Filter for ear biometrics"*, Proceedings of I*nternational Conference on Pattern Recognition (ICPR), Tampa, Florida, 2008.*

[2] Michael Maggs, "*Feature level fusion in person Identification"*, Proceedings of IEEE computer society conference on computer vision and pattern recognition (CVPR'05), 2005.

[3] Md. Mahbubur, Md. Rasheedul Islam, Nazmul Islam Bhuyian, Bulbul Ahmed, Md Aminul Islam, "*Person Identification using Ear biometrics", International Journal of the Computer, Internet and Management*, Vol.15, No.2,

pp. 1-8.2007
[4] Nitin Saluja, Anoop Kumar, Amisha, and Rajesh Khanna, *"Cropping image in rectangular, circular, square and triangular form using MATLAB"*, National Conference on Computer Instrumentation, 2010, CSIO Chandigarh, India.
[5] Dakshina Ranjan Kisku, Phalguni Gupta, Jamuna Kanta Sing, *"Ear identification by fusion of segmented slice regions using invariant features: An experimental manifold with dual-fusion approach",* IS&T/SPIE Electronic Imaging (Media Forensics and Security XII), California, USA, 2010.
[6] K. Sasidhar, Vijaya L kakulapati, kolikipogu Ramakrishna, K. Kailasa Rao , *"Multimodal Biometrics systems to improve accuracy and performance"*, International Journal for computer science and Engineering survey (IJCSES) Vol.1 No.2, 2010.
[7] Y.Ramadevi, T.Sridevi, B.Poornima, B.Kalyani, *"Segmentation and object recognition using edge detection techniques"*, International Journal for Computer Science and Engineering, 2010.
[8] S.M.S. Islam, M. Bennamoun, A.S. Mian, and R. Davies, *"Score level fusion of Ear and face 3D features for fast and Expression-invariant human Recognition"*, ICIAR, Canada, 2009, pp. 387-396.
[9] Image Analysis and Recognition, Lecture Notes in Computer Science, 2009, Volume 5627/2009, pp. 387-396, 2009.
[10] Surya Prakash, Umarani Jayaraman, Phalguni Gupta, *"Ear localization from side face images using Distance transform and template matching",* Proceedings of IEEE International workshop on Image processing and Theory, Tools and Applications (IPTA'08) pp. 1-8, 2008.
[11] Mini Singh Ahuja, Sumit Chabbra, *"A Survey of Multimodal Biometrics",* International Conference on Advanced Computing, Communication and Networks, 2011.
[12] Anupam Sana and Phalguni Gupta, "*Ear biometrics: A new approach",* WSPC Proceedings of ICAPR 2007.
[13] M. Burge and W. Burger, *"Ear biometrics for Machine vision",* Kluwer Academic, 1998.
[14] Bir Bhanu and Hui Chen, "Human Ear recognition by computer", In Advances in Pattern Recognition series ISSN 1617-7916, 2008.
[15] http://www.itl.nist.gov/div895/biometrics/
[16] http://biometrics.cse.msu.edu/
[17]http://www.tech.purdue.edu/it/resources/biometric
[18] http://www.wvu.edu/~bknc/
[19] http://www.citer.wvu.edu/
[20] http://www.scribd.com/doc/50269708/null
[21] Bueno G, Gonzelez R, Deniz O, Gonzelez J, Garcia-Rojo M, *"Colour Model Analysis for Microscopic Image",* In 9th International Congress on Telepathology and Virtual Microscopy, 2008.

