A Strong Approach of Human Recognition Using Ear Biometrics with Efficient Computation Time

Deepali Mahatma, Rishika Jain, Pankaj Singh Parihar
Sangam University, Bhilwara

***Abstract*--According to modern examination the recognition of human outer ear could be better unique identification mark in human beings than finger prints especially in crime investigation. The main purpose is to improve the processing speed or recognition rate of ear biometric recognition with in efficient computation time. In this paper, the basics of using ear as biometric for person identification and authentication and a proposed strong approach of human identification using ear biometrics are presented. A set of 10 people has been used for experiments having 10 images each. Experimental results have demonstrated the effectiveness of the proposed system in term of recognition accuracy in comparison with previous methods. In proposed technique expected time is 3-5 Seconds with above 90% Recognition Rate.**

The proposed technique has been evaluated on one ear databases, namely University of Notre Dame ear database (Collection E)[10].University of Notre Dame Database consists of ear images with variable illumination, pose changes and poor contrast. Experimental results show that the proposed technique provides a considerable improvement in terms of performance over existing Techniques.

Therefore, the main objective of this research is to represent a new approach for human recognition using ear biometrics which is based on Statistical approach, Vector based proposal and Neural based proposal as well.

Keywords: Biometrics, Ear Recognition, Neural Networks, Particle Swarm Optimization(PSO), Singular Value Decomposition (SVD), Independent component analysis (ICA), Particle Swarm Optimization with Singular Value Decomposition, A Strong Approach Of Human Recognition Using Ear Biometric.

I.INTRODUCTION

1.1 Automated Personal Identification and Authentication using biometrics

Personal identification

- Two basic modes of operation:
- a) Verification (or authentication)
- b) Identification (or recognition)

a)*Verification or authentication:* Its basically refer as tries to respond the query "Is the claimant the person who he or she claims to be?" The user claims an identity and the system verifies his/her identity by comparing the biometric information rendered by the user with a reference for the claimed identity stored in the system (for example, in a smartcard). It is a one-to-one comparison.

Practical questions deriving as:- Is the claimant the owner of this card/computer/document? (Verification)

b) Identification or recognition: Its basically refer as tries to respond the following query:"Is the claimant an enrolled user and who is he/she?" The user simply provides his/her biometric information and the system compares his/her biometric data with templates stored in the system database. It is a one-to-many comparison.

Practical questions deriving as:- Should this individual be given access to the system/room/file? (Identification)

Objects of Personal Identification

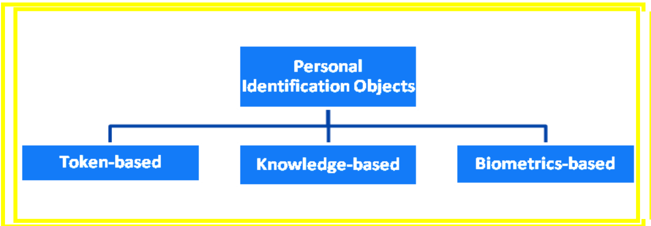

Figure 1: Objects of Personal Identification

There are basically three major types of automatic personal identification objects:

- *Token-based:*-This type of identification is accomplished by something that the individual has such as passport, ID card, keys, a USB token, a smartcard.
- *Knowledge-based*: This type of identification is accomplished using something that the individual knows such as PIN, password.
- *Biometrics-based:* This type of identification is accomplished by using something that the

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individual is such as some physiological or behavioural characteristic.

Some resolutions':- Token-based and knowledge-based identification objects do not rely on any inherent attribute of an individual to accomplish personal identification and therefore suffer from a number of disadvantages. Tokens can be lost, stolen, forgotten, misplaced but also can voluntarily be given to an impostor. PIN and passwords can be forgotten, guessed, peeped at, and also be voluntarily disclosed to an impostor. Biometrics are inherently more reliable and do not suffer from these disadvantages. However, as we'll see, they do have other disadvantages. So we can look forward to one day enjoying a cashless, keyless, passless the world credits to biometrics.

Biometric

Definition:-Standard defines terminology of biometrics as "A measurable biological or behavioral characteristic, which consistently distinguishes one person from another, used to recognize the identity, or verify the claimed identity, of an enrollee". **The meaning of Biometrics**: This is basically made by two terms as (Bio + metrics) **Bio** (from the Greek bios = life): biological, of living beings And **Metrics** means measuring-system, measurement. Biometric Consortium definition as automatically recognizing a person using distinguishing traits.

Biometric Identifiers:- An ideal identifier should possess the following properties: universality: nearly all people in the target population should have the characteristic.

- **Uniqueness:** the characteristic of each individual should be unique, i.e. the biometric feature of each individual in the population should be different from that of every other individual.

- **Stability:** the characteristic should neither change with time nor allow alteration.

- **Collectability**: it should be possible to measure the characteristic quantitatively. There are yet some other issues to be considered when a biometric system is being developed:

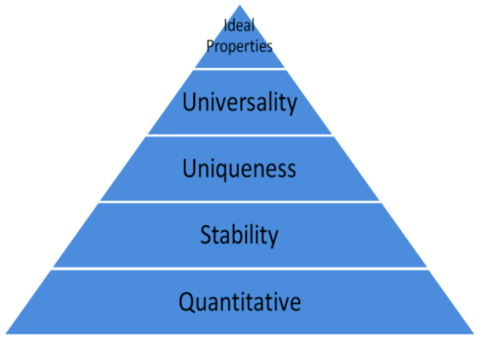

Figure 2: Biometric identifier's (I)

Any physiological or behavioral characteristic having these properties can be used for personal identification. However, for the purpose of automatic personal identification, the biometric feature should have one more property:

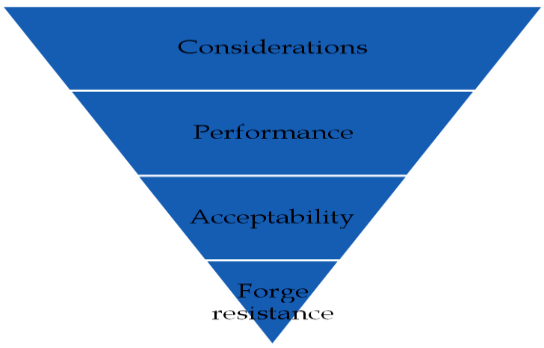

Figure 3:- Biometric Identifier's (II)

- **Performance**: achievable identification accuracy, speed, memory requirements.

- **Acceptability:** the extent to which people are willing to accept a particular biometric system in their daily lives.

- **Forge resistance**: how easy it is to fool the biometric system by fraudulent methods.

II.**Biometric System Architecture**

❖ **Data Acquisition Module: -** It Reads the biometric info from the user and captures the biometric data presented by the individual.

❖ **Feature Extraction Module:-**Discriminating features extracted from the raw biometric data. Raw data transformed into small set of bytes storage and matching.

❖ **Matching Module:-** module receives the processed data from the feature extraction system and compares it with the biometric template from the storage module. The matching module has a key role in the biometric architecture.

- **Storage Module:-** It maintains the reference templates for enrolled users. It may contain a single template for each user or thousands of templates depending on the system

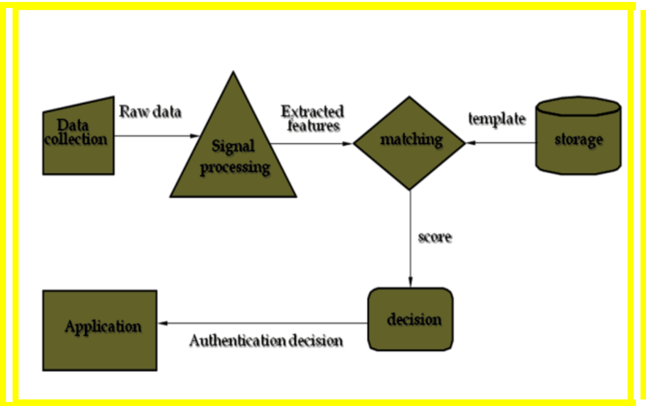

Figure 4: Biometric System Architecture

Architecture or intended use.

- **Enrolment:-**Enrolment is the process of collecting biometric samples from a user and subsequent processing and storing of their biometric reference in the system database or portable token.

- **Possible Decision Outcomes:-**The matching module rates the similarity between the collected biometric data and the reference template. If the match score is above a tolerance (or confidence) threshold, the claimant is accepted. If it is below the tolerance threshold, the claimant is rejected.

- **Tolerance Threshold**:- In any biometric scheme, the key parameter is the error tolerance threshold. If the tolerance threshold is relatively low, more valid users are rejected (false non-match rate is low) but more impostors are accepted (false acceptance rate is high).

III.EAR BIOMETRICES

There are people in crime laboratories that suppose that the human external ear characteristics are unique to each individual and static during the lifetime of an adult . The medical literature reports [1] that ear growth after the first four months of birth is relative.

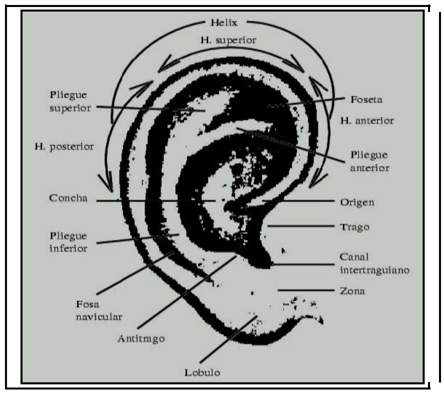

Figure 5:- Anatomy of the Human Ear

Anatomy of the Human Ear

The ear does not have a completely random structure; it is made up of standard features just like the face.

IV.LITERATURE REVIEW

Using ear in identifying people has been interesting in the past few years [1]. There are many methods proposed in human recognition using ear biometrics. Iannarelli, "Ear Identification, Forensic Identification Series", *Paramount Publishing Company, Fremont, California, 1989.* Iannarelli System of Ear Identification was given as follows by him.[1]

Figure 6:-Iannarelli Ear Structure [1]

- **Methodology/Approach/Techniques**

1) 38 years of research in earology
2) Thousands of ears that were examined by visual means, photographs, ear prints, and latent ear print impressions.

Conclusion/Result

1)No two ears were found to be identical.

This uniqueness held true in cases of identical and fraternal twins, triplets, and quadruplets. Another proposed approach was given Mark Burge and Wilhelm Burger, "EAR BIOMETRICS", *Johannes Kepler University, Linz, Austria, {burge, burger}@cast.uni-linz.ac.at*[2]**.** They approach the method is additionally paper because they make a Iannarelli to their base paper and given the proof of problem

Localizing anatomical points and the frailty of basing all subsequent feature measurements on a single such point.[2]

Methodology/Approach/Techniques used

1. Acquisition
2. Localization
3. Edge/Curve extraction
4. Construction of Vornoi Diagram

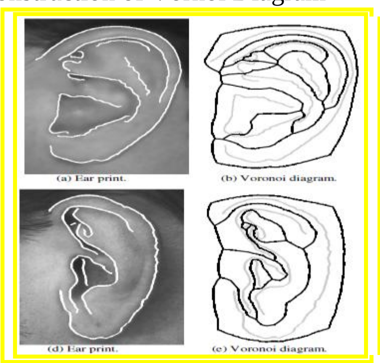

Figure 7:- Burge and Burger approach [2]

Conclusion/Result

Not Very Good in terms of Recognition Rate but In this 73%detection ratio which is good as compare to Iannarelli.

Another proposed approach given in addition of human recognition by ear bio metrics using Wavelets by M. Ali, M. Y. Javed, A. Basit, "Ear Recognition Using Wavelets", *Proceedings of Image and Vision Computing New Zealand 2007, pp. 83–86, Hamilton, New Zealand,Dec2007*.[3]

V.EXSISTING TECHNIQUE

Table 1:- Existing Technique in Summarized format

Concept	**Using Wavelets**
Process 1	**Aquision of image:-** Image is taken from any camera./ Or Picked randomly.
Process 2	**Preprocessing:-** 1) Ear image is cropped manually from the complete head image of a person (Using Image Editor) 2) Cropped ear image is resized (Make a Unique Size [64*64 pixels] for all Pictures.) 3) Colored image is converted to grayscale image (either using by Image Editor or by any other tool)[3]
Process 3	**Feature Extraction:- Haar Wavelet-2**
Process 4	**Training:-** Training of database.
Process 5	**Matching-** Finding of the raw image with your data base.[3]
Process 6	**Decision:-** Found match with one picture.

Result of existing technique:- 78.5% to 94.3% Depend upon No. of Training Images and Avg. Processing Time is 7.5 to 9.1 Seconds.

VI.EXSISTING PROBLEM

In Existing technique Results obtained are promising and encouraging with correct recognition rate as well as time required. Results will improve if the orientation of the images is done in Preprocessing phase because recognition rate and Training Images and Average Processing Time is 7.5 to 9.1 Seconds. So this processing time is reduced in the proposed method.

VII.THE PROPOSED SOLUTION

However when going through literature survey, one can easily identify that researchers has put their soul and heart in grasping the main concept in detail, find out sufficient methodologies, work flow and various tools and modules. In this, I have described in detail the proper methodology and workflow of human recognition using ear biometrics. In addition, a simple and fast training algorithm, particle swarm optimization (PSO) with support vector machine (SVM) is also introduced for training.

- *Schemes used in proposed solution*

The Proposed scheme based on basically uses the combination of 3 approaches as well as schemes. The proposed technique has been evaluated on one public database, namely University of Notre Dame ear database (Collections E).[10]Experimental results confirm that the use of proposed fusion significantly improves the recognition accuracy as well as reduced the time complexity for the recognition. There were totally 10 subjects with 100 ear images in the experiment, of which all ear pictures were left most ears. Some of the images were from the same person but taken in different days for testing the day variation of the ears. This is requirement for reasonable comparison and evaluation.

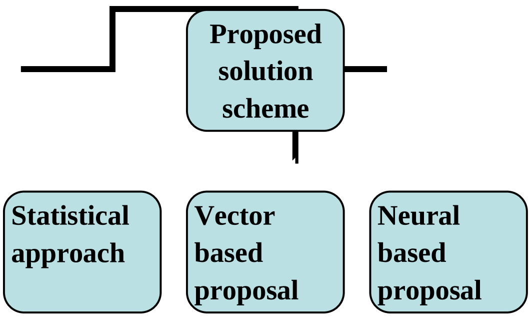

Figure 8:- Approaches name used in Proposed Solution scheme

Independent component analysis (ICA):- It is a computational method for separating a multivariate signal into additive subcomponents supposing the mutual statistical independence of the non-Gaussian source signals. It is a special case of blind source separation.

ICA Estimation principles

For estimating the proposed on statistical data I applied two principals as follows.

Principle 1: "Nonlinear decorrelation. Find the matrix W so that for any $i \neq j$, the components y_i and y_j are uncorrelated, and the transformed components $g(y_i)$ and $h(y_j)$ are uncorrelated, where g and h are some suitable nonlinear functions."

Principle 2: "Maximum nongaussianity". Find the local maxima of nongaussianity of a linear combination y=Wx under the constraint that the variance of x is constant.

SVD (Feature Extraction) :-Transforming the input data into the set of features is called feature extraction. The Singular Value Decomposition (*SVD*) of a matrix is a linear algebra tool that has been successfully applied to a wide variety of domains

Neural based proposal

PSO_SVM (training with optimization):- A simple and fast training algorithm, particle swarm optimization (PSO) with support vector machine (SVM) is also introduced for training.

Classification

In proposed scheme

Initially the values for initial position is done for this consider the two variables 'x' and 'y' as the Ear images of the person. They are moving in the database inputs and take randomly to reach the particular destination w respectively after 100 iterations.

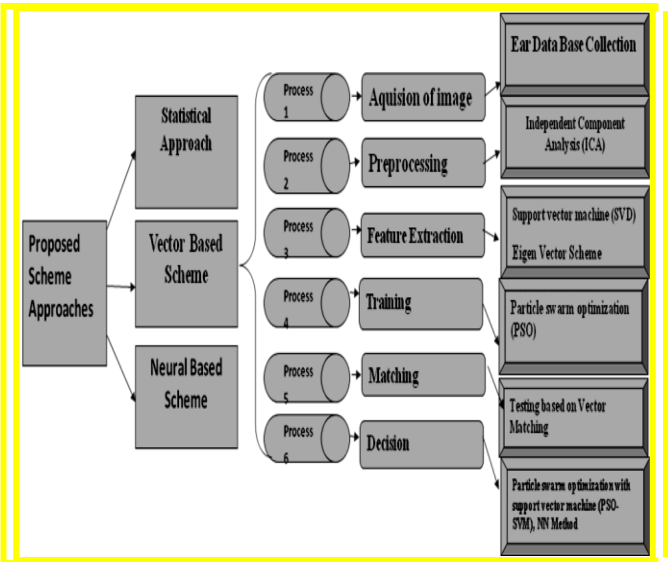

Figure 9 : - Flow Diagram of the Proposed Ear Recognition

For Entering the Specific Person Identity to Match with taking example like

- ri=10*input
- x=10;
- y=10;

Initialize the next positions decided by the individual images as w

- w= database output(x,y);

After that the Selection of any Random Image from the data base is done.

Let us the selected random image position is represented

- ri=round(100*rand(1,1));

Here the 100 iteration are done with the random image selection

After that the generation of random image from the resulted data base outputs of w that generalized with the x, y and after the iterations they simulated with the new one random variable chosen as r

- r=w(ri);

Initialize the matching and training of the parameters and image coordination with the correlation here selected the database without selection image

- v=w([1:ri-1 ri+1:end]);

By these applying for the recognition of the perfect match is easily done because the recognition with optimization is varying from the one random image with database and others without database so coordination is achieved

Repeat the steps 3 to 6 for much iteration to reach the final decision.

Pattern Search Vector for each image using the upper N calculations is done by the optimistic data generalization for this consider the optimistic variable o and dignity that to the random vector variable v

- O=(v,2);

After that the mean variance of the image is done Mean and variance of the collected ear images are made almost equal using mean and variance normalization technique.

- m= (mean (v, 2))

Calculating eigenvectors of the correlation matrix

In the next stage Group of vectors are described as the Vector space. All the vectors in the space are spanned by the particular set of orthonormal basis known as Eigen Basis as described below. (i.e.) any vector in the space is represented as the linear combination of Eigen basis. The two dimensional vector are randomly generated and are plotted as given below. The vectors mentioned in the diagram are the Eigen vectors.

VIII. EXPERIMENTS AND RESULTS

A system based on human recognition using ear biometrics is proposed with efficient computation time A Unique Size [272*204pixels] or 55488 bytes for all Pictures.)[10]

Table 2:- Summary of Database Used in Experiment

Database	**Number of Subjects**	**Total Samples**	**Description**
UND Dataset (Collection E)	**10**	**100**	10 samples per subject, images affected by illumination and pose variations, poor contrast and registration

❖ *University of Notre Dame Database*

The University of Notre Dame (UND) [10] offers a large variety of different image databases, which can be used for biometric performance evaluation.

Among them is one database containing 2D images and depth images, which are suitable for evaluation ear recognition Systems.

All databases from UND can be made available underlicense(http://cse.nd.edu/~cvrl/CVRL/Data_Sets.html).[10]University of Notre Dame Database, Collection E (UND-E) consists images collected from 10 subjects, 10 samples per subject.

The images are collected on deferent days with deferent conditions of pose and illumination. Some of the sample ear images from UND-E database are shown in Figure 4. It can be noted that there is a huge intra-class variation present in these images due to pose variation and deferent imaging conditions.

A experimental flow of proposed technique shown in the graph which indicate the efficient computation time of recognition of human ear using biometrics and represent the high recognition rate.

Iterations	**Enter the Person Id**	**Time elapsed in (sec)**	**Person Found**	**Person Searched For**	**Recognition type**
1	1(UND data set)	3.4261	1	1	correct
2	2(UND data set)	3.9271	2	2	correct
3	3(UND data set)	3.1879	3	3	correct
4	4(UND data set)	3.7494	4	4	correct
5	5(UND data set)	3.8838	5	5	correct
6	6(UND data set)	3.8975	6	6	correct
7	7(UND data set)	3.7465	7	7	correct
8	8(UND data set)	3.4117	8	8	correct
9	9(UND data set)	3.3447	9	9	correct
10	10(UND data set)	3.4295	10	10	correct

Table 3:- Experimental Evaluation of Proposed Algorithm

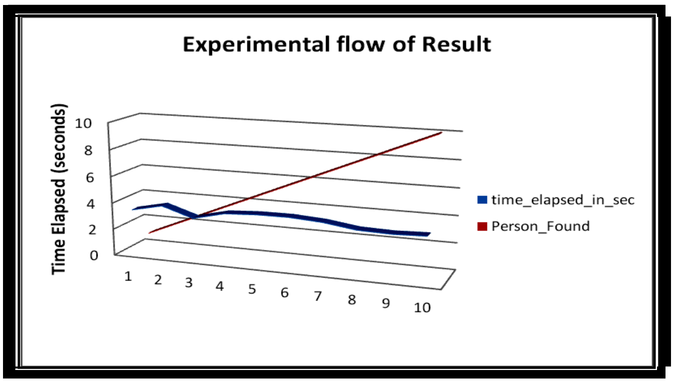

Figure 10:- Experimental results in Graphical Format

IX.CONCLUSION AND FUTURE WORK

After completing this research, it is concluded that: In this paper, I have described a system that tracks and detects ear features simply and robustly with efficient computation time. Mainly A simple and fast training algorithm, particle swarm optimization (PSO) with support vector machine (SVM) is also introduced for training that produced the training with optimization. Data taken from the ear image is compared with the database. Proposed ear detection algorithm is quite simple and hence, has low computation complexity in proposed technique expected time is 3-5 Seconds with above 90% Recognition Rate and can be applied in many real-time applications. In selected populations (e.g. those with short hair as in the defense industry), it is especially applicable. Currently we are working to enhance the Identification rate of the system using multibiometrics

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