IRIS Recognition System

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***Abstract*- Humans recognize each other according to their various characteristics for ages. We recognize others by their face when we meet them and by their voice as we speak to them. Identity verification (authentication) in computer systems has been traditionally based on something that one has (key, magnetic or chip card) or one knows (PIN, password). Things like keys or cards, however, tend to get stolen or lost and passwords are often forgotten or disclosed. To achieve more reliable verification or identification we should use something that really characterizes the given person. Biometrics offer automated methods of identity verification or identification on the principle of measurable physiological or behavioral characteristics such as a fingerprint or a voice sample. The characteristics are measurable and unique. These characteristics should not be duplicable, but it is unfortunately often possible to create a copy that is accepted by the biometric system as a true sample.In biometric-based authentication, a legitimate user does not need to remember or carry anything and it is known to be more reliable than traditional authentication schemes. However, the security of biometric systems can be undermined in a number of ways. For instance, a biometric template can be replaced by an impostor's template in a system database or it might be stolen and replayed. Consequently, the impostor could gain unauthorized access to a place or a system. Moreover, it has been shown that it is possible to create a physical spoof starting from standard biometric templates. Hence, securing the biometric templates is vital to maintain security and integrity of biometric systems. This report actually gives an overview of what is biometric system and a detail overview of a particular system i.e. iris recognition system.**

I. INTRODUCTION

Biometrics are automated methods of identifying a person or verifying the identity of a person based on a physiological or behavioral characteristic. Biometric-based authentication is the automatic identity verification, based on individual physiological or behavioral characteristics, such as fingerprints, voice, face and iris. Since biometrics is extremely difficult to forge and cannot be forgotten or stolen, Biometric authentication offers a convenient, accurate, irreplaceable and high secure alternative for an individual, which makes it has advantages over traditional cryptography- based authentication schemes. It has become a hot interdisciplinary topic involving biometric and Cryptography. Biometric data is personal privacy information, which uniquely and permanently associated with a person and cannot be replaced like passwords or keys. Once an adversary compromises the biometric data of a user, the data is lost forever, which may lead to a huge financial loss. Hence, one major concern is how a person's biometric data, once collected, can be protected.

1.1 HISTORY AND DEVELOPMENT OF BIOMETRICS

Jithin A Manjaly is with Computer Science and Engineering, Sahrdaya College Of Engineering & Technology, The idea of using patterns for personal identification was originally proposed in 1936 by ophthalmologist Frank Burch. By the 1980's the idea had appeared in James Bond films, but it still remained science fiction and conjecture. In 1987, two other ophthalmologists Aram Safir and Leonard Flom patented this idea and in 1987 they asked John Daugman to try to create actual algorithms for this iris recognition. These algorithms which Daugman patented in 1994 are the basis for all current iris recognition systems and products.Daugman algorithms are owned by Iridian technologies and the process is licensed to several other Companies who serve as System integrators and developers of special platforms exploiting iris recognition in recent years several products have been developed for acquiring its images over a range of distances and in a variety of applications. One active imaging system developed in 1996 by licensee Sensar deployed special cameras in bank ATM to capture iris.

1.2 ANATOMY OF THE HUMAN IRIS

The iris is a thin circular diaphragm, which lies between the cornea and the lens of the human eye. The iris is perforated close to its center by a circular aperture known as the pupil. The function of the iris is to control the amount of light entering through the pupil, and this is done by the sphincter and the dilator muscles, which adjust the size of the pupil. The average diameter of the iris is 12 mm, and the pupil size can vary from 10% to 80% of the iris diameter. The iris consists of a number of layers; the lowest is the epithelium layer, which contains dense pigmentation cells. The stromal layer lies above the epithelium layer, and contains blood vessels, pigment cells and the two iris muscles. The density of stromal pigmentation determines the color of the iris. The externally visible surface of the multi-layered iris contains two zones, which often differ in color . An outer ciliary zone and an inner pupillary zone, and these two zones are divided by the collarets – which appears as a zigzag pattern. Formation of the iris begins during the third month of embryonic life .The unique pattern on the surface of the iris is formed during the first year of life, and pigmentation of the stroma takes place for the first few years. Formation of the unique patterns of the iris is random and not related to any genetic factors . The only characteristic that is dependent on genetics is the pigmentation of the iris, which determines its color. Due to the epigenetic nature of iris patterns, the two eyes of an individual contain completely independent iris patterns, and identical twins possess uncorrelated iris patterns.

It includes Three Main Stages: Image Acquisition and Segmentation Image Normalization

Feature Coding and Matching

1.2.1 IMAGE ACQUISITION AND SEGMENTATION

Image Acquisition of the major challenges of automated iris recognition is to capture a high-quality image of the iris while remaining noninvasive to the human operator.

- Concerns on the image acquisition rigs.
- Obtained images with sufficient resolution and sharpness.
- Good contrast in the interior iris pattern with proper illumination
- Well centered without unduly constraining the operator
- Artifacts eliminated as much as possible

SEGMENTATION

The first stage of iris recognition is to isolate the actual iris region in a digital eye image. The iris region can be approximated by two circles, one for the iris/sclera boundary and another, interior to the first, for the iris/pupil boundary. The eyelids and eyelashes normally occlude the upper and lower parts of the iris region. Also, specular reflections can occur within the iris region corrupting the iris pattern. A technique is required to isolate and exclude these artifacts as well as locating the circular iris region.

This can be done by using the following techniques:-

Hough Transform

Hough transform is a standard computer vision algorithm that can be used to determine the parameters of simple geometric objects, such as lines and circles, present in an image. The circular Hough transform can be employed to deduce the radius and center coordinates of the pupil and iris regions. Firstly, an edge map is generated by calculating the first derivatives of intensity values in an eye image and then thresholding the result. From the edge map, votes are cast in Hough space for the parameters of circles passing through each edge point. These parameters are the center coordinates xc and yc, and the radius r, which are able to define any circle according to the equation A maximum point in the Hough space will correspond to the radius and center coordinates of the circle best defined by the edge points. Wildes et al. make use of the parabolic Hough transform to detect the eyelids, approximating the upper and lower eyelids with parabolic arcs. In performing the preceding edge detection step, Wildes et al. bias the derivatives in the horizontal direction for detecting the eyelids, and in the vertical direction for detecting the outer circular boundary of the iris, this is illustrated in Figure shown below. The motivation for this is that the eyelids are usually horizontally aligned, and also the eyelid edge map will corrupt the circular iris boundary edge map if using all gradient data.

1.2.2 IMAGE NORMALIZATION

Once the iris region is successfully segmented from an eye image, the next stage is to transform the iris region so that it has fixed dimensions in order to allow comparisons. The dimensional inconsistencies between eye images are mainly due to the stretching of the iris caused by pupil dilation from varying levels of illumination. Other sources of inconsistency include, varying imaging distance, rotation of the camera, head tilt, and rotation of the eye within the eye socket. The normalization process will produce iris regions, which have the same constant dimensions, so that two photographs of the same iris under different conditions will have characteristic features at the same spatial location.

1.2.3 FEATURE ENCODING AND MATCHING

In order to provide accurate recognition of individuals, the most discriminating information present in an iris pattern must be extracted. Only the significant features of the iris must be encoded so that comparisons between templates can be made. Most iris recognition systems make use of a band pass decomposition of the iris image to create a biometric template. The template that is generated in the feature encoding process will also need a corresponding matching metric, which gives a measure of similarity between two iris templates.

Each isolated iris pattern is then demodulated to extract its phase information using quadrature 2D Gabor wavelets. This encoding process amounts to a patch-wise phase quantization of the iris pattern, by identifying in which quadrant of the complex plane each resultant phasor lies when a given area of the iris is projected onto complex-valued 2DGabor wavelets. Only phase information is used for recognizing irises because amplitude information is not very discriminating, and it depends upon extraneous factors such as imaging contrast, illumination, and camera gain. The phase bit settings which code the sequence of projection quadrants as shown in Fig. The extraction of phase has the further advantage that phase angles are assigned regardless of how poor the image contrast
may be.

The phase demodulation process used to encode iris pat- terns. Local regions of an iris are projected onto quadrature 2D Gabor wavelets, generating complex-valued projection coefficients whose real and imaginary parts specify the coordinates of a phasor in the complex plane. The angle of each phasor is quantized to one of the four quadrants, setting two bits of phase information. This process is repeated all across the iris with many wavelet sizes, frequencies, and orientations, to extract 2048 bits.

2. MATCHING

For matching, a test of statistical independence is required which helps to compare the phase codes for 2 different eyes. The test of statistical independence is implemented by the simple Boolean Exclusive OR operator (XOR) applied to 2048 bit phase vectors that encode any 2 iris templates, masked by both of their corresponding mask bit vectors to prevent non iris artifacts from influencing iris comparison. The XOR operator detects disagreement between any corresponding pair of bits, while AND operator ensures that the compared bits are not corrupted by eyelashes etc. The norms(|| ||) of resultant bit vector and the AND the mask vector are computed to determine a fractional Hamming distance.

The Hamming distance was chosen as a metric for recognition, since bit-wise comparisons were necessary. The Hamming distance algorithm employed also incorporates noise masking, so that only significant bits are used in calculating the Hamming distance between two iris templates. Now when taking the Hamming distance, only those bits in the iris pattern that correspond to '0' bits in noise masks of both iris patterns will be used in the calculation. In order to account for rotational inconsistencies, when the Hamming distance of two templates is calculated, one template is shifted left and right bit-wise and a number of Hamming distance values are calculated from successive shifts. This bit-wise shifting in the horizontal direction corresponds to rotation of the original iris region by an angle given by the angular resolution used. If an angular resolution of 180 is used, each shift will correspond to a rotation of 2 degrees in the iris region. This method is suggested by Daugman, and corrects for misalignments in the normalized iris pattern caused by rotational differences during imaging. From the calculated Hamming distance values, only the lowest is taken, since this corresponds to the best match between two templates. The number of bits moved during each shift is given by two times the number of filters used, since each filter will generate two bits of information from one pixel of the normalized region. The actual number of shifts required to normalize rotational inconsistencies will be determined by the maximum angle difference between two images of the same eye, and one shift is defined as one shift to the left, followed by one shift to the right.

3 ADVANTAGES AND DISADVANTAGES

A critical feature of this coding approach is the achievement of commensurability among iris codes, by mapping all irises into a representation having universal format and constant length, regardless of the apparent amount of iris detail. In the absence of commensurability among the codes, one would be faced with the inevitable problem of comparing long codes with short codes, showing partial agreement and partial disagreement in their lists of features.

3.1 ADVANTAGES

- It is an internal organ that is well protected against damage by a highly transparent and sensitive membrane. This feature makes it advantageous from finger print.
- Flat, geometrical configuration controlled by 2 complementary muscles control the diameter of the pupil makes the iris shape more predictable.
- An iris scan is similar to taking a photograph and can be performed from about 10 cm to a few meters away.
- Encoding and decision-making are tractable.
- Genetic independence no two eyes are the same iris Recognition System

3.2 DISADVANTAGES

- The accuracy of iris scanners can be affected by changes in lightning.
- Obscured by eyelashes, lenses, reflections
- Deforms non-elastically as pupil changes size.
- Iris scanners are significantly more expensive than some other form of biometrics.
- As with other photographic biometric technologies, iris recognition is susceptible to poor image quality, with associated failure to enroll rates
- As with other identification infrastructure (national residents databases, ID cards, etc.), civilrights activists have voiced concerns that iris-recognition technology might help governments to track individuals beyond their will.

4. APPLICATIONS

Iris-based identification and verification technology has gained acceptance in a number of different areas. Application of iris recognition technology can he limited only by imagination. The important applications are those following: ATM's And Iris Recognition: In U.S many banks incorporated iris recognition technology into ATM's for the purpose of control- ling access to one's bank accounts. After enrolling once (a "30 second" process), the customer need only approach the ATM, follow the instruction to look at the camera, and be recognized within 2-4 seconds. The benefits of such a system are that the customer who chooses to use bank's ATM with iris recognition will have a quicker, more secure transaction. Applications of this type are well suited to iris recognition technology. First, being fairly large, iris recognition physical security devices are easily integrated into the mountable, sturdy apparatuses needed or access control, The technology's phenomenal accuracy can be relied upon to prevent unauthorized release or transfer and to identify repeat offenders re- entering prison under a different identity.

- Computer login: The iris as a living password.
- National Border Controls: The iris as a living password.
- Telephone call charging without cash, cards or PIN numbers.
- Ticket less air travel.
- Premises access control (home, office, laboratory etc.).
- Driving licenses and other personal certificates.

5. CONCLUSON

There are many mature biometric systems available now. Proper design and implementation of the biometric system can indeed increase the overall security. There are numerous conditions that must be taken in account when designing a secure biometric system. First, it is necessary to realize that biometrics is not secrets. This implies that care should be taken and it is not secure to generate any cryptographic keys from them. Second, it is necessary to trust the input device and make the communication link secure. Third, the input device needs to be verified. Iridian process is defined for rapid exhaustive search for very large databases: distinctive capability required for authentication today. The extremely low probabilities of getting a false match enable the iris recognition algorithms to search through extremely large databases, even of a national or planetary scale. As iris technology superiority has already allowed it to make significant inroads into identification and security venues which had been dominated by other biometrics. Iris- based biometric technology has always been an exceptionally accurate one, and it may soon grow much more prominent.

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