www.ijecs.in
International Journal Of Engineering And Computer Science ISSN:2319-7242
Volume 6 Issue 3 March 2017, Page No. 20742-20750
Index Copernicus value (2015): 58.10 DOI: 10.18535/ijecs/v6i3.61

Ear Recognition by Feature Extraction Using Force Field Transformation

K. Mohanapriya, Mr.M.Babu,Me,(Ph.D)
(PG Scholar)
Associate Professor,
Department of Computer Science and Engineering,
GKM Engineering College, Chennai

ABSTRACT

Biometrics is the study of automatic techniques for recognizing human beings based on physical or behavioral traits. Among several biometric features, ear is quite stable because it does not vary with age and emotion. It is an important means to guarantee the quality of teaching by the standard and the optimization of the teaching process. Large amounts of data which generated in the process of teaching such as attendance, class performance, homework and testing results and so on are used to process manually. At the same time, there is quite randomness. And it is difficult to accurately reflect the teachers' working condition. This study explores the use of an Ear Visual Biometric as a measure of identification unit for the Teaching Management System in Universities and Colleges. It is significantly reduces the workload of teachers' teaching process and improved the credibility and controllability of data by the data acquisition equipment and the whole system. Ear detection and recognition is achieved through the use of Feature Extraction approaches like Force Field Transformation and Chord Point Detection Algorithm is used for better performance than the method to other algorithm.

Keywords: Biometric, Ear Feature Extraction, Force Field Transformation Ear Recognition

1. INTRODUCTION

In many institutions and academic organizations, attendance and performance evaluation is a very important criterion which is used for various purposes. These purposes include record keeping, assessment of students, and promotion of optimal and consistent attendance and result in class. In developing countries, a minimum percentage of class attendance is required in most institutions and this policy has not been adhered to, because of the various challenges the present method of taking attendance presents. [2]. this traditional method involves the use of sheets of paper or books in taking student attendance. This method could easily allow for impersonation and the attendance sheet could be stolen or lost. Taking of attendance is time consuming and it is difficult to ascertain the number of students that have made the minimum percentage and thus eligible for exam. [2] Thus, there is a need for a system that would eliminate all of these trouble spots. The design of teaching management system using biometrics would provide the needed solution. The teaching management system is software developed for daily student attendance in institutions and helps in evaluating student's performance and test results. It facilitates access to the attendance of a particular student in a particular class. This system will also help in generating performance reports and evaluating the test results. Rather than signing an attendance sheet, individuals ear image will be captured as a biometric and by Eigen vector calculation and things technology comparison will be carried out against a list of pre-registered users, and once a match is made, the individual will be registered as having attended that lecture. [1] This paper discusses related works in the problem domain; highlights the general overview of the proposed system; details design considerations of the system, both at the hardware and software level; discusses the operation and how the system was tested in conformity to system design and functional objectives; concludes the observations made; and makes recommendations for future improvement.

1.1 BIOMETRIC SYSTEM

Biometrics is a method of direct human identification chosen over other methods of determining identity because it truly identifies a person instead of being dependent upon keys and cards they possess which can be stolen or lost or passwords that can be forgotten or shared easily. Biometrics allows human identification to be more secure as a whole and it is based on the physical and behavioral characteristics that humans possess. Behavioral Characteristics include keystroke, which is the rhythm in which you type, voice patterns, gait, which is human motion or how you walk, or signature while characteristics such as DNA, Fingerprints, facial patterns, ear geometry, etc. are classified as physical. Physical characteristics tend to be more stable and consistent that behavioral characteristics. There are four main modules that make up the design of a Biometrics System as shown in Figure 1.1

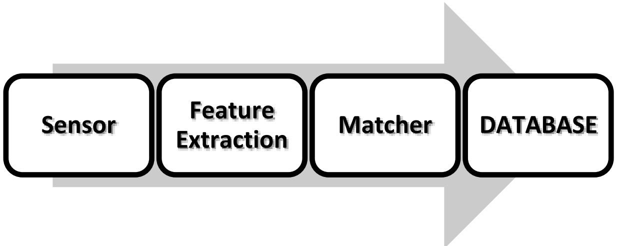


Fig: 1.1 System Components

The **Sensor**, which is used for detection of the characteristic, whether it is a camera, microphone, etc., is used to capture the biometric data of the individual. The next component is the **Feature Extraction** where the acquired biometric data is then processed to extract a set of significant features. The **Matcher** module is where the extracted features are compared against the stored templates (which are features already stored in the system after a was enrolled or entered into the system) and a match score is generated. A match score is a determination of the similarities between the extracted features and the template features. The last component, the **System Database**, is used to store the biometric templates of the enrolled users.

1.2 EAR RECOGNITION – ADVANTAGES

It is passive. Unlike the fingerprint and iris, it can be easily captured from a distance without a fully cooperative subject, Ears does not change during human life, and face changes more significantly with age, Ears are smaller than faces → reduced spatial resolution, Ears are not as variable as for example faces, Ear image cannot be disturbed by glasses, beard nor makeup. Colour distribution is more uniform in ear than in human face, iris or retina.

1.3 EAR RECOGNITION – APPLICATION

Security, Surveillance, Computer access, Physical access, Handheld devices, Military/Govt. Agencies/DOD, Financial services, Hospitals, Telecommunication

1.4 VARIOUS FORMS OF BIOMETRIC SYSTEM

Physical and behavioural methods are two different types of biometric methods which are divided again in two types invasive and non invasive. In invasive method we require a human being cooperation to gain the data which is needed for the comparison of human feature to the data already stored in the dataset. In non invasive method we do not require any human being to cooperate because we can also use their captured data without telling anything about our work. And the person does not know anything about it.

The Biometric System has been classified into active and passive biometric.

1. **Active biometrics:** They are inherently invasive. They require the subject to participate actively in both enrolling into the system and during subsequent identification. The willing participation of the

subject in the controlled environment of these systems is intrinsic to the success of the identification. Examples include all Fingerprint technologies, Hand geometry technologies, Retina scanning technologies and Signature recognition technologies.

2. **Passive biometrics:** Do not require a user's active participation and can be successful without a person even knowing that they have been analyzed. Examples include Voice recognition technologies (limited), Iris recognition technologies (limited) and Facial recognition (truly passive).

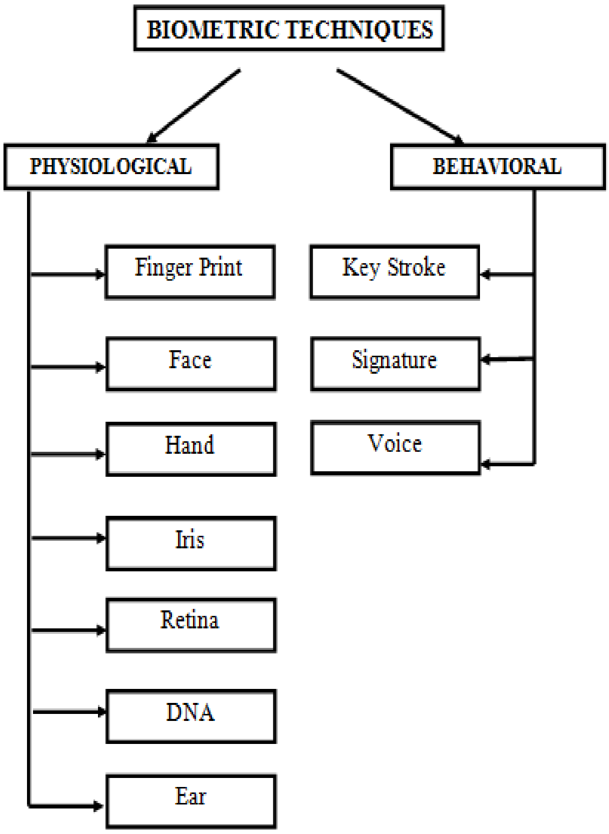


Fig: 1.2 Forms of Biometrics

II. STUDY OF EAR STRUCTURE

2.1 THE ANATOMY OF THE EAR

In addition to the familiar rim or helix and ear lobe, the ear also has other prominent features such as the anti-helix which runs parallel to the helix, and a distinctive hairpin-bend shape just above the lobe called the intertragic notch. The central area or concha is named for its shell-like appearance.

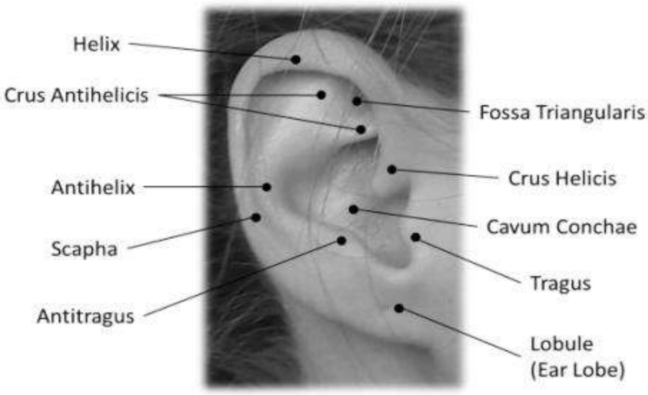


Fig: 2.1 Anatomy of the Ear

2.2 OVERVIEW OF TEACHING MANAGEMENT SYSTEM USING EAR BIOMETRICS

The development of teaching management system using biometrics is proposed. Managing student attendance during lecture periods and student performance evaluation has become a difficult challenge. The ability to compute the attendance percentage and test results becomes a major task as manual computation produces errors, and also wastes a lot of time. For the stated reason, an efficient teaching management system using biometrics is designed.[30] This system takes attendance electronically with the help of a web camera and the records of the attendance are stored in a database. Attendance is marked after student identification. For student identification, a biometric (ear image) identification based system is used. This process however, eliminates the need for stationary materials and personnel for the keeping of records. Eighty candidates were used to test the system and success rate of 94% was recorded. The manual attendance system and performance average execution time for eighty students was 17.83 seconds while it was 3.79 seconds for the automatic teaching management system using biometrics. The results showed improved performance over manual attendance management system. Attendance is marked after student identification.

The overall process includes various steps as below:

A. Image acquisition
B. Pre-processing
C. Feature extraction

2.3 Image Acquisition

The side face images are acquired using Digital camera under same lightening conditions with no Illumination changes (use of flash gives a fairly constant illumination). Digital camera here specified is web camera. To capture the image under illumination conditions.[15]. All the images are taken from the right side of the face with a distance of approximately 20-25 cm between the face and the camera. The images have been stored in JPEG format.

2.4 Preprocessing

In this approach the ear part is manually cropped from the side face image and the portions of the Image which do not constitute the ear are colored black leaving only the ear. The cropped color image is converted to grayscale image. But due to the noise in the image noisy edges may be detected which are of no use and moreover may reduce the accuracy of the algorithm.[15]

2.5 Feature Extraction

To isolate the important and relevant information from the image this method uses the following

DOI: 10.18535/ijecs/v6i3.61

Operations: [15]

· **Edge Detection**
· **Dilation**
· **Thinning**

For edge detection the **Chord Point Detection Algorithm** is used with a threshold of 0.3 as Chord Detection gives the best results under the given illumination conditions.

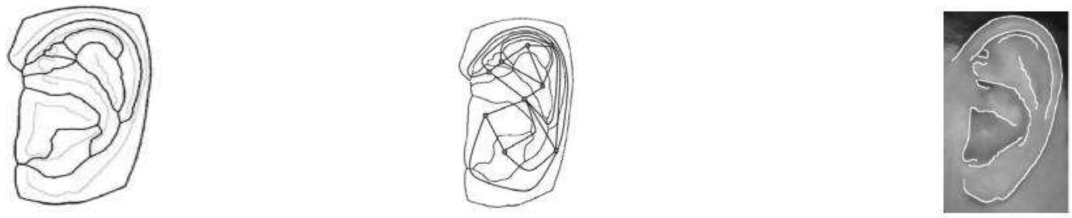
Along with this, **Dilation** is used to connect the edges which may be broken by the edge detection process.

Thinning has already been incorporated in the canny detection. The Second phase of the project involves extracting feature vectors using Geometric Feature Extraction and Force Field Transformation.

Ear vector recognition from the extracted vectors of the ear image of the student, data acquisition by fv1 (presto red db) and fv2 (current capture) and result (match).

III. SYSTEM ANALYSIS.

In the existing system it has been proposed a simple and less time consuming method for 2D ear feature extraction. For this MATLAB is used as a processing tool. Image preprocessing has been done to remove unwanted information of ear images, also performed steps like image segmentation and feature extraction to get desirable shape of ear for ear recognition system purpose. The authors in [3] designed and implemented a system that authenticates the user based on passwords, this type of system allows for impersonation since the password can be shared or tampered with. Passwords could also be forgotten at times thereby preventing the user from accessing the system. In order to overcome these issues we implemented teaching management system using ear biometrics and things technology.



(a) Voronoi diagram (b) Neighborhood graph (c) Canny extracted curve

Fig: 3.1 Edge Detected Graph

3.1 The MATLAB language

This is a high-level matrix/array language with control flow statements, functions, data structures, input/output, and object-oriented programming features. It allows both “programming in the small” to rapidly create quick and dirty throw-away programs, and “programming in the large” to create complete large and complex application programs.

3.2 Handle Graphics

This is the MATLAB graphics system. It includes high-level commands for two-dimensional and three-dimensional data visualization, image processing, animation, and presentation graphics. It also includes low-level commands that allow you to fully customize the appearance of graphics as well as to build complete graphical user interfaces on your MATLAB applications.

3.3 The MATLAB Application Program Interface (API)

This is a library that allows you to write C and Fortran programs that interact with MATLAB. It include facilities for calling routines from MATLAB (dynamic linking), calling MATLAB as a computational engine, and for reading and writing MAT-files

Syntax

MATLAB application is built around the MATLAB scripting language. Common usage of the MATLAB application involves using the Command Window as an interactive mathematical shell or executing text files containing MATLAB code

Structures

MATLAB has structure data types. Since all variables in MATLAB are arrays, a more adequate name is "structure array", where each element of the array has the same field names. In addition, MATLAB supports dynamic field names (field look-ups by name, field manipulations, etc.). Unfortunately, MATLAB JIT does not support MATLAB structures; therefore just a simple bundling of various variables into a structure will come at a cost.

Functions

When creating a MATLAB function, the name of the file should match the name of the first function in the file. Valid function names begin with an alphabetic character, and can contain letters, numbers, or underscores. Functions are also often case sensitive.

Function handles

MATLAB supports elements of lambda calculus by introducing function handles, or function references, which are implemented either in .m files or anonymous nested functions.

3.4 MALTAB IN IMAGE PROCESSING

Image Processing Toolbox provides a comprehensive set of reference-standard algorithms, functions, and apps for image processing, analysis, visualization, and algorithm development. You can perform image analysis, image segmentation, image enhancement, noise reduction, geometric transformations, and image registration. Many toolbox functions support multicore processors, GPUs, and C-code generation. Image Processing Toolbox supports a diverse set of image types, including high dynamic range, gigapixel resolution, embedded ICC profile, and tomographic. Visualization functions and apps let you explore images and videos, examine a region of pixels, adjust color and contrast, create contours or histograms, and manipulate regions of interest (ROIs). The toolbox supports workflows for processing, displaying, and navigating large images.

IV. EAR RECOGNITION WHEN OCCLUSION

Partial features are extracted from the detected un-occluded blocks of the test image. Haar dwt is applied to all un-occluded blocks, and four sub-bands images (LL, LH, HL, HH) are obtained. The low frequency sub-band (ll) of each block is considered as the local features of corresponding block and converted to a feature vector and index-based feature matching is applied. During recognition, features are extracted from only un-occluded portion of the ear image and matched with corresponding portion of the enrolled samples, which reduces the probability of unreliable matching of the occluded portion. Finally, similarities between the partial features of test ear and corresponding features of enrolled ears are measured for recognition.

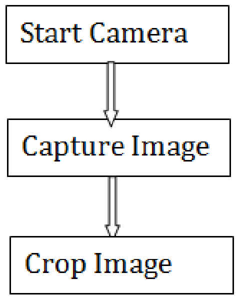
4.1 Image Acquisition

The side face images are acquired using digital camera under same lightening conditions with no illumination changes (use of flash gives a fairly constant illumination). All the images are taken from the right side of the face with a distance of approximately 20-25 cm between the face and the camera. The images have been stored in jpeg format.

4.2 Pre-processing

In this approach the ear part is manually cropped from the side face image and the portions of the image which do not constitute the ear are colored black leaving only the ear. The cropped color image is converted to greyscale image. But due to the noise in the image noisy edges may be detected which are of no use and moreover may reduce the accuracy of the algorithm.

DESIGN



4.3 Extraction of Feature Vector

4.3.1 Feature Extraction

To isolate the important and relevant information from the image this method uses the following operations:

- Edge Detection
- Dilation
- Thinning

For edge detection the canny edge detection is used with a threshold of 0.3 as canny detection gives the best results under the given illumination conditions. Along with this dilation is used to connect the edges which may be broken by the edge detection process. Thinning has already been incorporated in the canny detection.

4.3.2 Extraction of Feature Vector

There are two feature vectors which are under consideration. Both these are taken from the outer edge of the ear to reduce the computational complexity and to minimize the errors from the feature extraction process.

4.4 Ear Feature Vector Recognition

A database of 1st and 2nd feature vector of the subjects who are considered is made in MS Access. Comparison is made as follows. 1st feature vector is compared with the entire subjects 1st vector; if it is greater than a threshold then further comparison is made. All subjects whose 1st feature vector match are compared for 2nd vector matching and all where match is greater than threshhold2 are short listed. Now subject who has maximum vector point matches is displayed as matching subject.

The evolution proceeds from top left to bottom right. We see that in the top left image a set of 40 test pixels is arranged in an ellipse shaped array around the ear and allowed to follow the field direction so that their trajectories form field lines describing the flow of the force field.

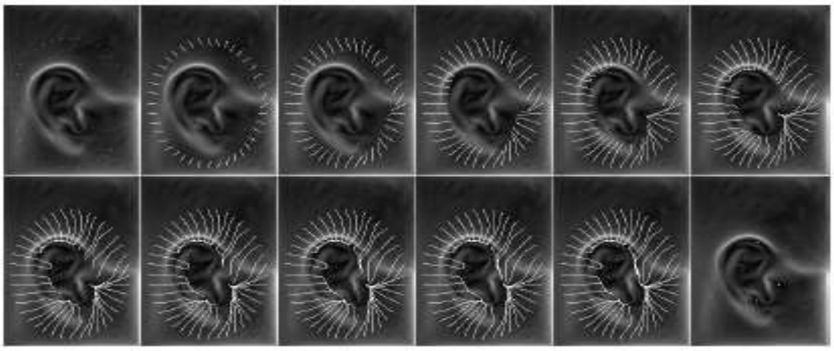


Fig. 4.1. Field line, channel, and well formation for an ear.

The concept of the divergence of a vector field will first be explained, and then used to define the new function. The function's properties are then analyzed in some detail, and the close correspondence between field line feature extraction and the convergence technique is illustrated by superimposing their results for an ear image.

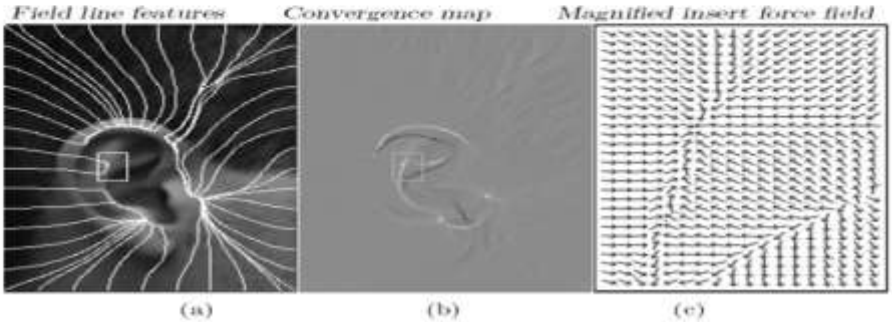


Fig. 4.2 Convergence Feature Extraction

4.5 Experiment results and analysis

The force field technique gives a correct classification rate of 99.2% on this set. Running PCA on the same set gives a result of only 62.4%, but when the ears are accurately extracted by cropping to the average ear size of 11173, running PCA then gives a result of 98.4%, thus demonstrating the inherent extraction advantage. The first image of the four samples from each of the 63 subjects was used in forming the PCA covariance matrix. Fig. shows the first 4 eigenvectors for the 111 73-pixel images. The effect of brightness change by addition was also tested where we see that in the worst case where every odd image is subjected to an addition of 3 standard deviations the force field results only change by 2%. whereas those for PCA under the same conditions fall by 36%, or by 16% for normalized intensity PCA, thus confirming that the technique is robust under variable lighting conditions.

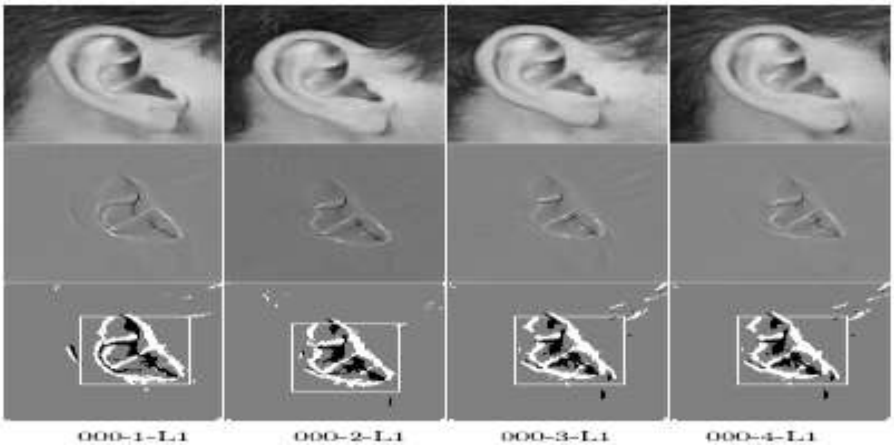


Fig 4.3. Feature extraction for subject 000 at 141101 pixels

V. CONCLUSION

The system successfully took the attendance and test report both at lectures and examinations. The prototype successfully captured new ear images to be stored in the database; captured ear images placed on the device sensor and compared them against those stored in the database successfully. The performance of the system was acceptable and would be considered for full implementation especially because of its short execution time and reports generation. Everyone who tested the system was pleased and interested in the product being developed for use in universities.

REFERENCES

1. Wang, Jingli The Design of Teaching Management System in Universities Based on Biometrics Identification and the Internet of Things Technology, The 10th International Conference on Computer Science & Education (ICCSE 2015) July 22-24, 2015. Fitzwilliam College, Cambridge University, UK
2. Mr.Jitendra B. Jawale, Dr. Smt. Anjali S. Bhalchandra, Ear Based Attendance Monitoring System, proceedings Of Icetect 2011IEEE
3. A Book on Biometric Technology Application Manual,(2008), National Biometric Security Project(NBSP).
4. D. J. Hurley, B. Arbab-Zavar, And M. S. Nixon, The Ear As A Biometric, 15th European Signal Processing Conference (Eusipco 2007), Poznan, Poland, September 3-7, 2007, Copyright By Eurasip
5. Muhammad Fuzail1, Hafiz Muhammad Fahad Nouman2, Muhammad Omer Mushtaq3, Binish Raza4, Awais Tayyab5, Muhammad Waqas Talib6, Face Detection System For Attendance Of Class' Students, International Journal Of Multidisciplinary Sciences And Engineering, Vol. 5, No. 4, April 2014
6. A Review on Biometrics and Ear Recognition Techniques, Sukhdeep Singh, Dr. Sunil Kumar Singla, Volume 3, Issue 6, June 2013, ISSN: 2277 128X
7. Human Computer Interpreting with Biometric Recognition System, GajananPandurangrao, Khetri, SatishL.Padme, Dinesh Chandra Jain, IJARCSSE, Volume 2, Issue 12, December 2012.
8. A Review on Biometrics and Ear Recognition Techniques, Sukhdeep Singh, Dr. Sunil Kumar Singla, Volume 3, Issue 6, June 2013, ISSN: 2277 128X
9. David J. Hurley, Mark S. Nixon*, John N. Carter, Force field feature extraction for ear biometrics, IEEE,2005
10. A. V. Iannarelli, Ear Identification, 1989
11. Ear Localization from Side Face Images using Distance Transform and Template Matching, Surya Prakash, UmaraniJayaraman and Phalguni Gupta, Proceedings of IEEE Int'l Workshop on Image Processing Theory, Tools and Applications, IPTA 2008, Sousse, Tunisia, pp. 1-8, Nov 2008.
12. The Human Identification System Using Multiple Geometrical Feature Extraction of Ear –An Innovative Approach, Jitendra B. Jawale, Dr. SMT. Anjali S. Bhalchandra, IJETAE, ISSN 2250-2459, Volume 2, Issue 3, March 2012.
13. Ear Recognition Using Wavelets, M. Ali1, M. Y. Javed and A. Basit, Proceedings of Image and Vision Computing New Zealand 2007, pp. 83–86, Hamilton, New Zealand, December 2007.
14. Robust Multi-biometric Recognition Using Face and Ear Images‖, NazmeenBibiBoodoo, R K Subramanian, IJCSIS, Vol. 6, No. 2, 2009.
15. D. Neelima and S. S. Satuluri. (2012). A global shape-template based human detection. http://ijesat.org/Volumes/2012_Vol_02_Iss_05/IJESAT _2012_02_05_21 .pdf
16. Hugh Wimberly, Lorie M. Liebrock, Using Fingerprint Authentication to Reduce System Security: An Empirical Study, 2011 IEEE Symposium on Security and Privacy
17. Israa M. Alsaadi, Physiological Biometric Authentication Systems, Advantages, Disadvantages And Future Development: A Review; International Journal Of Scientific & Technology Research Volume 4, Issue 12, December 2015
18. S. Prakash and P. Gupta, "An efficient ear recognition technique invariant to illumination and pose," Telecommunication Systems, vol. 52, no. 3, pp. 1435-1448, 2011
19. Michał Chorea's and Ryszard S. Chore's, Geometrical Algorithms of Ear Contour Shape Representation and Feature Extraction, Proceedings of the Sixth International Conference on Intelligent Systems Design and Applications (ISDA'06)
20. DasariShailaja and Phalguni Gupta. A Simple Geometric Approach for Ear Recognition, 9th International Conference on Information Technology (ICIT'06)