Personal Authentication using Multimodel Fusion

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Abstract: ***It is a Biometric used to authenticate a person, Fingerprint and Palmprint which is unique and permanent throughout a person's life. A minutia matching is mostly used for fingerprint recognition, and can be classified as ridge ending and ridge bifurcation. Palmprint matching is a challenging problem because latent prints large number of minutiae in full prints, and the presence of many creases in latents and full prints. A match score estimate using the local ridge direction and frequency in palmprints developed a highly robust algorithm. This facilitates the extraction of ridge and minutiae features even in poor quality palmprints. . In this paper Fingerprint Recognition using Minutia Score Matching method. Distinctive information around each minutia is captured using a fixed-length minutia descriptor, Minutia Code andalignment-based minutiae matching algorithm is used to match two palmprints. In this paper person Verification based on fusion of Minutia Score Matching method for fingerprint and alignment-based minutiae matching algorithm for palmprints is presented.***

***Key-words**: Fingerprint Recognition, Binarization, Matching score and Minutia.*

I. INTRODUCTION

Biometrics (or biometric authentication) consists of methods for uniquely recognizing humans based upon one or more intrinsic physical or behavioral traits. In computer science, in particular, biometrics is used as a form of identity access management and access control. It is also used to identify individuals in groups that are under surveillance.

Digital image processing is the use of computer algorithms to perform image processing on digital images. Digital image processing has many advantages over analog image processing. It allows a much wider range of algorithms to be applied to the input data and can avoid problems such as the build-up of noise and signal distortion during processing. Since images are defined over two dimensions (perhaps more) digital image processing may be modeled in the form of Multidimensional Systems Biometric systems operate on behavioral and physiological biometric data to identify a person. The behavioral biometric parameters are signature, gait, speech and keystroke, these parameters change with age and environment. However physiological characteristics such as face, fingerprint, palm print and iris remains unchanged throughout the life time of a person.

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The biometric system operates as verification mode or identification mode depending on the requirement of an application. The verification mode validatesa person's identity by comparing captured biometric data with readymade template. The identification mode recognizes a person's identity by performing matches against multiple fingerprint biometric templates. Fingerprints are widely used in daily life for more than 100 years due to its feasibility, distinctiveness, permanence, accuracy, reliability, and acceptability.

Fingerprint is a pattern of ridges, furrows and minutiae, which are extracted using inked impression on a paper or sensors. A good quality fingerprint contains 25 to 80 minutiae depending on sensor resolution and finger placement on the sensor. The false minutiae are the false ridge breaks due to insufficient amount of ink and cross-connections due to over inking. It is difficult to extract reliably minutia from poor quality fingerprint impressions arising from very dry fingers and fingers mutilated by scars, scratches due to accidents, injuries. Minutia based fingerprint recognition consists of Thinning, Minutiae extraction, Minutiae matching and Computing matching score.

In this paper Fingerprint Recognition using Minutia Score Matching method is done with the help of IDL codes. The fingerprint is one of the popular biometric methods used to authenticate human being. The proposed fingerprint verification FRMSM provides reliable and better performance than the existing technique. Pre-processing the original finger print involves image binarization, ridge thinning and noise removal. In this paper the personal authentication using fingerprint matching is done by using the minutia score matching method.

II. FINGERPRINT AND PALMPRINT RECOGNITION

Fingerprint and Palmprint are unique and permanent throughout a person's life. The fusion of Minutia Score Matching method for fingerprint and alignment based minutiae matching algorithm for palmprints.

A fingerprint is comprised of ridges and valleys. The ridges are the dark area of thefingerprint and the valleys are the white area that exists between the ridges. Many classifications are given to patterns that can arise in the ridges and some examples are given in the figure to the right. These points are also known as the minutiae of the fingerprint. The most commonly used minutiae in current fingerprint recognition technologies are ridge endings and bifurcations because they can be easily detected by only looking at points that surround them.

Most modern fingerprint matching technologies use minutiae matching. The idea being if you can find enough minutiae in one image that have corresponding minutiae in another image then the images are most likely from the same fingerprint. Minutiae are usually matched together by their distance relative to other minutiae around it. If multiple points in one image have similar distances between them then multiple points in another image then the points are said to match up. It is the idea of this paper to add the constraint that the regions and possibly edges between the minutiae should be the approximately thesame as well.

Minutia Code and alignment-based minutia matching algorithm is used to match two palmprints.A match score estimate is calculated using the local ridge direction and frequency in palmprints. The distinctive information around each minutiae is calculated using the fixed length minutiae descriptor.

III. MODEL

A.Fingerprint

The input fingerprint image is the gray scale image of a person, which has intensityvalues ranging from 0 to 255. In a fingerprint image, the ridges appear as dark lines while the valleys are the light areas between the ridges. Minutiae points are the locations where a ridge becomes discontinuous. A ridgecan either come to an end, which is called as termination or it can split into two ridges, which is called asbifurcation. The two minutiae types of terminations and bifurcations are of more interest for further processescompared to other features of a fingerprint image.

1) Binarization: The pre-processing of FRMSM uses Binarization to convert gray scale image into binary image by fixing the threshold value. The pixel values above and below the threshold are set to '1' and '0' respectively.

2) Thinning: The binarized image is thinned using Block Filter to reduce the thickness of all ridge lines to a single pixel width to extract minutiae points effectively. Thinning does not change the location and orientation of minutiae points compared to original fingerprint which ensures accurate estimation of minutiae points. Thinning preserves outermost pixels by placing white pixels at the boundary of the image, as a result first five and last five rows, first five and last five columns are assigned value of one. Dilation and erosion are used to thin the ridges.

3) Noise Reduction: A method to remove noise is by convolving the original image with a mask that represents a low-pass filter or smoothing operation. This convolution brings the value of each pixel into closer harmony with the values of its neighbors. In general, a smoothing filter sets each pixel to the average value, or a weighted average, of itself and its nearby neighbors; the Gaussian filter is just one possible set of weights.

Smoothing filters tend to blur an image, because pixel intensity values that are significantly higher or lower than the surrounding neighborhood would "smear" across the area. Because of this blurring, linear filters are seldom used in practice for noise reduction; they are, however, often used as the basis for nonlinear noise reduction filters Smoothing filters are also called low-pass filters because they let low frequency components pass and reduce the high frequency components.

4)Minutia Detection: The minutiae location and the minutiae angles are derived after minutiae extraction. The terminations which lie at the outer boundaries are not considered as minutiae points, and Crossing Number is used to locate the minutiae points in fingerprint image. Crossing Number is defined as half of the sum of differences between intensity values of two adjacent pixels. If crossing Number is 1, 2 and 3 or greater than 3 then minutiae points are classified as Termination, Normal ridge and Bifurcation respectively, is shown in figure.

To calculate the bifurcation angle, we use the advantage of the fact that termination and bifurcation are dual in nature. The termination in an image corresponds to the bifurcation in its negative image hence by applying the same set of rules to the negative image, we get the bifurcation angles. Figure shows the original image and the extracted minutiae points. Square shape shows the position of termination and diamond shape shows the position of bifurcation as in figure.

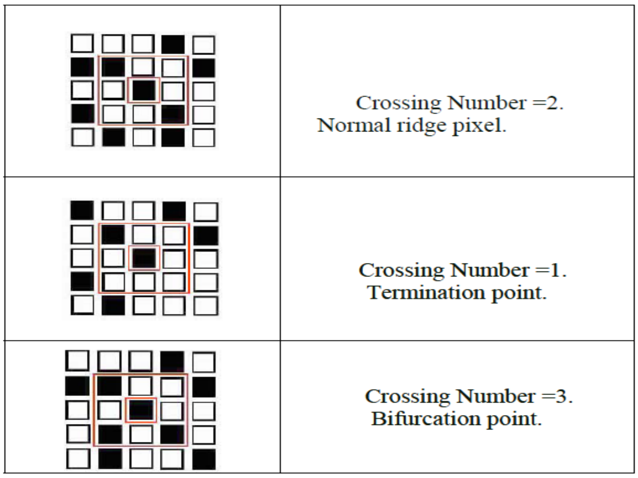

Fig.1 Cross number and type of minutia

5) Minutia Matching: To compare the input fingerprint data with the template data Minutiae matching is used. For efficient matching process, the extracted data is stored in the matrix format. The data matrix is as follows.

Number of rows: Number of minutiae points.

Number of columns: 4

Column 1: Row index of each minutia point.

Column 2: Column index of each minutia point.

Column 3: Orientation angle of each minutia point.

Column 4: Type of minutia. (A value of '1' is assigned for termination, and '3' is assigned for bifurcation).

During the matching process, each input minutiae point is compared with template minutiae point. In each case, template and input minutiae are selected as reference points for their respective data sets. The reference points are used to convert the remaining data points to polar coordinates. The Equation is used to convert the template minutiae from row and column indices to polar coordinates

$$\begin{pmatrix} r_k^{\,T} \\ \phi_k^{\,T} \\ \theta_k^{\,T} \end{pmatrix} = \begin{pmatrix} \sqrt{\left(row_k^{\,T} - row_{ref}^{\,T}\right)^2 + \left(col_k^{\,T} - col_{ref}^{\,T}\right)^2} \\ \tan^{-1}\left(\dfrac{row_k^{\,T} - row_{ref}^{\,T}}{col_k^{\,T} - col_{ref}^{\,T}}\right) \\ \theta_k^{\,T} - \theta_{ref}^{\,T} \end{pmatrix}$$

$r_k^{\,T}$ = radial distance of kth minutiae.

$\phi_k^{\,T}$ = radial angle of kth minutiae.

$\theta_k^{\,T}$ =orientation angle of kth minutiae.

$row_{ref}^{\,T}, col_{ref}^{\,T}$ = row index and column index of reference points currently being considered.

Similarly the input matrix data points are converted to polar coordinates using the Equation.

$$\begin{pmatrix} r_m^{\,I} \\ \phi_m^{\,I} \\ \vartheta_m^{\,I} \end{pmatrix} = \begin{pmatrix} \sqrt{\left(row_m^{\,I} - row_{ref}^{\,I}\right)^2 + \left(col_m^{\,I} - col_{ref}^{\,I}\right)^2} \\ \tan^{-1}\left(\dfrac{row_m^{\,I} - row_{ref}^{\,I}}{col_m^{\,I} - col_{ref}^{\,I}}\right) + \\ rotatevalues(k,m) \\ \theta_m^{\,I} - \theta_{ref}^{\,I} \end{pmatrix}$$

Rotate values (k, m) represents the difference between the orientation angles of Tk and Im. Tk and Im represent the extracted data in all the columns of row k and row m in the template and input matrices, respectively.

B. Palmprint

Palmprint and fingerprint share some common characteristics such as creases and ridges. Other palmprint characteristics are principle lines and wrinkles.

Fig. 2 shows a typical palmprint image. There are two basic features in a palmprint: ridges and creases. Ridges are formed by the arrangement of the mastoid in the dermal papillary layer. They come into being during the three-to four months of the fetal stage and are fixed in the adolescence stage. The ridge pattern of the palm is unique for an individual, just like the finger tip. But unlike the fingerprint, there are many creases in the palmprint.

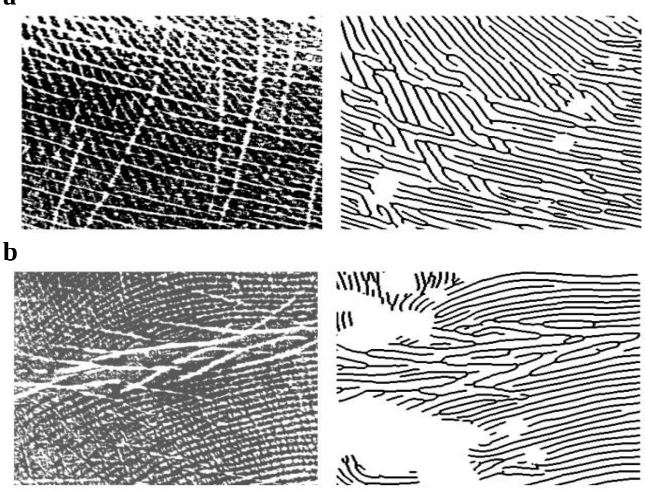

Fig.2 Creases in palmprints. (a) A palmprint region with a major crease and its ridge skeleton image produced by VeriFinger and (b) a palmprint region with many thin creases and its ridge skeleton image produced by VeriFinger.

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The creases can be further classified as immutable and mutable creases. Immutable creases mainly consist of three principal lines, namely, radial transverse crease, proximal transverse crease, and distal transverse crease. They divide the palmprint into three regions: thenar, hypothenar, and interdigital. Mutable creases mainly come from drying cracks, which come into being in spring and winter when the weather is dry and disappear when it is wet in summer and autumn. These are also easily masked by compression and noise. Both the principal lines and ridges are firmly attached to the dermis, and are immutable for the whole life.

IV. EXPERIMENTS AND RESULTS

The experiments reported in this paper utilize inkless hand images obtained from digital camera. We collected 1,000 hand images, 10 samples from each user, for 100 users. The first five images from each user were used for training and the rest were used for testing. The palmprint images, of size 300 x 300 pixels, were automatically extracted. Each of the palmprint images were divided into 144 overlapping blocks of size 24 x 24 pixels, with an overlap of 6 pixels (25 %). Thus a 1 x 144 feature vector was obtained from every palmprint image. The receiver operating characteris tic curves for three distinct cases, (i) hand geometry alone, (ii) palmprint alone, and (ii) using decision level fusion with max rule, i.e., highest of the similarity measure from fingerprint or palmprint, are shown in figure 3.

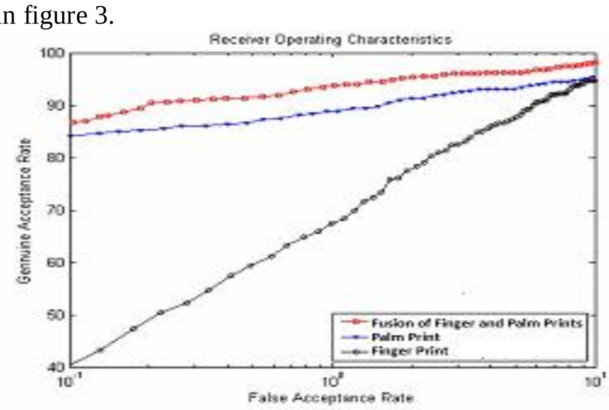

Fig. 3 Comparative performance of palmprint and geom etry features (on 500 images) using decision level f usion.

Some users failed to touch their palm/fingers on the imaging board. It was difficult to use such images, mainly due to change in scale, and these images were marked as of poor quality. A total of 28 such images were identified and removed. The FAR and FRR scores for 472 test images, using total minimum error as criterion i.e., decision threshold at which the sum of FAR and FRR is minimum, is shown in table 1. The comparative performance of two fusion schemes is displayed in figure 4.

Table 1. Performance scores for total minimum error on 472 test images

	FAR	FRR	Decision Threshold
Palmprint	4.49 %	2.04 %	0.9830
Finger print	5.29 %	8.34 %	0.9314
Fusion at Representation	5.08 %	2.25 %	0.9869
Fusion at Decision	0 %	1.41 %	0.9840

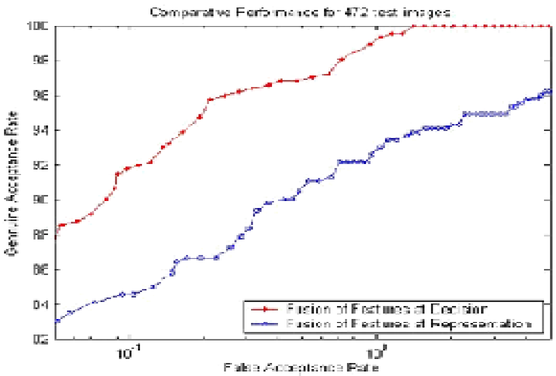

Fig. 4 Comparative performance of two fusion scheme on 472 test images.

V. CONCLUSION AND FUTURE ENHANCEMENT

In this paper, we presented Fingerprint matching using FRMSM. Pre-processing the original fingerprint involves image binarization, ridge thinning, and noise removal. Binarization was used to convert gray scale image into binary image by fixing the threshold value. Ridge thinning was done to reduce the thickness of all ridge lines to a single pixel width to extract minutiae points effectively. Noise reduction was done by using the mean filter. Minutiae matching were used to compare the input fingerprint data with the template data. Fingerprint Recognition using Minutia Score Matching method is used for matching the minutia points. Distinctive information around each minutia was captured by using a fixed-length minutia descriptor. The proposed method FRMSM gives better FMR values compared to the existing method.

In this paper the popular biometric used to authenticate a person, is fingerprint which is unique and permanent throughout a person's life is proposed. A minutia matching method is mostly used forfingerprint recognition, and can be classified as ridge ending and ridge bifurcation. The Fingerprint Recognition was done by using the Minutia Score Matching method. Distinctive information around each minutia is captured by using a fixed-length minutia descriptor. Here the personal authentication using fingerprint matching was done by using the minutia score matching method. But multi-model biometric systems perform better than single mode.

So multimodal biometric system ie; personal authentication using the fusion of fingerprint and palm print identification is proposed. Here person verification based on fusion of Minutia Score Matching method for fingerprint and alignment-based minutiae matching algorithm for palmprints will be done.

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