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A Succession Multi-Modal Biometric Identification Hypothesis

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ABSTRACT

Multibiometrics is the combination of one or more biometrics (e.g., Fingerprint, Iris, and Face). Researchers are focusing on how to provide security to the system, the template which was generated from the biometric need to be protected. The problems of unimodal biometrics are solved by multibiometrics. The main objective is to provide a security to the biometric template by generating a secure sketch by making use of multibiometric cryptosystem and which is stored in a database. Once the biometric template is stolen it becomes a serious issue for the security of the system and also for user privacy. The drawbacks of existing system include accuracy of the biometric need to be improved and the noises in the biometrics also need to be reduced. The proposed work is to enhance the security using multibiometric cryptosystem in distributed system applications like e-commerce transactions, e-banking and ATM. A practically viable multi-biometric recognition system should not only be stable, robust and accurate but should also adhere to real-time processing speed and memory constraints. One of the key features of the author's framework is that each classifier in the ensemble can be designed to use a different modality thus providing the advantages of a truly multimodal-biometric recognition system. The proposed approach presents a very low degree of complexity, which makes it suitable for real-time applications. The performance of the proposed system is evaluated both for single and multimodalities to demonstrate the effectiveness of the approach.

Keywords: Multi-modal Biometrics, Selection/Binning Ridge, Finger Print Feature Extraction, Finger Image/Preprocessing, Grayscale images, thresholding, Edge Detection, Pupil Detection, Canny Edge Detection, Fused Random Key, Normalization, Gray scale, Hough transforms, Ridge detection, Hamming distance, Feature extraction

I. INTRODUCTION

A reliable identity management system is a critical component in several applications that render services to only legitimately enrolled users. Examples of such applications include sharing networked computer resources, granting access to nuclear facilities, performing remote financial transactions or boarding a commercial flight. The proliferation of web-based services (e.g., online banking) and the deployment of decentralized customer service centres (e.g., credit cards) have further enhanced the need for reliable identity management systems. Traditional methods of establishing a person's

Identity include knowledge-based (e.g., passwords) and token-based (e.g., ID cards) mechanisms, but these surrogate representations of identity can be easily lost, shared, manipulated or stolen thereby undermining the intended security. Biometrics offers natural and reliable solution to certain aspects of identity management by utilizing fully automated or semi-automated schemes to recognize individuals based on their inherent physical and/or behavioural characteristics. By using biometrics it is possible to establish an identity based on who you are, rather than by what you possess, such as an ID card, or what you remember, such as a password

II. METHODS AND MATERIAL

MODULE DESCRIPTION

The following are the modules of the project along with the way they are implemented and that is planned with respect to the proposed system, while overcoming existing system and also providing the support for the future enhancement system. There are totally three modules with sub modules used in our project which is listed below. Each module has specific usage in the project and is description is given below followed by the list of modules.

1. Finger Print Feature Extraction
    i. Finger Image/Preprocessing
    ii. Ridge Indexing
    iii. Selection/Binning Ridge
    iv. Minutiae Feature Extraction
2. Iris code extraction
    i. Image conversion
    ii. Edge detection
    iii. Pupil detection
    iv. Normalization
3. Fused Random Key

1. Finger Print Feature Extraction

I. Finger Image/Preprocessing

Before extracting the proposed ridge features we need to perform some pre-processing additional procedures for quality estimation and circular variance estimation. To estimate the ridge orientation and the ridge frequency is calculated. Gabor/Gaussian Filter is applied to enhance the image and obtain a skeleton zed ridge image. A robust pre-processing method to reduce the finger image enhancement errors.

II. Ridge Indexing

Ridge indexing is known as ridge count, that the ridge count methods find the number of ridges that intersect the straight line between two minutiae in the spatial domain is counted. When the ridge-counting line is parallel to the ridge structures, the line may meet the same ridge at one point, at more than two points, or at no point, due to skin deformation. The ridge count (rc) is not always a positive number and the sign of the ridge count follows the sign of the vertical axis.

III. Selection/Binning Ridge

The Ridge length (rl) is the distance on the horizontal axis from the intersection of the vertical and horizontal axis. The absolute differences of ridge length elements are mostly less than 16 pixels. Therefore, the threshold of the ridge length feature is set to determine the same fingerprint as 16 pixels. To define the Ridge curvature sampling points are used along the horizontal axis from the intersection of the vertical axis. Ridge curvature based sampling point is calculated as, 1) Ridges may have more than two inflection points. 2) Some ridges are too straight to define a curved direction. Therefore, to avoid the error caused by more than two inflection points. Due to the feature extraction error, skin condition changes, and different finger pressures, end points may appear as bifurcations and vice versa. To improve the discriminating power of ridge features, the ridge type (rt) is used as one of the ridge features instead of a minutia type.

IV. Minutiae Feature Extraction

The ridge coordinates and extract ridge features is defined between two minutiae. In the ridge-based coordinate system is defined by a minutia (called origin) and vertical and horizontal axes starting from the origin minutia. To represent the relative position of the minutiae according to the origin, horizontal axes should be defined. The ridge-based coordinate system, the ridge features that describe the relationship between the origin and arbitrary minutiae. To determine the ridge type (rt), each minutia is first classified as an end point or a bifurcation. If a minutia is an end point, there is only one ridge belonging to the minutia. If a minutia is a bifurcation, there are three ridges connected to the minutiae.

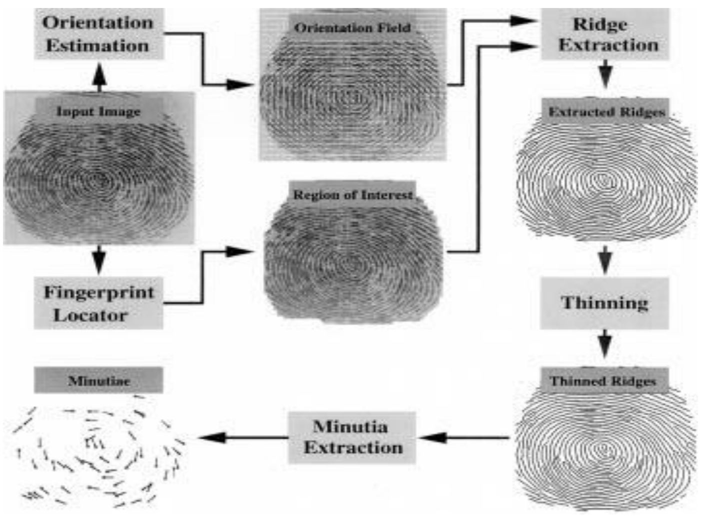

Figure 1: Minutiae Extraction Data Flow Diagram

2. Iris code extraction

I. Image Conversion

Grayscale images are distinct from one-bit black-and-white images, which in the context of computer imaging are images with only the two colors, black, and white (also called bi-level or binary images). Grayscale images have many shades of gray in between. Grayscale images are also called monochromatic, denoting the absence of any chromatic variation.

Grayscale images are often the result of measuring the intensity of light at each pixel in a single band of the electromagnetic spectrum (e.g. infrared, visible light, ultraviolet, etc.), and in such cases they are monochromatic proper when only a given frequency is captured. But also they can be synthesized from a full color image; see the section about converting to grayscale.

II. Edge Detection

Edge detection is a fundamental tool in image processing and computer vision, particularly in the areas of feature detection and feature extraction, which aim at identifying points in a digital image at which the image brightness changes sharply or, more formally, has discontinuities. The edges extracted from a two-dimensional image of a three-dimensional scene can be classified as

- Viewpoint dependent
- Viewpoint independent.

A viewpoint independent edge typically reflects inherent properties of the three-dimensional objects, such as surface markings and surface shape. A viewpoint dependent edge may change as the viewpoint changes, and typically reflects the geometry of the scene, such as objects occluding one another.

III. Canny Edge Detection Algorithm:

The Canny algorithm basically finds edges where the grayscale intensity of the image changes the most. These areas are found by determining gradients of the image. Gradients at each pixel in the smoothed image

The algorithm runs in 5 separate steps:

1. **Smoothing**: Blurring of the image to remove noise.
2. **Finding gradients**: The edges should be marked where the gradients of the image has large magnitudes.
3. **Non-maximum suppression**: Only local maxima should be marked as edges.
4. **Double thresholding**: Potential edges are determined by thresholding.
5. **Edge tracking by hysteresis**: Final edges are determined by suppressing all edges that are not connected to a very certain (strong) edge.

IV. Pupil Detection

The acquired iris image has to be pre-processed to detect the iris, which is an annular portion between the pupil (inner boundary) and the sclera (outer boundary). The first step in iris localization is to detect pupil which is the black circular part surrounded by iris tissues. The centre of pupil can be used to detect the outer radius of iris patterns. The important steps involved are:

1. Pupil detection(Inner Circle)
2. Outer iris localization

Circular Hough Transformation for pupil detection can be used. 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

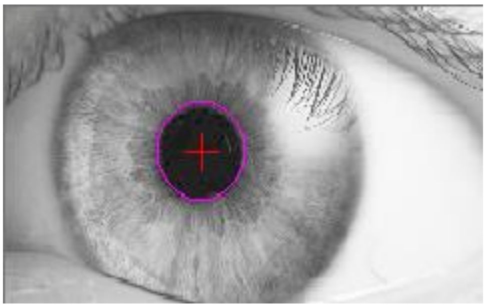

Figure 2: Inner Pupil Detection

External noise is removed by blurring the intensity image. But too much blurring may dilate the boundaries of the edge or may make it difficult to detect the outer iris boundary, separating the eyeball and sclera. Thus a special smoothing filter such as the median filter is used on the original intensity image. This type of filtering eliminates sparse noise while preserving image boundaries. After filtering, the contrast of image is enhanced to have sharp variation at image boundaries using histogram equalization.

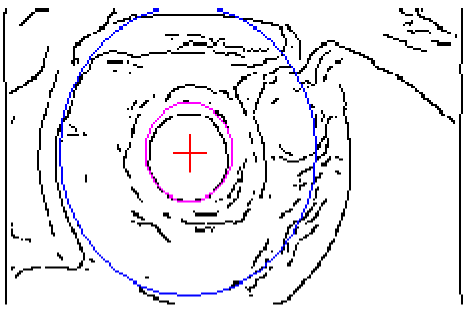

Figure 3: Normalization

V. Normalization

Must remove blurred images before feature extraction. Localizing iris from an image delineates the annular portion from the rest of the image. The concept of rubber sheet modal suggested by Daugman takes into consideration the possibility of pupil dilation and appearing of different size in different images. For this purpose, the coordinate system is changed by unwrapping the iris and mapping all the points within the boundary of the iris into their polar equivalent. The mapped image has 80 × 360 pixels. It means that the step size is same at every angle. This normalization slightly reduces the elastic distortions of the iris.

3. Fused Random Key

The templates which are extracted separately are fused with the random key which is given as input from user and stored in the database. In the verification stage, the fused single vector is compared with the vector which is stored in the database. If the key which is not public matches, then the user is valid or it is decided that user is invalid.

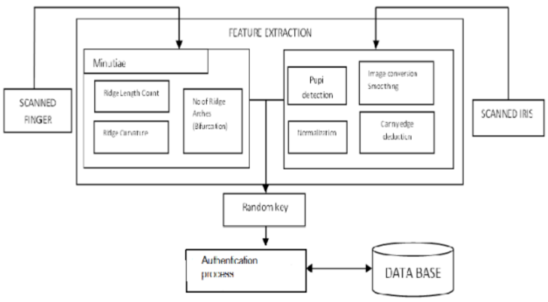

Figure 4: System Architecture

VI. Algorithm

Gray scale:

Grayscale images are distinct from one-bit bi-tonal black-and-white images, which in the context of computer imaging are images with only the two colors, black, and white (also called bi-level or binary images). Grayscale images have many shades of gray in between. Grayscale images are often the result of measuring the intensity of light at each pixel in a single band of the electromagnetic spectrum, and in such cases they are monochromatic proper when only a given frequency is captured. But also they can be synthesized from a full color image; see the section about converting to gray scale.

Median filter:

Use of a median filter to improve an image severely corrupted by defective pixels. It is often desirable to be able to perform some kind of noise reduction on an image or signal. The median filter is a nonlinear digital filtering technique, often used to remove noise. Such noise reduction is a typical pre-processing step to improve the results of later processing (for example, edge detection on an image). Median filtering is very widely used in digital image processing because, under certain conditions, it preserves edges while removing noise.

Hough transforms:

The Hough transform is a feature extraction technique used in image analysis, computer vision, and digital image processing. The purpose of the technique is to find imperfect instances of objects within a certain class of shapes by a voting procedure. This voting procedure is carried out in a parameter space, from which object candidates are obtained as local maxima in a so-called accumulator space that is explicitly constructed by the algorithm for computing the Hough transform.

Normalization:

Most normalization techniques are based on transforming iris into polar coordinates, known as unwrapping process. Pupil boundary and limbus boundary are generally two non-concentric contours. The non-concentric condition leads to different choices of reference points for transforming an iris into polar coordinates. Proper choice of reference point is very important where the radial and angular information would be defined with respect to this point.

Feature extraction:

When the input data to an algorithm is too large to be processed and it is suspected to be notoriously redundant then the input data will be transformed into a reduced representation set of features. Transforming the input data into the set of features is called feature extraction. If the features extracted are carefully chosen it is expected that the features set will extract the relevant information from the input data in order to perform the desired task using this reduced representation instead of the full size input.

Hamming distance:

The Hamming distance between two strings of equal length is the number of positions at which the corresponding symbols are different. In another way, it measures the minimum number of substitutions required to change one string into the other, or the minimum number of errors that could have transformed one string into the other.

Ridge detection:

The ridges (or the ridge set) of a smooth function of two variables are a set of curves whose points are, in one or more ways to be made precise below, local maxima of the function in at least one dimension. This notion captures the intuition of geographical ridges. For a function of N variables, its ridges are a set of curves whose points are local maxima in $N-1$ dimensions. In this respect, the notion of ridge points extends the concept of a local maximum. Correspondingly, the notion of valleys for a function can be defined by replacing the condition of a local maximum with the condition of a local minimum. The union of ridge sets and valley sets, together with a related set of points called the connector set form a connected set of curves that partition, intersect, or meet at the critical points of the function. This union of sets together is called the function's relative critical set.

Orientation:

Fingerprint image typically divided into number of non-overlapping blocks and an orientation representative of the ridges in the block is assigned to the block based on grayscale gradients in the block. The block size depends on the inter-ridge distance, i.e. it should include at least one ridge and one valley in a block. The block orientation can be determined from the pixel gradients by averaging or voting

III. CONCLUSION

Biometrics is not only a fascinating pattern recognition research problem but, if carefully used, could also be an embedding technology with the potential to make our society safer, reduce fraud and lead to user convenience. The proposed methodology presented here provides security to the distributed system and feature level fusion framework is provided. Likewise, it cannot be guessed it out how many biometrics is used and what type of biometrics are used. As secure sketch is generated from the template and stored in the database, the hackers cannot be able to use the template, unless and until they know the secret key. In future, the work is to overcome the failure of biometrics, which can be addressed by using multimodal model which gain the advantage of other biometrics in case of failure of one biometrics.

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