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# Review: Biometric Authentication for Fingerprint and Iris

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**Abstract**— In the world of computer science & Information Technology security is essential and important issue. Identification and Authentication Techniques plays an important role while dealing with security and integrity**.** The human physical characteristics like fingerprints, face, hand geometry, voice and iris are known as biometrics. These features are used to provide an authentication for computer based security systems. Biometric verification refers to an automatic verification of a person based on some specific biometric features derived from his/her physiological and/or behavioral characteristics. Biometrics 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. By using biometrics it is possible to confirm or establish an individual's identity. In this paper we have outlined the usability of biometric authentication systems, comparison between different techniques.
**Keywords**- Image Segmentation; Minutiae; fingerprint, IRIS, Authentication.

## I. INTRODUCTION

Biometric recognition involves recognition of biometric images that are deformed in degradations during the acquisition process due to factors such as imaging geometry, lens aberration, wrong focus, motion of scene and other random and systematic errors. Some of the challenges encountered by these systems are Noise in sensed data [1]. Image acquisition is the first step in the digital image processing; based on the mode of acquisition, a fingerprint image may be classified as off-line or live-scan. An off-line image is typically obtained by smearing ink on the fingertip and creating an inked impression of the fingertip on paper. A live-scan image, on the other hand, is acquired by sensing the tip of the finger directly, using a sensor that is capable of digitizing the fingerprint on contact. Live-scan is done using sensors. There are three basic types of sensors used. They are optical sensors, ultrasonic sensors and capacitance sensors [2]. Image enhancement is the process of manipulating the image so that the result is more suitable than the original image. Enhancement techniques use so many different image processing approaches that are difficult to assemble meaningful techniques suitable for the enhancement [3]. Morphological processing deals with tools for extracting image components that are useful in representation and description with the tools for extracting image components that are useful in representation and description with the help of shape of the image. It is used to represent the attribute of the image [3, 4].Feature Extraction is the next step used in the Biometric system Authentication. The extracted features are then classified with the help of different classifier. These are the steps which are used in the biometric Identification and verification system.

## II. BIOMETRIC SYSTEM

The term Biometric comes from the Greek word bios which mean life and metrikos which means measure. It is well known that humans intuitively use some body characteristics such as face, gait or voice to recognize each other. Since, a wide variety of application requires reliable verification

 

schemes to confirm the ID of an individual, recognizing human on basis of their characteristics [5].The characteristics are as follows.

1. Voice
2. Finger Prints
3. Body contours
4. Retina & Iris
5. Face
6. Soft Biometrics etc.

Biometric systems based on single source of information are called Unimodal systems [6]. Unimodal biometric system has some limitations of these Systems are considered when deploying with the real World applications. Some of the challenges encountered by these systems are Noise in sensed data, Intra class variations, Inter class similarities, Non universalities, spoof attacks [7]. Multi biometric (multimodal) systems seek to alleviate some of the drawbacks encountered by Unimodal biometric systems by consolidating the evidence presented by multiple biometric traits / sources [8]. Biometric system can also be designed to recognize a Person based on information acquired from multiple biometric sources. Such system is known as Multimodal biometric system. Multibiometric system can offer substantial improvement in the matching information being combined and fusion methodology accuracy of a biometric system depending upon the adopted. It addresses the issue of non universality or insufficient population coverage. This system also effectively addresses the problem of noisy data. These systems also help in continuous monitoring and tracking of individual in situation when a single trait is not sufficient. Fusion schemes should be employed to combine the information presented by multiple biometric sources. There are various data combination levels that can be considered, examples are the feature level, score level and decision level [9].A simple biometric system consists of four basic components [10 ,11]:

Sensor module which acquires the biometric data.

Feature extraction module where the acquire data is processed to extract feature vectors.

Matching module where attribute vectors are compared against those in the template.

Decision-making module in which the user's identity is established or a claimed identity is accepted or rejected.

## III. Various techniques of Biometric Traits

Biometric characteristics can be divided in two main classes:

A. Physiological are related to the shape of the body and thus it varies from person to person Fingerprints, Face recognition, hand geometry and iris recognition are some examples of this type of Biometric.

B. Behavioral are related to the behavior of a person. Some examples in this case are signature, keystroke dynamics and of voice. Sometimes voice is also considered to be a physiological biometric as it varies from person to person [12].

The techniques for biometric authentication have been developed based on these characteristics. Details of different techniques are discussed below.

## IV. Fingerprint Recognition System

Fingerprints are unique for each finger of a person including identical twins. One of the most Instead; only a touch provides instant access. Fingerprint systems can also be used in identification mode [13]. The biometric fingerprint sensor takes a digital picture of a fingerprint. The fingerprint scan detects the ridges and valleys of a fingerprint and converts them into ones and zeroes. Complex algorithms analyze this raw biometric scan to identify characteristics of the fingerprint, known as the “minutiae”. Minutiae are stored in a template, but only a subset of these has to match for identification or verification. The images acquired by these sensors are used by the feature extraction module to compute the feature values [14]. The feature values typically correspond to the position and

 

orientation of certain critical points known as minutiae points (ridge endings and ridge bifurcations) that are present in every fingerprint (Fig. 1).

Figure 1: Fingerprint Image

**Fingerprint matching techniques:**

The large number of approaches to fingerprint matching can be coarsely classified into three families.

• Correlation-based matching: Two fingerprint images are superimposed and the correlation between corresponding pixels is computed for different alignments (e.g. various displacements and rotations).

• Minutiae-based matching: This is the most popular and widely used technique, being the basis of the fingerprint comparison made by fingerprint examiners. Minutiae are extracted from the two fingerprints and stored as sets of points in the two- dimensional plane. Minutiae-based matching essentially consists of finding the alignment between the template and the input minutiae sets that result in the maximum number of minutiae pairings.

• Pattern-based (or image-based) matching: Pattern based algorithms compare the basic fingerprint patterns (arch, whorl, and loop) between a previously stored template and a candidate fingerprint. This requires that the images be aligned in the same orientation. To do this, the algorithm finds a central point in the fingerprint image and centers on that. In a pattern-based algorithm, the template contains the type, size, and orientation of patterns within the aligned fingerprint image. The candidate fingerprint image is graphically compared with the template to determine the degree to which they match [15].

## V. Iris Recognition Technologies

Iris recognition is a method of biometric authentication that uses pattern-recognition techniques based on high resolution images of the irises of an individual's eyes [16]. The human iris, an annular part between the pupil (generally, appearing black in an image) and the white sclera has an extraordinary structure and provides many interlacing minute characteristics such as freckles, coronas, stripes, etc. These visible characteristics, which are generally called the texture of the iris, are unique.


Fig 2: View of Human EYE

The whole iris recognition process is basically divided into four steps [17]:

1) Image acquisition;
2) Iris image preprocessing;
3) Iris feature extraction; and
4) Matching.
5) Result

**1) Image acquisition:**

The iris image acquisition includes the lighting system, the positioning system, and the physical capture system (Wields, 1997). The iris recognition includes preprocessing and neural networks. During iris acquisition, the iris image in the input sequence must be clear and sharp. Clarity of the iris's minute characteristics and sharpness of the boundary between the pupil and the iris, and the

 

boundary between the iris and the sclera affects the quality of the iris image. A high quality image must be selected for iris recognition [18].

**2) Iris Pre-processing:**

The original eye image must be pre-processed in order to extract iris features from an eye image. The pre-processing involves localization and normalization of the iris image. The popular approach for iris is localized using Daugman's integro-differential operator (IDO) and normalized with the help of Daugman's rubber sheet model. The half iris is preferred from the entire normalized iris image, for extracting the iris features, because the region closer to the pupil provides more discriminating iris information [19].

**3) Iris feature extraction:**

Various techniques are used for iris feature Extraction.

1) Corner detection based IRIS encoding [20] ,in this approach the authors presented an iris recognition algorithm using corner detection . The basic idea of this technique is to find curves that can be parameterized like straight lines, polynomials, circles, etc., in a suitable parameter space. In the first step author finds intensity image gradient at all the locations in the given image by convolving with the sobel filters.

2) LPCC and LDA based Iris feature extraction [21], in this paper, the iris recognition algorithm based on LPCC and LDA is first presented. So far, the two algorithms are not found for iris recognition in literature. LPCC and LDA to extract the feature vector of iris images.

3) Feature Extraction Using HAAR wavelet [22], in this approach calculated the features of the iris using Haar wavelet transform for recognition. Authors compared the results using Haar transform with the wavelet tree obtained using other wavelets and found slightly better results.

4) Feature Extraction Using DWT (Discrete Wavelet Transform)[23] ,In this approach the DWT analyses a signal based on its content in different frequency ranges. Therefore it is very useful in analyzing repetitive patterns such as texture. The 2-D transform decompose the original image into different channels, the decomposition process can be recursively applied to the low frequency channel (LL) to generate decomposition at the next level. DWT decomposition of an image. The LP and HP filters are used to implement the wavelet transform. The features are computed as the local energy of the filter responses.

5) Feature Extraction using Gabor Filter [24] this approach extracted the features of the normalized iris by filtering the normalized iris region. This filtering is performed by convolution with a pair of Gabor filters. Information about noise position in this stage are also extracted and stored. So, the iris code is formed by some characteristic information extracted from normalized iris filtered by convolution.

6) Statistical Pattern Recognition [25] in this approach Fast Fourier transform is used to extract the features. A test is conducted and it is found that mid-to-high frequencies are the most important features in classification. Upon first glance of an iris, the mid-to-higher frequency content appears to be concentrated near the boundary of the pupil. An FFT of the individual samples was then taken and the mid-to-high spectral bands were averaged to produce the results. The spikes on the outer bands are largely due to the interfering eyelids.

**4) Iris Matching Techniques:**

1) Hamming Distance: After the extraction process, the iris code matching task is performed by pairing the iris code extracted from the input and the template iris images. In iris matching we use an efficient method taking the Hamming Distance between the two feature vectors. The distance between the two featured vector are calculated by

$$D(F_c, F_c^i), i = \overline{1, N}$$

Where

Fc = Feature of the input pattern

Fci = Feature of the ith pattern from the database

N = Number of patterns in the database

 

In such a process, there is a most similar pattern which is assigned as i*, to the database pattern. i* is the pattern which has a minimum distance value of Di*

$$D_{i^*} = \min D_i(F_c, F_c^i), i = \overline{1, N}$$

This enables the comparison of two iris patterns based on the idea that the greater the Hamming Distance between the two feature vectors, greater the difference between them. Two similar irises will fail in this test since the distance between them will be approximately zero. This enables the comparison of two iris patterns based on the idea that the greater the Hamming Distance between the two feature vectors, greater the difference between them. Two similar irises will fail in this test since the distance between them will be approximately zero.

The Hamming Distance was originally conceived for detection and correction of errors in Digital communication. It is defined as the number of bits that are different between two bit vectors. The Hamming Distance between the two Boolean vectors is given by

$$HD = \frac{1}{N}\sum_{j=1}^{N} C_A(j) \oplus C_B(j)$$

where CA and CB are the coefficients of the two iris images and N is the size of the feature vector. $\oplus$ is the Boolean operator that gives a binary 1 if the bit sat position j in CA and CB are different and 0 if they are similar. The minimum distance determines the input pattern which is the most similar to the database pattern [26].

2) Neural Network based model: In this approach, the normalized and enhanced iris image is represented by a two-dimensional array. This array contains the grayscale values of the texture of the iris pattern. These values are input signals for the neural network. NN is used for the classification [27].

## V. Conclusion

Every individual have unique physiological characteristics. Fingerprint patterns, Iris patterns may be used for reliable visual recognition. Available Feature extraction method and matching techniques of fingerprint and feature extraction methods for iris pattern are studied in this paper. This paper is an analysis various feature extraction methods. The survey of the techniques provides a platform for the development of the novel techniques in this area as future work.

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