 ISSN : 0976-8491 (Online) | ISSN : 2229-4333 (Print)

Softcomputing Techniques of Ear Biometrics

[1]Chithra P, [2]Bhavani Petchiammal C, [3]Ramesh P, [4]Sowmyalakshmi.R
[1,2,3,4]Dept. of ECE, College of Engineering Munnar, Kerala, India

Abstract
Soft computing is the process that aim to exploit the tolerance for imprecision and uncertainty to achieve tractability, robustness, and low solution cost. The simple example for soft computing is the human mind. In this paper we have implemented a simple method of ear biometrics in which the era features are extracted using Radon Feature extraction method and the extracted features of the ear is applied to two classifiers namely KNN classifier and Adaptive feed forward neural networlk for recognition. we use MATLAB as a processing tool. We use image preprocessing to remove the unwanted information and noise from ear images, and also performed steps like image segmentation and feature extraction to get desirable shape of ear for ear recognition system purpose. Our aim is to determine which method recognizes the image in the better way so that we could determine the accuracy of recognition and which classifier works better.

Keywords
Preprocessing, Feature extraction, Radon Transformation, KNN Classifier, Adaptive Feed Forward Neural Network,

I. Introduction
Ear recognition is non-invasive, reliable and passive biometric system used to identify the person based on the physiological characteristics. Recently, human ear is becoming an emerging technology in the field of biometrics because it has some desirable properties such as uniqueness, universality, permanence, collectability and acceptability. Compared to other biometric traits such as finger vein, iris, fingerprint, the human ear etc can be easily captured by using digital camera and is also less expensive. Ear recognition system consists of various stages such as image acquisition, preprocessing, feature extraction and matching. In pre-processing stage a median filter smoothen the image by utilising the median of the neighbourhood to minimise salt-and-pepper noise. Edge detection is a important part in image processing to extract the edge points in an image. Then the features are extracted using Radon Transform. Radon transform can be used to capture directional features in different orientations. In the identification side we use two classifiers namely KNN classifier and Adaptive feed forward neural network. One more important parameter is response time, as user cannot wait forever for authentication. The response time of the proposed system is satisfactory due to selection of classifiers in this approach which requires fraction of seconds to classify a user. Our aim is to determine the method that recognizes the ear images.

II. Advantages of Biometric system
1. No more forgotten or stolen password
2. Positive and accurate
3. Highest level of security
4. Offers modality
5. Impossible to forge
6. Serves as a key that cannot be transferred

III. Biometric Features

A. Uniqueness
An identical trait and which won't appear in two people.

B. Universality
The existence of the pattern is consistent throughout the universe.

C. Performance
It doesn't change over time that is it remains same for Life time.

D. Measurability
Measurability means it is measurable with simple technical instruments.

IV. Related Work
A new force field transformation was proposed by Hurley DJ et al. (2005) in which the image was treated as an array of Gaussian force field functions. This force filed transformation of ear images had contributed to high speed implementation and robustness to noise. Naseem I et al. (2008) proposed sparse representation of ear modalities along with the identification of a tuning parameter called Operating Point (OP) which enabled optimum recognition. Such a sparse representation was found to be robust against illumination changes and rotations, resulting in a high recognition rate of 98%. Watabe D et al. (2008) applied elastic graph matching along with principal component analysis (PCA) to form Gabor jets of various ear parts. A similarity metric called 'Jet space similarity' was then used for matching.
Multi scale Histogram of Oriented Gradient (HOG) features were extracted to capture complex structure from 2D ear images in Damer N et al. (2012). Dimensionality reduction was also performed for efficient recognition. Ragan EJ et al. (2016) investigated that the helix region of human ear is the most unique anatomical structure and was able to achieve re-identification rate of 100 % with both ears of every patient paired. Ghoualmi L et al. (2016) proposed gray level mapping along with Artificial Bee Colony (ABC) optimizer algorithm for improving the contrast of ear images acquired in poor lighting conditions. SIFT features were then extracted from them and Euclidean distance measure was used for recognition. Ear recognition was carried out in both visible and thermal domain under various illumination conditions by Ariffin SMZSZ et al. (2016). Two ear databases were developed by acquiring ear images of subjects in both visible and thermal spectrums. Recognition rates were compared for both datasets.

V. Methodology
The effective part of the biometric recognition system depends on the preprocessing and feature extraction techniques employed in it. since the pre-processing technique used is independent of the recognition approach, the feature extraction and biometric template generation techniques are consistent with the recognition approach. The work is to be done with IIT Delhi database. The database provides 3 to 6 images of same person. The Procedure starts with training a set of images. The trained set of image is

arranged in separate folders. It is arranged in such a way that each folder consist of subset with two images in Left and Right. A set of datasets with 4 images in each folder with 100 images in total is arranged and trained. The training process includes preprocessing and feature extraction. Then the images are recognized using two recognition methods KNN classifier and adaptive feed forward neural network. An testing folder with about 46 images from same database is used for testing the procedure. Thus we can determine the method that recognizes the ear images better.

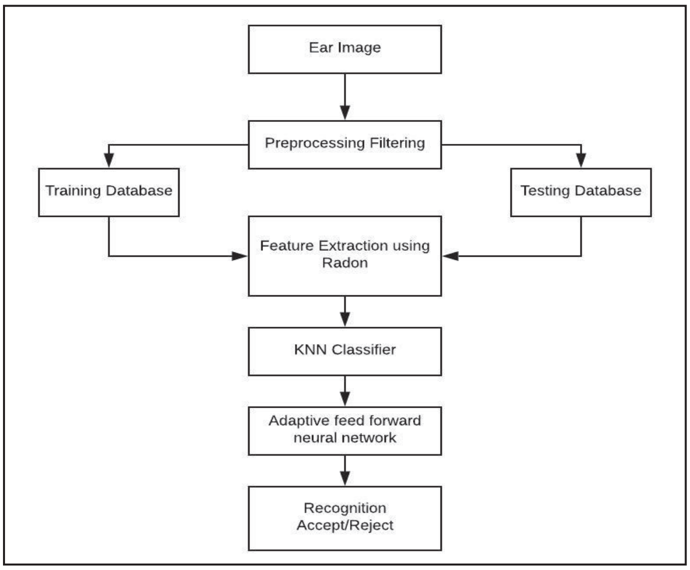

Fig. 1:Overview of Work

The preprocessing system performs the following operations in any biometric recognition system and prepares the acquired biometric raw data into a usable format.

- Noise removal
- Contrast enhancement
- ROI detection and segmentation
- Resizing
- Normalization

A. Feature Extraction Method

1. Radon Transform: Radon Transform

The reduced features of ear image can be formed using the Radon transformation to extract the directional features of an image. The Radon transform is a line integral and computes the projection of the image matric to detect the local features of an edge. The pixel intensity values of the image given is the projection of the image intensity along radial line at different orientations. It transforms the 2D image with

$$R(\theta) = \sum_{u=-\infty}^{\infty} a_k(x, y)\,|_{x=t\cos\theta - u\sin\theta,\, y=t\sin\theta + u\cos\theta}$$

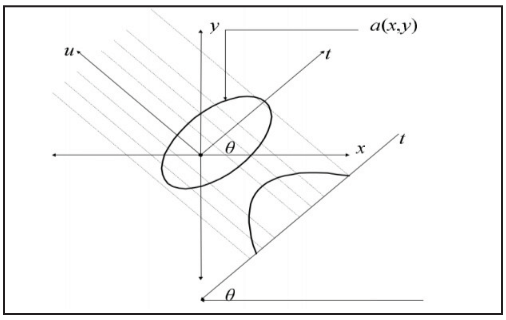

Fig. 2: Radon Transform

lines and converts the rotation of f(x,y) into translation of R(r,θ) and based on the parameterization of straight lines.

aThe Radon transform of 2 D function f(x,y) is defined as

$$R(r,\theta)=\iint f(x,y)\,(r - x\cos\theta - y\sin\theta)dxdy$$

Where r is the perpendicular distance of a line from the origin and θ is the angle between the distance vector and x-axis. The mean value of the white noise is zero and the Radon transform improves the signal to noise ratio. The main key feature of the radon transform is the ability to extract lines from noisy images. It is feasible to evaluate the Radon transform of any rotate,translate, and scaled image as knowing the radon transform of the original image and parameters of the transformation is applied to it.

B. Recognition Method

1. KNN Classifier

The Euclidean distance metric is often chosen to determine the closeness between the data points in KNN. The distance is assigned between all pixels in above dataset. Distance is defined as the Euclidean distance between two pixels.The Euclidean distances is given by:

$$D(X,Y) = \sqrt{(x_1 - y_1)^2 \ldots\ldots\ldots\ldots (x_n - y_n)^2}$$

This Euclidean distance is by default in a KNN classifier. But the distance between two features can be measured based on one of the distance cosine and correlation.

1. K-NN Algorithm

The k-nearest neighbour algorithm (k-NN) is a method for classifying objects based on closest training examples in the feature space. K-NN is a method of instance-based learning, or lazy learning where the function is only approximated locally and all computation is deferred until classification. The k-nearest neighbor algorithm is the simplest method of all the machine learning algorithms: an object is classified by a majority of its neighbors, with the object being assigned to the class most common among its k nearest neighbours (k is a positive integer, typically small). If k = 1, then the object is assigned to the class of its nearest neighbour.

- Each data pixel value within the data set has a class label in the set, class = {c1,...,cn}
- The data points, k-closest neighbour (k being the number of neighbours) is then found by analyzing the distance matrix.
- The k-closest data points is then analyzed to determine which class of label is the most common among the set.
- The common class label will be then assigned to the data point being analyzed.

We have implemented method of feature extraction for ear database in frequency domain using Radon Transformation and further recognition is done using classifier named KNN classifier. On calculating the rate the Radon Transform given more accurate result as compared to neural network method.

2. Adaptive feed forward neural network

The structure of the 2-layer feed forward neural network is shown in fig.

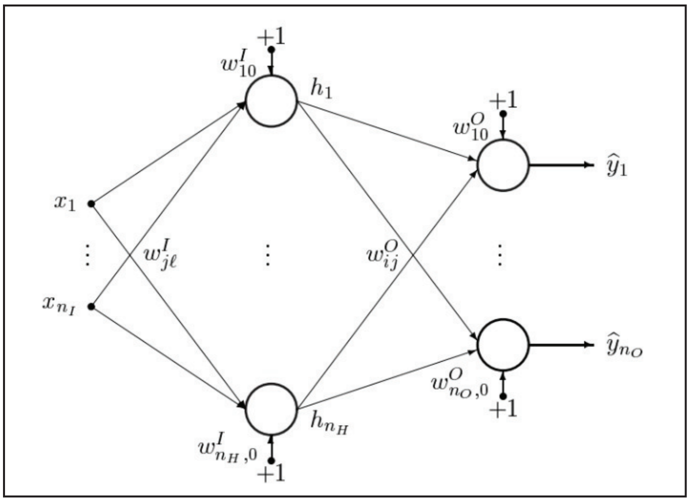

Fig. 3: Two layer (n_I, n_H, n_O) Feed Forward Neural Network Architecture

The 2-layer feed forward network has n_I input, n_H hidden neurons, and n_O output neurons; for short hand the nomenclature (n_I, n_H, n_O) is used. The network is a graphical representation of a layered computation: The hidden unit activation h_1…..,h_{nI} in the first layer is calculated from the inputs x_1…..x_{nI}. Next the output y_1….y_{no} are calculated from the hidden unit activations. The processing in networks is given,

$$\begin{aligned} h_j(\boldsymbol{x}) &= \psi\left(\sum_{\ell=1}^{n_I} w_{j\ell}^I x_\ell + w_{j0}^I\right) \\ \widehat{y}_i(\boldsymbol{x}) &= \psi\left(\sum_{j=1}^{n_H} w_{ij}^O h_j(\boldsymbol{x}) + w_{i0}^O\right) \end{aligned}$$

Where,

X=[1,x_1,……,x_{nI}] is the input vectors

VII. Experimental Result

Our approach is implemented is in MATLABP R2014a. The approach is evaluated on the widely used dataset of IITdelhi ear database. It includes 471 ear images of 121 different subjects with at least three ear images per subject. We use Ear images of 25 persons each with two images for right and Left side (100 images) for the traning set and all these images are trained with necessary Preprocessing and Feature extraction Techniques. The evalutation of the system is carried out with the help of a testing database with 46 images. The image is Preprocessed and Features are extracted and the recognized image is obtained.

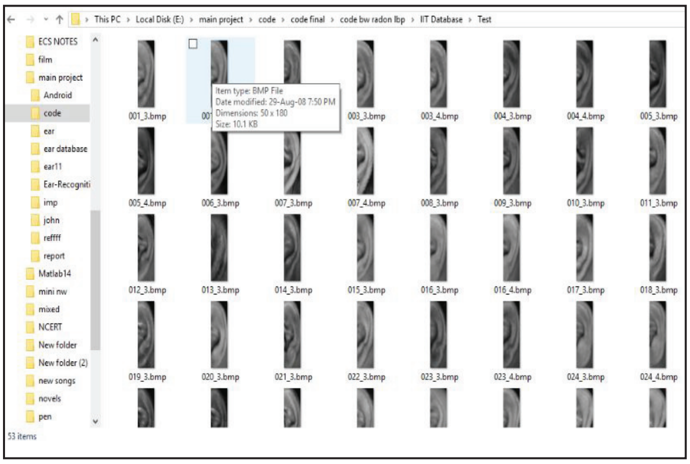

Fig. 4: Testing Dataset

Fig. 5: Dialog Box Asking to Select Ear Image

Table 1: Shows the Comparison of Performance of the Two Models.

S. No.	Methods	No. of Testing Images	Recognition Rate	Execution Time
1.	Random Transform+ KNN Classifier	46	93%	High
2.	Random Transform +Adaptive Feed Forward Neural Network	46	95%	Low

As stated earlier the testing dataset consists of about 46 images from the IIT-D dataset.we use a novel feature extraction technique namely Radon Transform since it is not used in past for ear biometrics. Our aim is to Prove that when two recognition method is implemented in same database set we are to determine the method that recognizes better.We calculate the recognition rate manually for two methods. when the work is recognized with KNN 43 images out of 46 is recognized correctly, and when features are extracted using RLBP 44 images out of 46 is recognized correctly. Thus we can conclude that the adaptive feed forward neural networks recognizes the images better than the KNN classifier and the time consumption in this case is high

VIII. Conclusion

It is concluded that the proposed human recognition methodology using ear biometrics by extracting Features by Radon Transform is really a potential technique. The necessity to propose a new feature extraction technique for ear recognition is also emphasized in this work. The Biometric system can be built either as verification or an identification system depending upon the application. The effectiveness of the proposed ear biometric recognition methodology is tested using one of the benchmark ear databases, IIT Delhi ear image database. Biometric data to be trained and tested is put into separate datasets. Ear images in the training, test datasets are preprocessed before extracting feature from them. We have implemented two feature extraction techniques to testing datasets containing 46 images in which Radon Transformation extracts the feature better. Preprocessing is done on the ear images of all the three of testing training and recognition phases to segment out the desired Region-Of-Interest (ROI). Recognition of ear images in test and evaluation datasets are carried out by constructing classifier based on KNN classifier and adaptive feed forward classifier. On working with these feature extraction technique and two recognition method the adaptive feed forward neural network recognizes accurately and the time taken for execution is also low while KNN classifier consumes more time.

As a future work the proposed ear biometric recognition system is developed to recognize human based on ear biometric images which are still, it is also suggested to extend the efficiency of the proposed ear biometric recognition system for security, intelligence work etc. The classifiers such as SVM, multi class classifiers can be used for this purpose. Various feature extraction technique can also be implemented like UMRT etc

References

[1] Choras, M.,"Image feature extraction methods for ear biometrics – asurvey". Sixth Int. Conf. On Computer Information Systems and Industrial Management Applications, 2007, CISIM'07, 2007, pp. 261-265.

[2] Pun, K.H., Moon, Y.S.:,"Recent advances in ear biometrics". Proc. Sixth IEEE Int Conf.On Automatic Face and Gesture Recognition, 2004.

[3] Abaza A., Ross A., Herbert C., Harrison M.A.F., Nixon M.,"A survey on ear biometrics, Commun. ACM, accepted", 2011.

[4] M. Burge, W. Burger,"Ear biometrics," In Biometrics: Personal Identification in Networked Society, A. Jain, R. Bolle, and S.Pankanti, Eds., pp. 273-285, Kluwer academic, Boston, Ma, 1999.

[5] A. Asano,"Radon transformation and projection theorem", Topic %, Lecture notes of subject pattern information processing, 2002 Autumn Semester, [Online] Available: http://kuva.mis.hiroshimau.ac.jp/~asano/Kougi/02a/PIP

[6] T.N Tan, aScale and Rotation Invariant Texture Classification. oIEEE Colloquium Texture Classification: Theory and Application 1994.

[7] Yan, P & Bowyer, KW 2005,"Ear biometrics using 2D and 3d image", IEEE computer Society Conference on Computer Vision and Pattern Recognition-Workshope, CVPR Workshops, pp. 121-121

[8] Wang, X Yuan, W.,"Gabor wavelets and general discriminant analysis for ear recognition". Eighth World congress on Intelligent Control and Automation (WCICA), pp. 6305, 2010.

[9] Nixon, MS, Aguado, AS,"Feature extraction & image processing for computer vision", Academic Press, 2012.

[10] Lai, PH, O'Sullivan, JA, Chen, M, Sirevaag, EJ, Kaplan, AD & Rohrbaugh, JW 2008,"A robust feature selection method for noncontact biometrics based on laser dopplervibrometry", In Biometrics Symposium, BSYM'08, pp. 65-70.

[11] Lowe David, G,"Object recognition from local scale-invariant features." Computer vision', the proceedings of the seventh IEEE international conference on IEEE, Vol. 2, 1999.

[12] S. Khobragade, D. D. Mor and A. Chhabra,"A method of ear feature extraction for ear biometrics usingMATLAB," **2015 Annual IEEE.**

Chithra P received her degree on bachelor of technology in ECE in Al-Ameen College of engineering Shoranur affiliated to AICTE Delhi. She is pursuing M.Tech in VLSI and Embedded System from College of engineering Munnar.

Bhavani Petchiammal C received her degree on bachelor of technologyin ECE in College Of Engineering Munnar affiliated to AICTE Delhi. She is pursuing M.Tech in VLSI and Embedded System from College of engineering Munnar.

Ramesh P received his degree in bachelor of technology from cochin university and technology in ECE.He obtained his post graduation in instrumentation engineering from kerala university. Currently he is persuing Ph.D from electrical engineering from IIT Bombay. Presently he is working as assistant Professor in College of Engineering Munnar Kerala.

Sowmyalakshmi R has received her degree on bachelor of engineering in ECE in from Institute of Road and Transport Corporation, Trichy .She completed her M.Tech in Microwave and Radar from cochin university and Technology and completed Ph.D in Biometrics from anna university. Currently she is working as assistant Professor in Anna University BIT Campus, Trichy.