Multi Bio-metric Authentication using Finger Vein and Palm Print

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Abstract— Today world advances in the field of information technology also make information security an inseparable part of it. Bio-metric systems are widely used in access control and security based applications. To provide better security for all endorsement system we use modalities for biometric authentication to authenticate by finger vein and palm print. We capture finger vein using Near InfraRed (NIR) camera through light transmission methodologies, and we capture palm print using optical scanner that use CCD sensor and CMOS sensor. A small set of data of the images has been established for algorithm testing and evaluation. ROI segmentation is done for both Finger Vein (FV) image and Palm Print (PP) image separately, Normalization is done after segmentation. For the feature extraction, Competitive Matching Code (C2 code) is used. This authentication system is well suited for backing system when comparing with the other authentication system and it provides better result on EER, FRR (Equal Error Rate, False Rejection Rate) and Total Processing Time.

Keywords: NIR, CMOS Sensor, FRR

I. INTRODUCTION

Nowadays authentication plays major role in all domain. Authentication is needed for security and privacy.ID cards, metal keys and password, pattern, pin etc are basic authentication schemes used in real world to examine whether person is authenticated user. In first scheme the external hardware can be easily hacked by duplicating, second scheme includes password, pattern, pin, so in any case if the user forgot their password, pattern lead to reset the entire security system. Biometric authentication system can overcome these problems. There is no need to remember any secret key and user should be physically present for the authentication, by using biometrics. Finger print can be easily extracted from the authenticated user without their knowledge. So for unique feature we go for finger vein which is very unique bio-metric feature for authentication that is identified in 2008. Finger vein cannot be extracted from user without their knowledge. We use the Palm print & Finger vein as key factor.

II. SYSTEM OVERVIEW

A. Capturing Finger Vein Image:

Near Infra-Red (NIR) camera through light transmission method is used to capture the finger vein images. Finger vein image is captured by placing the finger dorsal at NIR and passing light through the finger. To get high contrast images, some light transmission methods are adapted as shown in figure.

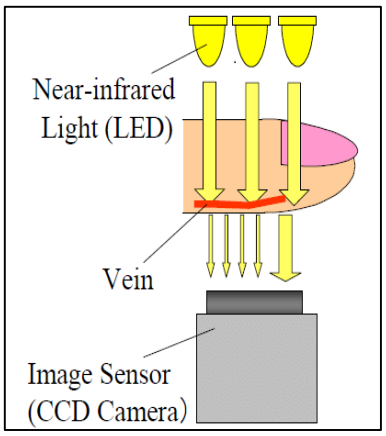

Fig. 2.1.1: Light Transmission Method

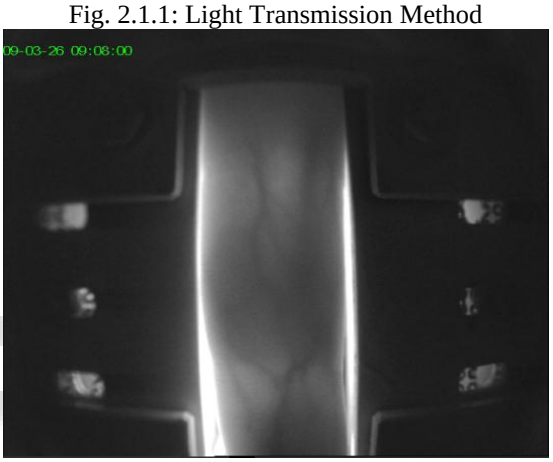

Fig. 2.1.2: Finger Vein raw image

B. Capturing Palm Print Image:

Capacitive scanner and optical scanner used to capture palm print. Initially photograph of the palm is captured and processed through sensor or CMOS sensor to avoid dirty photograph and to get a perfect palm print image measuring the distance of the hollows between the ridges in the particular of palm electrically and build up a final image based on the measuring distance.

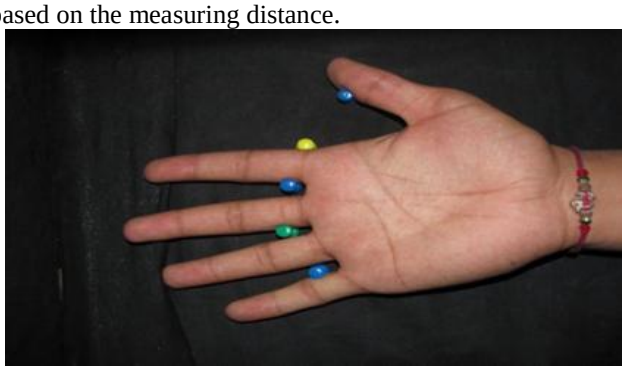

Fig. 2.2.1: Palm Print Raw Image

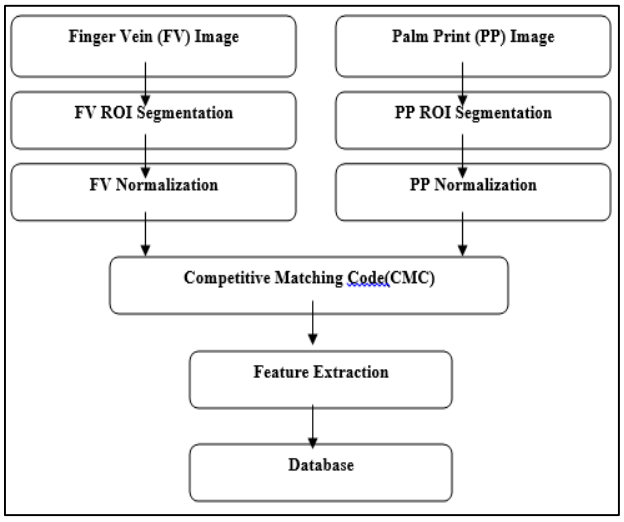

Fig. 2.2.2: Proposed Recognition Frame work

C. Recognition Frame work:

The proposed verification frame work is shown in the finger. The preprocessing consists of the ROI segmentation. Both the palm print and finger vein is preprocessed. The extracted ROI of palm print and finger vein is then normalized. Feature extraction algorithm is applied to the normalized sub images. Gabor Filter are applied to these normalized sub images. The output is used to get the magnitude preserved CMC code. CMC is known as competitive code that is a state of the bio metric algorithm which preserves the magnitude information of the filtered image and is used for further processing. The external features related to the code map is stored in Nearest Neighbour (NN) classify and used for the verification process.

D. Palm Print Segmentation:

A well-known older method algorithm is justified. That is used for earlier biometric authentication factor for palm print mean and variance based. Palm print pattern generally composes two regions. They are Foreground and Background. Foreground important information that is essential thing for accepting the correct palm print pattern in biometric authentication system. Background contains noise information here it contributes to the extraction of little important details. To limit these types of little important information, ROI segmentation of palm print is performed. The main intention of segmentation is to separate the foreground and background.

Algorithm based on Mean and Variance

1) With dividing the palm print image I into non over lapping blocks of size M*N
2) Calculate the mean value

   Mean = $\frac{\sum_{i=1}^{M}\sum_{j=1}^{N} I(i,j)}{M*N}$

   Where I (i, j) is the pixel gray value of i^{th} row and j^{th} column.
3) Mean value is used to derive the variance value

   Variance=$\frac{\sum_{i=1}^{M}\sum_{j=1}^{N}[(i,j)-mean]^2}{M*N}$
4) Choose a common threshold value that works on all the different images. If the threshold value is less than the variance then block is considered as foreground otherwise it is assumed to be background.

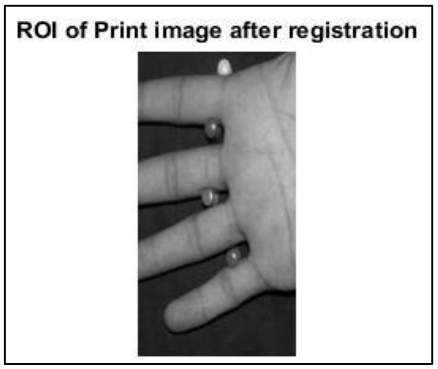

Fig. 2.4: ROI Image

1) Finger Vein Segmentation:

In finger vein segmentation, the horizontal direction on the finger edges of the finger vein image has perfect jumps. The gradient operator is used to find the vertical lines which are the edges of finger. In motion of mask to image side, an edge was detected if the norm of the sling was greater than the threshold.

1	0	-1
2	0	-2
3	0	-3
4	0	-4
5	0	-5
6	0	-6
7	0	-7
6	0	-6
5	0	-5
4	0	-4
3	0	-3
2	0	-2
1	0	-1

Fig. 2.4.1 (a):

-1	0	1
-2	0	2
-3	0	3
-4	0	4
-5	0	5
-6	0	6
-7	0	7
-6	0	6
-5	0	5
-4	0	4
-3	0	3
-2	0	2
-1	0	1

Fig. 2.4.2 (b):

a) Edge Detection Masks

The left edge was acquired by image convolution by using the sling operator and mask is to detect the right one. The operations are shown in Fig 2.4.1 (a) and Fig 2.4.2 (b). The edge lines in the horizontal (x) direction were set to 100 pixels inwards the lower and upper bounds. Application of rotational alignment algorithm is done. Every low in the finger space is normalized to the same length by using linear interpolation. Final finger regions are certified (Normalized) to 100*200 pixels. The finger vein that is segmented is shown in Figure.

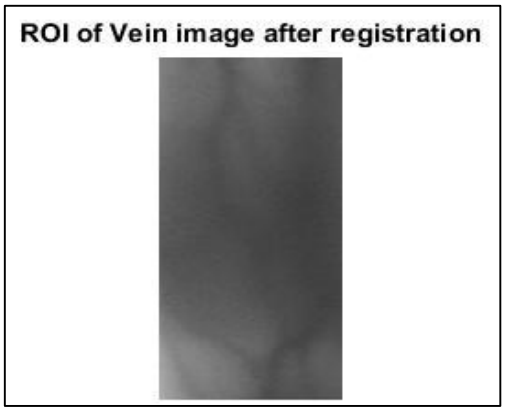

Fig. 2.4.3: ROI Vein Image

2) Proposed Algorithm of Finger Vein

1) Read on finger vein image from the image database.
2) Get the pruned border and boundaries of finger vein image and store it.
3) Get the ROI (Region of Interest) of input image by normalization and store it.
4) Apply the Gabor Filters. Perform edge detection on the image as a resultant of the Gabor Filter.

E. Feature Extraction

The palm print and finger vein sub images are applied to Gabor Filter. Gabor Filters is widely used in biometric system and it is a best extraction tool. The Magnitude code, Phase code and Orientation code are the three types of output from Gabor Filter. Outputs can be used by combining all the codes or individually to apply to a system.

Magnitude code and Orientation code is combined by CMC coding scheme

$$G(x, y) = e^{(-\frac{x_\theta^2}{\sigma_x^2}+\frac{y_\theta^2}{\sigma_x^2})} \cos(2\pi f x_\theta)$$

Even symmetric Gabor Filter in two dimension

$$\text{Where } \begin{pmatrix} x_\theta \\ y_\theta \end{pmatrix} = \begin{pmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix}$$

Here, denotes the filter centre frequency (Orientation parameter).

$$\theta = \frac{j\pi}{J}, \text{ J= } \{0,1,2,3,\ldots\ldots\ldots\text{J-1}\}$$

σ_x *and* σ_y are the standard deviation x_θ *and* y_θ are rotated versions of (x, y). The number of Gabor filters J is fixed to 6.

Some result pixel from the Gabor filter will not have increased variation, pay to low quality image, Due to such reasons the lower value of magnitude code that corresponds to the Orientation code value is stored. The CMC code is the final output image stored in Database.

1) Magnitude Preserved CMC Scheme

FKP and finger print recognition widely uses CMC code scheme.It amalgamates the palm print and finger vein images in the algorithm given. Gabor Filters are applied to palm print and finger vein images. OVCode and OPCode are Orientation code for finger vein and palm print whereas MVCode and MPCode are magnitude code for finger vein and palm print images respectively.

Algorithm 1:
Comparative Competitive Coding scheme
Input OVCode, MVCode, OPCode, MPCode
Output CMC code
For all CMC code Do
If OVCode(x, y)= OPCode(x, y)then
CMC code= OVcode(x, y)
Else if MVCode (x, y) MPCode(x, y) then
CMC code(x, y) = MPCode(x, y)
Else if MVCode(x, y) = MPCode(x, y) then

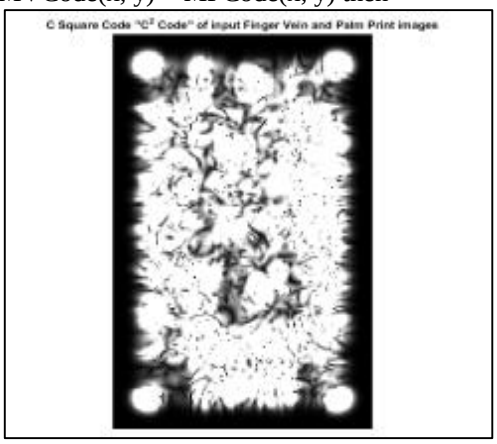

Fig. 2.5.1: Final image stored in Database

III. RESULTS

ROI Segmentation comes under preprocessing. The finger vein edges are detected using edge detection mask with threshold value. The palm print segmentation is done by finding mean and variance and setting a threshold value for all the different images. The ROI of palm print and finger vein are extracted.

A. Orientation Code

Fig. 3.1: Finger Vein at Orientation code

Fig. 3.2: Palm Print at Orientation code

B. Magnitude Code

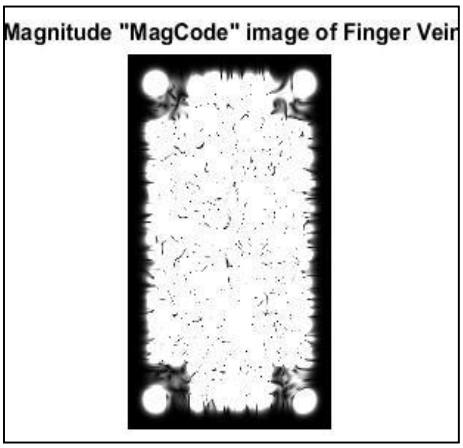

Fig. 3.3: Finger Vein at Magnitude code

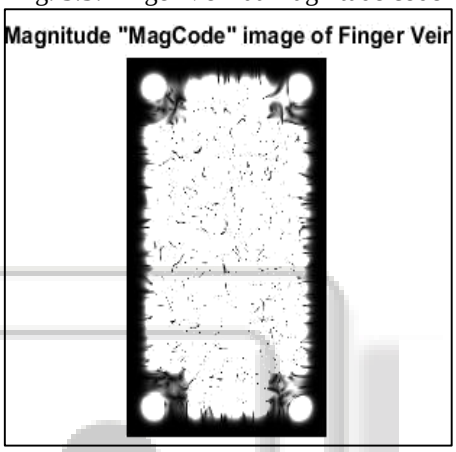

Fig. 3.4: Palm Print at Magnitude code

IV. CONCLUSION

EER algorithm used to predetermine the threshold value. The common value of FAR and FRR is referred as equal error rate (EER). Finger vein and Palm print are tough to get from user without their knowledge. Future extraction palm vein is included for Authentication and also accuracy and performance will be further more increased.

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