

# Ear Biometrics for Human Identification

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**ABSTRACT:** Ear biometrics is a developing method for human identification due steadiness of human ear features throughout the lifetime. This paper discusses three different ear segmentation methods along with their results. Finally the active region of interest segmentation method for ear segmentation is selected and then the resultant segmented ear image is given to the gabor feature extraction block. The gabor features like mean, standard deviation, entropy, x and y co-ordinates of gabor filtered images and their binarized images are considered as features. These features are fed to the knn classifier and to the svm classifier also. The efficiency of KNN classifier is found to be 87.09% and that of the SNM classifier is 90.32%.

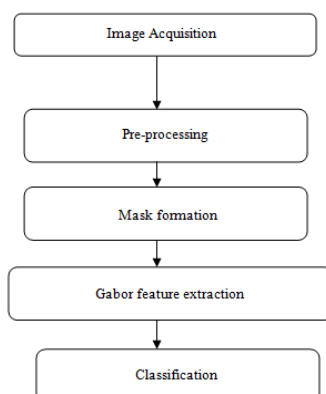
**KEYWORDS:** Active region of interest segmentation, canny edge detection, Gabor features, KNN classifier, SVM classifier.

## I. INTRODUCTION

Generally there are different kinds of biometrics methods implemented till date depending on iris, fingerprint, palm print, knuckle print, teeth biometrics, etc. the purpose to select ear as a biometric for this paper is that ear is such a stable biometric identity in human body which does not change in shape or appearance with age. Moreover ear does not have effects of emotions, sweating, etc. as it is in the case of eyes when tears come due to some reasons or in the case of finger or palm print due to sweating or as in the case of knuckle prints which always depends on the amount of the fold a finger is applied which can vary from one position of fold of knuckle to other for the same person which can reduce the reliability on the system based on knuckle print. So this steadiness of ear as a biometric identity in terms of emotions, age, physical factors motivated us to choose ear as a biometric.

## II. BLOCK DIAGRAM OF THE PROPOSED SYSTEM

The block diagram of the proposed system is as follows:



**Fig.1** : Block diagram of the proposed system

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The first step in the system is image acquisition. The ear images are acquired from the IIT Delhi ear biometric database. Some of the images of the ear biometric database are as follows:



**Fig.2:** Images in IIT Delhi ear biometrics database

After acquiring the images the next step is pre-processing. The pre-processing done in this work is image resizing to the size 400x350 and adaptive histogram equalization. This image is given for the segmentation process which gives the segmented ear image. This segmented ear image is given to the feature extraction block which will find out the gabor features of the image. The next block is of classification. The gabor features are given to the KNN and SVM classifier.

## III.METHODOLOGY

### Image Acquisition

As mentioned above the images are acquired from the IIT Delhi ear database.

### Pre-processing

The gray scale images in the database are to be resized to 400x350. This image is applied to adaptive histogram equalization block.

### Segmentation

Active region of interest method

The work in this paper uses this method for fully automated ear segmentation. In this method the region of interest is square only but not fixed. It varies according to the location of the ear in the image.

The ear specified masks in this method are generated as follows:

1. The image is resized.
2. Histogram equalization is applied on the resized image.
3. Otsu thresholding is applied to get the ear specific threshold value and then a binary mask is generated using this threshold value. This binary mask is applied with the original image.
4. Canny edge detector is applied to the masked image obtained after step 3.
5. The largest area component of the canny edge detected image is obtained in this step. The results of some of this step are as follows:



**Fig.3:** Largest edges detected images

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6. The next step is traversing from first column to last column and find the occurrence of the first and last non-zero pixels of the above obtained image and storing their co-ordinates.
7. The next step is traversing from first row to last row and find the occurrence of the first and last non-zero pixels of the above obtained image and storing their co-ordinates.
8. The mask is formed using proper threshold values set over co-ordinates of the final mask which are selected according to the co-ordinates of the white pixels obtained after step 6 and 7. These masks are different for different ear images and are shown as follows:



Fig.4: Ear specific square masks

The results of this method are as follows:

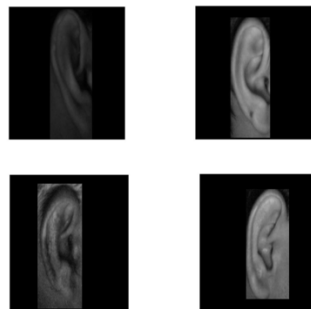


Fig.5: Segmented ear images using ear specific square masks

The accuracy of this method is 93%. The advantage of this method is that it does not need to select points around each ear every time. It is fully automated method for ear segmentation. The time required for this method of segmentation is found to be approximately half that using snake model in MATLAB.

## IV.FEATURE EXTRACTION

Gabor feature uses the Gabor wavelet which has many directions of multi-scale analysis ability, on a periodic or directional texture with good classification effect. A 2-D Gabor function can be expressed as:

$$\psi(x, y; f_0, \theta) = \frac{f_0^2}{\pi\gamma\eta} e^{-\frac{f_0^2}{\gamma^2}x'^2 + \frac{f_0^2}{\eta^2}y'^2} e^{j2\pi f_0 x'} \quad (1)$$

$$x' = x \cos(\Theta) + y \sin(\Theta) \quad (2)$$

$$y' = -x \sin(\Theta) + y \cos(\Theta) \quad (3)$$

In this equation,  $f_0$  represents the central frequency of the filter,  $\Theta$  represents the orientation.  $\gamma$  is the sharpness along the sharpness along major axis.  $\eta$  represents sharpness along minor axis.

The Gabor wavelet transformation of an image is the convolution of the image with Gabor kernels as defined by formula.

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$$O(x, y) = I(x, y) * \psi(x, y, f_0, \Theta) \tag{4}$$

Where  $I(x, y)$  is the gray level distribution of an image, and  $*$  denotes the convolution operator. The Gabor function is composed of real part and imaginary part. If we filter the image with the real part of the function, it will make the image over smooth. If we use the imaginary part of the function to filter the image, we can get the edge information of the image. The features that are used for classification of the gabor images are mean, standard deviation, entropy,  $x$  and  $y$  co-ordinates of the largest area component of the binarized real and imaginary parts of the gabor filtered images.

## V. RESULT AND DISCUSSION

### A. Results of different segmentation methods

The problem with fixed square mask segmentation method is that the mask is of fixed size and so it may cut some part of ear which should not be the case. Also a lot of redundant part is segmented. The accuracy of this fixed snake is 80%. In this method since the mask is fixed, redundant part may also be segmented. In some case some desired part of the image are cut. The accuracy of this method is 82%. The accuracy of ear specific snake method is 90%. There is need to select points for each ear image to form a separate mask using snake model. This method is not fully automated. The accuracy of active region of interest method is 93%. The advantage of this method is that it does not need to select points around each ear every time. It is fully automated method for ear segmentation. The time required for this method of segmentation is found to be approximately half of that using snake model in MATLAB.

### B. Results of gabor feature extraction

For more clarity, the real parts and imaginary parts of gabor filtered images are found separately and shown here.

The real parts of gabor filtered image are as follows for different values of lamda and theta.



**Fig.11:** Real parts of gabor filtered image

The imaginary parts of gabor filtered image for different values of lamda and theta are as follows:

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**Fig.12:** Imaginary parts of gabor filtered image

The mean, standard deviation, entropy, x and y coordinates of the largest area components of the binarized form of the real and the imaginary parts of the gabor filtered image are used as features for classification. These features are given to KNN classifier and SVM classifier. The system is tested on images of 31 persons of IIT Delhi ear database. The accuracy found using KNN classifier is 87.09% and that with SVM classifier is 90.32%.

## VI.CONCLUSION

In this proposed work a new method for ear segmentation is used called active region of interest method, the accuracy of which is found to be more than that of region of interest method and snake method for ear segmentation. The time required for this active region of interest segmentation is found to be approximately 2 to 3 seconds. This method of ear segmentation is fully automated. Later statistical features of gabor filtered images are used for classification. The features are given as input to KNN and SVM classifier and the accuracy is found. The accuracy of KNN classifier is found to be 87.09% and that SVM is found to be 90.32%.

## REFERENCES

- [1] Hui Zeng, Zhi-Chun Mu, Li Yuan, "Contourlet Transform Based Ear Recognition", Proceedings of the 2009 International Conference on Wavelet Analysis and Pattern Recognition, Baoding.
- [2] Alaraj, M.; Jingyu Hou; Fukami, T., "A Neural Network based Human Identification Framework using Ear Image", TENCON 2010 - 2010 IEEE Region 10 Conference.
- [3] M. Saranya, G.L. Infant Cyril, Santosh R.R., "An approach towards ear feature extraction for human identification", Proceedings of the 2016 International Conference on Electrical, Electronics and Optimization Techniques (ICEEOT).
- [4] Kumar A, Wu C., "Automated human identification using ear imaging", Pattern Recognition (2011), doi: 10.1016/j.patcog.2011.06.005.
- [5] Soni K. Gupta S.K., Kumar U., Agrawal S.L., "A new Gabor wavelet transform feature extraction technique for ear biometric recognition", 6th IEEE Power India International Conference; 2014 ; 1-3.
- [6] Md. Zahid Hasan Polin, A. N. M. Enamulkabir, Muhammad Sheikh Sadi, "2D Human ear Recognition Using Geometric Features", 2012 7<sup>th</sup> International Conference on Electrical and Computer Engineering.
- [7] Shubhangi Khobragade, Dheeraj Dilip Mor, Aman Chhabra, "A Method of Ear Feature Extraction for Ear Biometrics using MATLAB". India Conference (INDICON), 2015, Annual IEEE.
- [8] Tian Ying, ZangDebin, Zang Baihuan, "Ear recognition Based on weighted Wavelet Transform and DCT", 2014 26<sup>th</sup> Chinese Control and Decision Conference (CDCC).
- [9] Singh Amarendra, VermaNupur, "Ear Recognition for Automated Human Identification", Research Journal Of Engineering Sciences Vol.1(5),44-46, November(2012).
- [10] Ali Abdul Mun, "Iris recognition Using gabor filters", Al-Taqani, Vol.21, No.7, 2008.
- [11] Sadia Minhas, Muhammad Younus Javed, "Iris Feature Extraction Using Gabor Filter", 2009 International conference on emerging technologies.
- [12] Wai kin Kong, David Zhang, Wenxin Li, "palmprint feature extraction using 2-D Gabor filters", Pattern recognition 36(2003) 2339-2347.
- [13] Asmaa Sabet Anwar, Kareem Kamal A. Ghany, Hesham Elamahdy, "Human Ear Recognition Using Geometrical Features Extraction", Procedia Computer Science 65(2015) 529-537, (ICCMIT 2015).
- [14] Database of ear images available at [http://googleweblight.com/i?u=http://www4.comp.polyu.edu.hk/~csajaykr/IITD/Database\\_Ear.html&hl=en-IN&eid=1025](http://googleweblight.com/i?u=http://www4.comp.polyu.edu.hk/~csajaykr/IITD/Database_Ear.html&hl=en-IN&eid=1025)