# MULTIMODAL BIOMETRIC SYSTEM USING FINGER VEIN AND EAR BIOMETRIC

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***Abstract -- Single biometric systems have some issues like noisy information, non-universality and unacceptable error rate. Thus, to avoid these issues multimodal biometric system can be developed by fusing multiple biometric of a human.***
***In this paper, a multimodal biometric system using finger vein pattern and ear biometric is proposed. The vein patterns inside one's fingers are used for personal identification and verification as vein patterns are different for each finger and for every person and they are underneath the skin's surface so forgery is extremely difficult. These vein patterns are used along with unique ear patterns of a person that do not change over person's life span. Thus, these two biometric have been used to design a better multimodal biometric system.***

***Index Terms -- Biometric system, multimodal biometric system, vein patterns, ear patterns.***

## I. INTRODUCTION

Traditionally human verification has been carried out by using a password or ID cards that have many security flaws. For example, passwords can be easily forged, stolen or forgotten and same is for smart cards. Thus to increase the reliability and to reduce identity frauds, a wide range of biometric are used e.g. fingerprint, face and retina etc.

Biometric is defined as a technique that use unique and non transferable physical characteristics for verification based on some specific biometric features derived from person's physiological and behavioral characteristics.

Most of the biometric systems currently used are unimodal biometric systems that use single biometric trait for recognition purpose. There are many issues of unimodal biometric systems and some of these can be avoided using multimodal biometric systems that use multiple biometric traits. Multimodal biometric systems can improve the accuracy of a biometric system. They also address limitations like non-universality and noise etc.

Multimodal biometric system is a system in which more than one traits of an individual is combined to achieve high security and reliable authentication. Multimodal biometric system helps to achieve higher security, reliability and acceptability.

In contrast with unimodal biometrics, multimodal biometric systems use more than one biometric trait for identification using different mechanisms for biometric fusions.

Unimodal biometric systems often fail to correctly authenticate and verify an individual with a desired outcome and accuracy. However, this problem is hugely eliminated using multimodal biometric technology. Multimodal biometric systems combine multiple biometric characteristics derived from sources have been developed in order to overcome those problems.

## II. LITERATURE REVIEW

A lot of research and articles have been published on biometric systems. Ross et al.[8] provides good survey of multimodal biometric systems. The author provides detailed survey of various levels of fusion.. It also provides requirements for standardization to support multimodal biometric systems.

Muhammad Imran Razzak et al.[1] combined the face and finger veins at score level fusion to increase the robustness of the authentication system.

Piotr Dalka et al.[2] proposed multi-biometric system using lip movement and gestures. Lip gesture recognition is performed using artificial neural network (ANN) approach. It includes parameters like no gesture, mouth opening, formation of puckered lips, sticking out the tongue and all other gestures. This experiment used 6120 image frames.

The extraction of local 3D features from ear and face biometrics and their arrangement at the feature and score levels for identification has been proposed by S.M.S. Islam et al.[3]. 3D features extracted from ear and frontal face information are fused at feature level.

H. Mahoor et al.[5] proposed a 2D face and 3D ear fusion at the match scores level using weighted sum technique. Active Shape Model is used to extract a set of facial landmarks from frontal facial images. For the ear recognition, a set of frames is extracted from a video clip and ear region in each frame is restructured in 3D using Shape from Shading (SFS) algorithm.

Monwar *et al.*[6] attempted to alleviate the unimodal biometric system tradeoffs by combining physiological and behavioral traits by proposing a multi modal system based on face, ear, and signature. They fused the evidences based on rank level fusion technique for testing the proposed system by collecting and pairing public domain unimodal biometric databases into a virtual multimodal dataset.

Sim *et al* [4] proposed a framework for fusing the face and fingerprints for continuous monitoring of the presence of only legitimate users into the secured rooms.

They installed a system of Canon VCC4 video camera and a SecureGen mouse that contains a sweep FP sensor on a PC for continuously monitoring the person who accessing the secure resources. They captured 1000 FP images and 500 Face images from several users to train their system. They achieved a good performance by the fusion in a tradeoff between usability and probability of time to correct reject (PTCR) which is analogous to the FAR-FRR tradeoff.

Wei *et al.* [7] presented another MMBS based on palm print and hand geometry. They tested their MMBS using an experimental dataset of 51 persons with a reported accuracy of 99.36% for the fused 2 modalities.

## III. PROPOSED MULTIMODAL BIOMETRIC SYSTEM USING EAR AND FINGER VEIN BIOMETRIC TRAITS

Even after the advancemernt in recent years, there are still many challenges in obtaining reliable authentication through a unimodal biometric system. For a multimodal biometric system, selecting the appropriate biometric traits is one of the main important tasks. There is no single biometric trait that is the best. Therefore, the proposed multi modal biometric system is based on two biometric traits, namely Finger vein biometric and Ear biometric. These two biometrics are choosen because of their permanance, easy user acceptability and high performance.

**Finger vein Recognition**

This system uses near-infrared rays generated from a bank of LEDs [10] (light emitting diodes) that penetrate the finger and are partially absorbed by the hemoglobin in veins to capture a unique finger vein pattern image. The areas where the rays are absorbed in the image appears to be dark, taken by a camera located on the finger's opposite side in **fig. 1**. Image processing can then used to construct a finger vein pattern from the camera image.

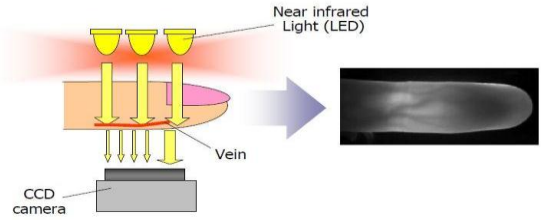


**Figure 1. Finger vein pattern captured by camera**

This captured vein pattern is then digitized so that it can be registered as a template of an individual's biometric authentication data. The finger vein pattern is then matched with a pre-registered profile to verify an individual and the templates are then authenticated by using pattern-matching technique.

**Ear Recognition**

In the last decade, efforts have been made for building automated authentication systems using the outer ear characteristics. The outer ear has been used as a stable and unique biometric trait, especially in the field of forensic image analysis because the outer ear possesses many characteristics which make each ear unique.

The observation of the outer ear in **fig. 2** which is frequently referred to as auricle is an emerging biometric method, which has drawn the attention of research during the last years. The outer ear is believed to be just as unique as some other biometric traits. Forensic investigators do not only value the uniqueness of the outer ear, but also its permanence.

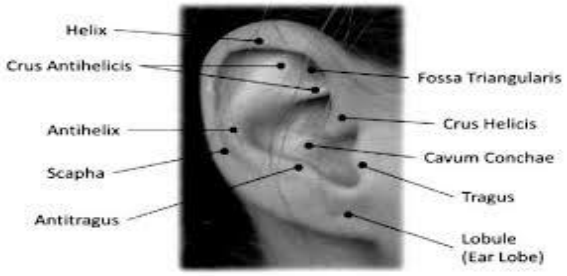


**Figure 2. Outer ear characteristics**

## IV. PROPOSED ARCHITECTURE OF FUSION OF EAR AND FINGER VEIN BIOMETRIC TRAIT

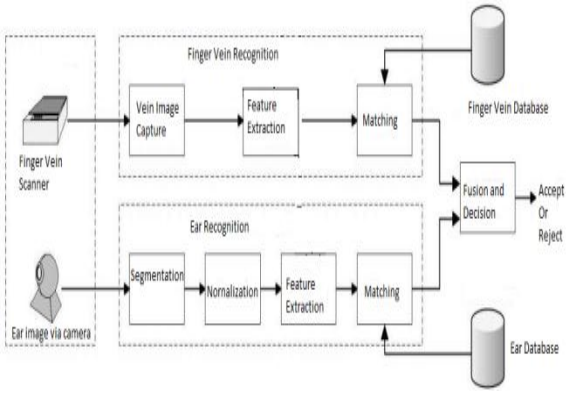


**Fig.3. Architecture for fusion of ear and finger vein biometric**

In the proposed system (**fig. 3**), an image of the finger vein pattern is produced through the image sensor and transfers the image data to the memory of the CPU. The brightness of the light source is adjusted by CPU through the use of LED power controller to eliminate error. The outline of the finger in the image is detected and the distinctive feature patterns are extracted from the image.

This process is important for reliable authentication and to control the variation of image data caused by changes in imaging conditions. It then calculates the correlation between the extracted feature pattern and the pre registered pattern in a database, which is called the "matching" process.

The vein pattern [9] is authenticated when the correlation value is higher than the predefined threshold value. The captured vein pattern image and the extracted feature pattern represent user's personal information. Therefore, strict administration of data is required when stored or transferred.

**In Ear recognition [3], authentication is done through four processes:**

Segmentation - The method for ear segmentation [14] depends on the type of the input media. It segments the ear region into half and full profile images using the Viola-Jones detection method.

Normalization - After segmentation of the ear region, the orientation of the ear needs to be normalized with respect to rotation and scale. The correction of these rotations is essential for accuracy of recognition, because a misaligned ear will cause wrong decisions in the comparison process. For the same reason, hair or skin around the ear should be removed before extracting features.

After normalizing the input images, texture features are obtained and are matched with pre -captured images from ear database.

Fusion and decision – At this stage, we combine (fuse) the results from both finger vein and ear recognition and if these results match with the images in the database then the user is authenticated and access is granted and if not authenticated, access is denied.

## V. CONCLUSION

Multimodal biometric systems can be used to address the problems that are observed in uni modal biometric systems. The methods to design a good multimodal biometric system is by choosing a good combination of multiple biometric modality and by various levels of fusion applied to get the possibly best recognition results.

The related work has shown the performance of the multimodal system under the different traits combination scheme, identification rate and databases. The combination of finger vein and ear biometric is suggested and the proposed architecture of the biometric system is given. The paper also claims that multi modal biometric can improve efficiency of a single or unimodal biometric system and resolve its limitations.

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