Volume 6, Issue 3, March 2016 ISSN: 2277 128X
International Journal of Advanced Research in Computer Science and Software Engineering
Research Paper
Available online at: www.ijarcsse.com

A Review on Ear based Biometric Identification System

Gurpreet Kaur, Ada
Sri Guru Granth Sahib World University, Fatehgarh Sahib,
Punjab, India

Abstract—Biometric systems for today's high security applications must meet stringent performance requirements. This paper provides an overview of the fundamentals of biometric identification, together with a description of the main biometric technologies currently in use, all of them within a common reference framework. Ear biometric for identification of human is quite complex task. It's use either uni-modal or multi-modal approach in order to authenticate a person. A uni-modal biometric system involves a single source of biometric to identify a person. Recognition by using human ear is an extensive field of research and this biometric is unique and stable as compared with face or iris biometric. The human ear recognition is the challenge but still researcher wants to explore this area for the identification purpose. Earlier, the researchers started to consider the obstacles which are related to computations for recognizing ear image.

Keywords: Biometric Identification, Ear recognition

I. INTRODUCTION

Biometric can be defined as the group of methods which are used to measure the physical and behavioural characteristics of human being for human recognition and verification. Examples of physical biometric are face recognition, eye retina and iris scanning. Hand shapes are very common related to their shape and size and easier than behavioral biometric which in turn are hand writing, gait and typing pattern recognition. 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. Biometric methods are most applicable in robotics, security and medical purposes. In these areas we can use face recognition, iris, retina scanning, and fingerprint. In these areas research communities gave their most attention.

The advancement in technologies has led to an increasing demand of security. The authentication of individuals is necessary to maintain the security. Over the course of last decade, tremendous work is going on in the field of biometrics. Biometric systems perform identification and recognition of an individual on the basis of biometric characteristic, trait, or feature. The means of identification can be possession based like token or identity cards and knowledge based like password or code word. But there is possibility of hacking or sometimes forgetting password or providing fake information. The main steps involved in biometric systems are: enrollment, verification and identification. Ear biometrics is gaining high acceptance for human identification in high security areas. And it has been found from the research work that ear has a structure which does not change with facial expressions or time. Also ear biometric is convenient as their acquisition is quite easy and participation is not necessary, hence it can be used in passive environment also. The shape of the outer ear of every individual is unique and quite relatively unvarying with respect to time or age.

The main benefit of biometric technology is that it is more safe and comfortable then traditional systems.

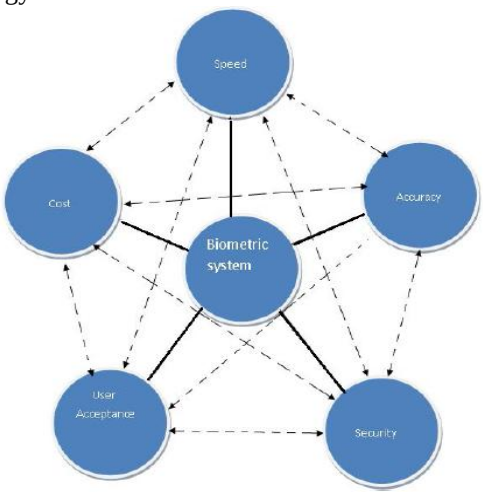

Fig 1: Objectives of Biometric System

Biometric traits can be split into two main categories [14]:
1. Physiological Biometrics: It is based on direct measurements of a part of the human body. Fingerprint, face, iris, and hand scan recognition belong to this group.
2. Behavioral Biometrics: It is based on asurements and data derived from an action performed by the user, and thus indirectly measures some characteristics of the human body. Signature, gait, gesture, and key stroking recognition belong to this group.

II. EXISTING TECHNIQUES

Existing Techniques of Human Authentication and Identification -
In information technology, biometrics refers to technologies that measure and analyzes human body characteristics, such as DNA, fingerprints, eye, retinas and irises, voice patterns, facial patterns and hand measurements, for authentication purposes. Since there are various biometrics characteristics in use, a brief over view on various biometrics characteristic is given.
Fingerprint - Fingerprint identification is probably the best known biometric technique, because of its widespread application in forensic sciences and law enforcement scenarios. Archeological evidence says that finger print impression were the only authentic identification since B.C. The pattern of fingerprint ridges and pores is different in each person; no two people have the same pattern of ridges. Even for the identical twins, they may have similar general pattern but fine details are different.

Principle of Operation -
There are three main technologies available today for the capture of fingerprint images [12]:
1. Optical technology-this is the oldest and most popular form used for image capture. Essentially, a camera (located in the fingerprint recognition device) takes raw images of the fingerprint.
2. Silicon technology-a silicon chip is used, and the capacitive characteristics of the fingerprint are captured into images.
3. Ultrasound technology-Basically, an ultrasound image of the fingerprint is captured. This technology has proved to work better than the other two, because it can penetrate through different types of fingerprint dirt and residue.

Area of Application -
Fingerprint recognition is the most stable biometric technology; it is longest and has more commercial applications. These are widely used in forensic department, in network access, physical access entry configuration; it is also choice of financial institutions.

Instrumentation Required -
- Fingerprint scanner can be of various types (such as optical, solid state e.t.c).
- Fourier transforms.
- Gabor filters.

Advantages -
It has relatively outstanding features of universality, permanence, uniqueness, Accuracy and low cost which makes it most popular and a reliable technique so is the leading biometric technology. There is archeological evidence that Assyrians and Chinese ancient civilizations have used fingerprints as a form of Identification since 7000 to 6000 BC.

Limitation -
- Fingerprint can be recreated in latex using an object touched by the person.
- Noisy data can also result film accumulation of dirt on a sensor or from ambient conditions.[3]
- Since the finger actually touches the scanning device, reduce sensitivity and reliability of optical scanners.

Face: Face recognition for its easy use and non intrusion has made it one of the popular biometric. Basically face recognition is done by verification and watch list. Face recognition can be made from still Images, video sequences, stereo, range images; etc Face recognition under well controlled acquisition conditions is more accurate and provides high recognition rates even when a large number of subjects are in the gallery [13, 14].
Principle of Operation: Some facial recognition software algorithms identify facial features by extracting land marks or features from image of the subject's face. For example an algorithm may analyze the relative position, size, and/or shape of eyes, nose, cheekbones, and jaws.These features are then used to search for other image with matching features. A newly emerging trend, claimed to achieve improved accuracies, by 3D face recognition. This technique uses 3D sensors.
Area of Application: The image capturing is done by with or without cooperation of the subject. Face recognition for its easy use and non instruction has made it one of the popular biometric. Properly designed systems installed in airports, multiplexes, and other public places can identify individuals among the crowd. Facial recognition systems are also beginning to be incorporated into unlocking mobile devices. The android market is working with facial recognition and integrating it into their cell phones.
Advantages - Advantage is that it does not require aid (or consent) from the test subject. This makes the system popular in typical application in security purpose. Properly designed systems installed in airports, multiplexes, and other public places can identify individuals among the crowd.

One advantage of 3D facial recognition is that it is not affected by changes in lighting like other techniques. The sensors work by projecting structured light onto the face which does a better job of capturing 3D face imagery [30].

Limitation -

- Uncontrolled lighting, changes in facial expression, aging, and the recognition rate decreases significantly.
- Another problem is the fact that the face is a changeable social organ displaying a variety of expressions [14].
- The bad quality of the input data used for 3D facial recognition systems

IRIS: Iris is the process of recognizing a person by analyzing the random pattern of the iris. This process of identification is relatively young. The performance of iris recognition systems is impressive.

Principal of Operation: Iris recognition uses camera technology with subtle infrared illumination to acquire images of the detail-rich, intricate structures of the iris without causing harm or discomfort to subject. Digital templates encoded from these patterns by mathematical and statistical algorithms allow the identification of an individual or someone pretending to be that individual. Databases of enrolled templates are searched by matcher engines at speeds measured in the millions of templates per second per (single-core) CPU, and with infinitesimally small false match rates.

Area of Application: Many millions of persons in several countries around the world have been enrolled in iris recognition systems, for convenience purposes such as passport-free automated border-crossings, and some national ID systems based on this technology are being deployed.

Advantages:

Responses of the iris to changes in light can provide an important secondary verification that the iris presented belongs to a live subject. The iris is stable, as it is an internal organ. This modality does not vary with age starting from the first year after birth until death. No foreign material usually contaminates the iris

Limitation:

- The accuracy of scanners can be affected by changes in lighting.
- Iris scanners are significantly more expensive than some other forms of biometrics,
- There would be problem for disabled people.

III. RELATED STUDY

Ear act as a physiological biometric trait that is related to the shape of the body, and thus a challenging field for identification.

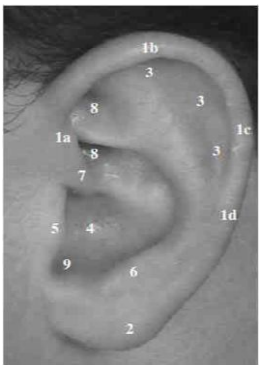

Fig 1: Anatomy of Ear

In 1949, Iannarelli developed the first recognition system based on ear biometrics based on 12 measurements by anthropometric technique for identifying human ear along with the analogy of the parts of the ear that can be used as parameters for feature extraction.

Ear act as a passive biometric that can be identified without active participation of the individual. Figure 1 shows the anatomy of the ear with label 1 Helix Rim, 2 Lobule, 3 Antihelix, 4 Concha, 5 Tragus, 6 Antitragus, 7 Crus of Helix, 8 Triangular Fossa and 9 Incisure Intertragica.

In the following section, we present a review on various techniques and methods used in the previous research work done in the field of ear biometrics:

In [1], it is revealed that ear shape and structure of outer ear are different for different human beings. Researchers have found that ear is an invariant and unique biometric trait that is least affected with factors like ageing or facial expressions. Ear is thus considered as a valuable means for personal identification especially used in criminal investigation or in surveillance areas. It suggested that future work can be done on multimodal recognition systems with gait & keystroke, ear & gait, or tri-modal system with gait, ear & keystroke recognition as biometric trait.

According to [2], ear is quite stable and robust to changes in facial expressions that makes it a relatively exploring field for biometric identification. Different means of identification can be: a) ear images, b) thermo graphic images of ear and c) ear prints that are retrieved by pressing ear against a flat paper. The technique of ear recognition is based on calculating and comparing distance among salient points on pinna from a particular location of ear.

[3] presents a survey on multimodal biometrics for identification and verification and elaborate the uni-modal system and their drawbacks that lead to the need of using multiple traits for identification and it suggests that it is better to use multiple traits in place of single biometric trait. It revealed the need for multimodal biometric system by highlighting the problems related to the uni-modal systems like noise in the data, non-particular and manipulating data. It discussed various fusion methods: rule-based, classification base and estimation- based.

In [5] a robust and reliable feature extraction technique is developed for ear biometrics that is force field transform also called invertible linear transformation that consist of an array of Gaussian attractors acting as source of force field. The work is extended to include face recognition. It received a remarkable invariance to initialization with good noise tolerance. The contribution involves a force field transformation and the directional properties are taken into account to locate potential energy channels.

According to [6], ear is a class of biometrics that is not affected with facial expressions, or eye glasses or makeup. It introduced an approach to 3D ear recognition by a two- step Iterative Closest Point (ICP). The method involves iterative steps of detection of helix in 3D ear images followed by transformation applied to selected ear locations. For matching error criterion, root mean square (RMS) parameter is used. The experiments done on 3D ear of 30 subjects and achieved 93.3% recognition rate.

[7] proposed a new approach to 3D ear recognition by local surface patch (LSP) representation computed at feature points. A transformation is applied on selected location by ICP algorithm that iteratively works for refining the transformation. For experiments, UCR datasets of 155 subjects with 902 images of ear under pose variation and Univ. of Notre Dame dataset of 302 subjects are used. The cumulative matching performance (CMP) on UCR and UND datasets demonstrate the effectiveness of the proposed system with recognition rate of 96.4% on rank 1 and 98% on rank 2 UND dataset and 94.4% on UCR dataset.

[8] introduced a new ear recognition method in which Haar wavelet transform of level two is used for feature extraction. Classification is based on Euclidean distance measure. A database of 32 people is taken and it observed that recognition time varies in accordance with number of training images being used. The experimental results give 94.3% recognition rate.

[9] implemented the concept of multi-modal biometric by using face and ear to identify person. Different modules were evaluated and Principle Component Analysis technique and Euclidean distance were used. The fusion was done at the time of matching to obtain final score.

[10] presented work on the geometric feature by finding Euclidean distance and angles of the triangle made by joining the lines formed between the farthest end points and the ear boundary. An angle between the lines joining the midpoints of the maxline and the point of intersection on the ear curve are calculated and stored as feature vector.

[11] implemented a technique based on the distance transform and templates by automatically locating the ear portions by computing skin and non-skin regions. A distance transform is calculated from the binary image using Euclidean distance approach. For verification, a shape analyzer based on Zernike moment is used for extraction of features from the ear.

[14] investigated the problem with Mid-wave infrared spectrum. For detection of ear they used AdaBoost framework and also they examined various feature extraction techniques and mentioned the drawbacks of thermal images.

IV. EAR BIOMETRIC SYSTEM

An ear biometric recognition system can be viewed as a classical pattern recognition system. This system reduces an input image to a set of features and then compares this against the feature sets of other images that are already stored in database known as template to determine its identity or authenticity. Ear recognition can be proficient use a 2D digital image as well as a 3D digital image of the ear. Ear recognition system can be defined by following four modules.

Ear detection or localization: The first step is to localize the position of the ear in a profile face image. The system normally uses a rectangular boundary to indicate the spatial point of the ear in the side profile of a face image. Ear detection is important because errors at this stage can undermine the utility of the system.

Feature extraction: During the matching stage, most of the recognition systems extract a salient set of features to represent the ear. Feature extraction step reduces the segmented ear to a mathematical model called as a feature vector that summarizes the discriminatory information present in the ear image.

Matching: In this matching step the recognition system compares the features extracted from the input ear image with the stored image in the database to establish the identity or authenticity of the ear. In its simplest form, matching generates scores indicating the similarity to other ear images.

Dcision: The recognition system uses the match scores to provide a final conclusion. In the verification mode, “yes” indicates a genuine match while “no” indicate an impostor. In the identification mode, the output is a potential matching identities ranked by match score. All biometrics systems suffer from two type of error. First one is a false acceptance and second one is a false rejection. First one happens when the bio- metric system authenticates an impostor. The second error occurs when the biometric system has rejected a valid user. The accuracy of biometric system is determined by combining the rates of false acceptance and rejection.

V. CONCLUSION

The aim of this paper is to review the usefulness of ear based and other biometric identification systems, their types, principle of operation, application area, instruments required, advantages, disadvantages and significant development in recent years. The biometrics systems are effective for human identification and authentication over various levels of

implementation, such systems are difficult to forge and can be made secure by combining more than one biometric traits, that is multimodal biometric systems. The latest research indicates avenues for human identification is more effective, and far more challengin***g.*** We studied various research papers, journals, international conferences summarizing we can say that development in direction of an innovative and cost-effective module has to be done.

REFERENCES

[1] Human Computer Interpreting with Biometric Recognition System, Gajanan Pandurangrao, Khetri, Satish L.Padme, Dinesh Chandra Jain, IJARCSSE, Volume 2, Issue 12, December 2012.

[2] A Review on Biometrics and Ear Recognition Techniques, Sukhdeep Singh, Dr. Sunil Kumar Singla, Volume 3, Issue 6, June 2013, ISSN: 2277 128X

[3] Automated Biometric Verification: A Survey on Multimodal Biometrics, Rupali L. Telgad, Almas M. N. Siddiqui,Dr. Prapti D. Deshmukh, International Journal of Computer Science and Business Informatics, ISSN: 1694-2108, Vol. 6, No. 1. October 2013.

[4] A Review Paper on Ear Biometrics: Models, Algorithms and Methods, Khamiss Masaud, S.Algabary, Khairuddin Omar, Md. Jan Nordin, Siti Norul Huda Sheikh Abdullah, Aust. J. Basic & Appl. Sci. 7(1): 411-421,2013.

[5] A New Force Field Transform for Ear and Face Recognition, David J. Hurley, Mark S. Nixon and John N. Carter, IEEE, 2000.

[6] Contour Matching for 3D Ear Recognition, Hui Chen and Bir Bhanu, Proceedings of the Seventh IEEE Workshop on Applications of Computer Vision (WACV/MOTION'05) 0-7695-2271-8/05, IEEE.

[7] Human Ear Recognition in 3D, IEEE Transactions On Pattern Analysis And Machine Intelligence, Vol. 29, No. 4, April 2007.

[8] 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.

[9] Robust Multi-biometric Recognition Using Face and Ear Images", Nazmeen Bibi Boodoo, R K Subramanian, IJCSIS, Vol. 6, No. 2, 2009.

[10] 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.

[11] Ear Localization from Side Face Images using Distance Transform and Template Matching, Surya Prakash, Umarani Jayaraman 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] Ear Recognition for Automated Human Identification, Singh Amarendra and Verma Nupur, Research Journal of Engineering Science, ISSN 2278 – 9472, Vol. 1(5), 44-46, November (2012)

[13] Ear Biometrics: A Survey of Detection, Feature Extraction and Recognition Methods, Anika Pflug, Christoph Busch, IET Biometrics, July 2012.

[14] On ear-based human identification in the mid-wave infrared spectrum, 2013, Ayman Abaza, Thirimachos Bourlai, Image and Vision Computing 31 (2013) 640–648, Elsevier.

[15] A Book on Biometric Technology Application Manual,(2008), National Biometric Security Project(NBSP).

