

# A Review on Multimodal Approach for Thumb and Ear Biometric System

Gurpinder Singh, Miss Varinderjit Kaur

**Abstract—** Biometric is the science and technology of measuring and analyzing biological data of human body, extracting a feature set from the acquired data and comparing this set against to the template set in the database. Biometric systems based on single source of information are called unimodal biometric system. The performance of unimodal system is affected by noisy sensor data and non-universality. Problems raised in the unimodal system can be resolved using multimodal biometric. This paper presents a review on unique approach of multi-modal thumbprint and ear based person recognition system.

**Index Terms—** Multimodal Biometrics, Thumbprint and Ear

## I. INTRODUCTION

A biometric framework is fundamentally a pattern acknowledgement method which functions by obtaining biometric information commencing a single person, via removing a feature set through the acquired data, and comparing this feature set against the template set in the database. Biometrics offers a natural and reliable solution for identity management by utilizing fully automated or semi-automated schemes to recognize individuals [1]. Uni-biometric system is insufficient to use in high security applications. Combining different biometric modalities enables to achieve better performances than single modalities [2-3]. Also, it was proved that the failure rate with multi-modal biometrics is less than 0.01. The multi-modal biometric framework considerably progresses the acknowledgement performance of a biometric system besides improving population coverage, decreasing the letdown-to-enroll rate as well as dissuading spoof attacks [4]. The multistage (or serial) multi-modal verification system [5] is a good trade-off between a parallel multi-modal and unimodal verification system where biometrics are sequentially requested according to a certain criterion [6]. In the field of criminal investigation, civilian, government and commercial devices applications such as passport, license card, security device etc., use of thumbprint technology is employed. Thumbprints of the person are distinctive in addition to they could not ever be identical. Thumbprint identification is the practice of identification of personality based on the impression pattern of ridges and valley on

fingers. There is a widespread use of thumbprint technology yet only modest work has been done to know the distinctiveness of the fingers. There are many factors that led to the interruption of recognition of thumbprints like pressure, small pressing spot, atmosphere factors, device noise, skin suppleness etc. Thumbprints are unalterable and they can diminish only after death. From the Egyptian time, thumbprints were used as a signature. The main features of a biometric gauge are universality, distinctiveness, durability, collectability, satisfactoriness, and recital.

Previous research has suggested the use of ears as a biometric for person identification. Scholars have encouraged that the shape and appearance of the outer ear for humans is single, in addition to moderately unaffected during the course of the lifespan of an individual. Although no one has proved that each person's ears are unique, studies in [2, 14]. Gave experimental subsidiary evidence, Face changes radically based on expression that issue does not occur with ears. Furthermore, the instantaneous background of the ear is very predictable it is always located on the side of the head, although facial acknowledgement characteristically requires a controlled background for accurate capture a situation that is obviously not always present.

Thus, in this paper we have studied about a new multimodal consists of Thumbprint as well as Ear print for identification and authentication.

## II. MULTIMODAL FUSION

The multimodal biometric systems [1] are found to be enormously valuable as well as unveil robust performance over the unimodal biometric systems in terms of several constituents. The objective of any multimodal framework [1] is in the direction of acquire multiple sources of information from different modalities also then diminish the error prone consequence of mono-modal frameworks. The focus to multimodal systems is the fusion of multiple biometric modalities can be carried out at various levels. At macro level, various levels of fusion are classified as

1. Fusion prior to matching
2. Fusion after matching. At micro level, multiple biometric systems are integrated in sensor level, future level, match score level, rank level and decision level [7]. As the features extracted from unique biometric trait are self-governing of those taken out from the other, it is reasonable to concatenate the two vectors into a single new vector [8]. We try to fuse the information prior to matching and at feature level due to the following reasons.

## III. THUMBPRINT RECOGNITION

Thumbprints are considered to be the best and fastest method for biometric identification [9]. Every person has unique so it

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is secured to use and do not change in lifetime of anyone. Except these, thumbprint recognition system implementation is cheap, easy and accurate up to satiability. Thumbprint recognition has been widely used in both forensic and civilian applications [10]. Most proven technique is thumbprint that based on biometric system as compared to other techniques and has the prevalent market shares. Not only it is quicker as compared to other techniques but also the energy consumption by such systems is too less.

Our thumb print is actually made of several ridges as well as valley on the surface of finger that can be unique to each and every human being [11]. "Ridges tend to be the top skin layer portions of the finger and also valleys are the lower portions". The certain individuality of a thumbprint possibly will be explained by the numerous designs of ridges and furrows plus the minutiae points. Thumbprint confirmation in genuine is a computerized technique of proving a match amongst dissimilar human thumbprints.

IV. ADVANTAGES

- These systems are usually quick to utilize along with install.
- It requires inexpensive products which commonly have low power consumption.
- A thumbprint design has independently distinguishing composition and features remains the same with time frame.
- Finger prints are generally largely universal. Only, of any 2% associated with human population are unable to employ finger prints due for you to skin damage or even hereditary points.
- Thumbprints tend to be utmost preferred biometric.
- Individual would not have to recall passwords, you just put-down your finger on scanner in addition to complete it.
- Biometric thumbprint scanner offers a great approach to record an identity feature that will be very difficult to be able to become fake, bringing in your current technology incredibly secure.
- It is not hard utilize alongside with the high verification process speed and accuracy.

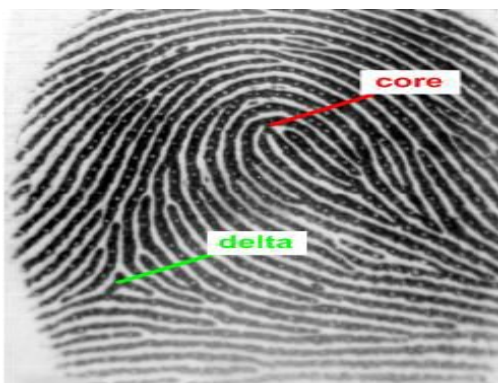


Figure 1 Image sample for Thumb Print Recognition

The major steps involved in thumbprint recognition using minutiae matching approach after image acquisition are:

1. Image Enhancement: A thumbprint image is corrupted due to various kinds of noises such as creases,

smudges and holes. So, image enhancement in thumbprint image is needed.

2. Minutiae Extraction: The enhanced fingerprint image is binarized in addition to acquiesce to the diminishing procedure that diminishes the ridge thickness to one pixel wide. The skeleton image is utilized in the direction of extracting minutiae points that are the points of ridge endings and bifurcations. For each extracted minutiae point, the following information is recorded:
  - Coordinates x and y,
  - Orientation of the associated ridge segment, and
  - Type of minutiae (ridge ending or bifurcation)
3. Matching: The database and query fingerprints are used for minutiae extraction and stored as points in 2-D plane. A minutia dependent upon matching fundamentally consists of finding alignment between the template and the input minutiae sets which usually consequences in the all-out number of minutiae pairings.

These are the steps followed while thumbprint identification of an individual.

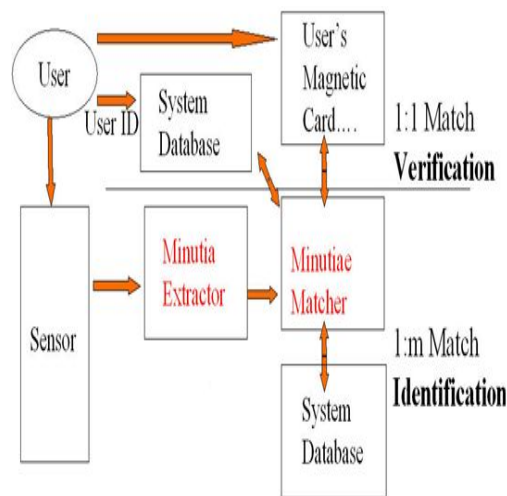


Figure 2 Thumbprint identification

V. EAR RECOGNITION

There are number reasons to choose ear recognition. As ear biometrics are suitable and also for the reason that their acquisition be likely to be perceived as less invasive. It is also very much accurate plus permits for extraordinary enrolment as well as authentication rates [2]. The aforementioned does not require an expert to interpret the comparison result. This one could probably utilize with prevailing cameras in addition to picture capture gadgets will work with no problems [3]. Unlike iris, retina, or fingerprint capture that are touching base biometrics, whereas ear does not have need of close proximity to achieve capture [14]. Figure shows the common terminology of the external ear. Ears have a noteworthy role in forensic science. Ear detection has collect little consideration match up to other prevalent biometrics for instance face, fingerprint and gait.



Figure 3 Ear Sample Image

Ear is a workable new class of biometrics subsequently the ear has anticipated assets for instance distinctiveness, universality, and stability.

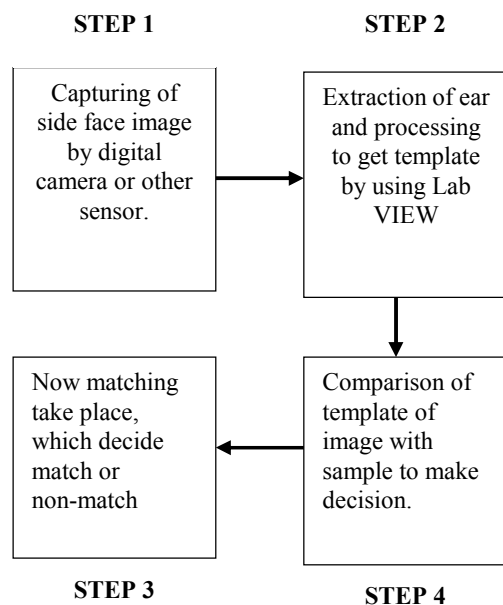


Figure 4 Steps of Ear Recognition

All steps of ear recognition are shown as:

#### VI. PREVIOUS WORK DONE

Hartwig Fronthaler et al. [11] projected a process to perk up the matching performance and resourcefully computation in fingerprint recognition. In support of this operation an image scale pyramid and directional filtering in the spatial domain is done.

M. R. Girgisa et al. [12] projected a fusion approach which used in facilitate of fingerprint matching on basis of line extraction and graph matching standard. Two phased existed one is genetic algorithm phase and other is a local search phase. Sturdiness of algorithm is established by results of implementation.

G. Sambasiva Rao et al [13] proposed a gray level watershed system for fingerprint recognition. It scanned fingerprints and locate out the ridges nearby on a fingerprint image.

Chen and Bhanu [14] developed another shape model-based method for discovering human ears inside face range images where presented a 3D ear recognition system that exploited the depth and structure of the ear's morphological components They started by locating the edge segments and grouping them into different clusters that are potential ear candidates. For each cluster, they register the ear shape model with the edges.

P. Gnanasivam and Dr. S. Muttan, [15] In this paper, ear and fingerprint biometrics are used for the personal identification. A novel technique of edge interaction point detection (EIPD) is used to determine the ear features. Fingerprint features are identified by line based connected component analysis and its feature vectors are generated using EIPD system. Fusion at the feature level is carried out through concatenation for features. Back propagation neural network is utilized for an identity verification system.

#### CONCLUSION

We have observed that multimodal biometrics is frontier to the unimodal biometrics as it overcomes the problems related with unimodal biometrics like noisy data, interclass similarities, intra class variation, non-universality and spoofing. There are many multimodal biometric systems in existence for authentication of a person but still selection of appropriate modals, choice of optimal fusion level and redundancy in the extracted features are some challenges in designing multimodal biometric system that needs to be solved. So this paper has proposed the implementation of thumbprint and ear biometrics for future work.

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