FEATURE LEVEL IMAGE FUSION TECHNIQUE FOR BIOMETRIC PERSON IDENTIFICATION

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Abstract - This paper proposed an innovative contact-less palm print and palm vein recognition system. Palm print is referred to as line textures, which contains principal lines, wrinkles and ridges on the inner surface of the palm. On the other hand palm vein is line texture below the inner surface of palm. These line patterns are unique and stable, and they offer bundle of useful information for personal recognition. The palm prints and palm vein features are extracted using Directional Coding technique. The proposed approach is rigorously evaluated on the CASIA database (100 subjects) and achieves the best FAR 0.2% & FRR 1%.

Finally, we propose a score level combination strategy to combine the multiple palm vein representations. We achieve consistent improvement in the performance, from the recognition experiments, which illustrates the robustness of the proposed schemes.

Keywords: contactless biometrics, palm print recognition, palm vein recognition, region of interest (ROI).

I. INTRODUCTION

Recently, biometrics has emerged as a reliable technology to provide greater level of security to personal authentication system. Among the various biometric characteristics that can be used to recognize a person, the human hand is the oldest, and perhaps the most successful form of biometric technology [1]. The features that can be extracted from the hand include hand geometry, fingerprint, palm print, knuckle print, and vein. These hand properties are stable and reliable. Once a person has reached adulthood, the hand structure and configuration remain relatively stable throughout the person's life [2]. Apart from that, the hand-scan technology is generally perceived as nonintrusive as compared to iris- or retinascan systems [3]. The users do not need to be cognizant of the way in which they interact with the system. These advantages have greatly facilitated the deployment of hand features in biometric applications.

At present, most of the hand acquisition devices are based on touch-based design. The users are required to touch the device or hold on to some peripheral or guidance peg for their hand images to be captured. There are a number of problems associated with this touch-based design. Firstly, people are concerned about the hygiene issue in which they have to place their hands on the same sensor where countless others have also placed theirs. This problem is particularly exacerbated during the outbreak of epidemics or pandemics like SARS and Influenza A (H1N1) which can be spread by touching germs leftover on surfaces. Secondly, latent hand prints which remain on the sensor's surface could be copied for illegitimate use. Researchers have demonstrated systematic methods to use latent fingerprints to create casts and moulds of the spoof fingers [4]. Thirdly, the device surface will be contaminated easily if not used right, especially in harsh, dirty, and outdoor environments. Lastly, some nations may resist placing their hands after a user of the opposite sex has touched the sensor.

II. Region of Interest(ROI) Extraction

Segmentation of the palm, i.e. the separation of the palm from the background. Since the background is uniformly black, the segmentation can be done using simple thresholding.

Figure1.ImageBinarization (a) Palmvein Image from Casia Multispectral Database (b)Binary image

The Region of Interest in the palm is taken as the central part of the palm because this part contains the most features. For the extraction of the ROI, the tips of the fingers and the valley points between the roots of the fingers are found .Line between little finger valley & middle finger valley is drawn. Line parallel to this line below 25 pixel drawn. Four corner point of square found & square is drawn . This square area is cropped fro original palm image. This procedure is shown in figure 2.

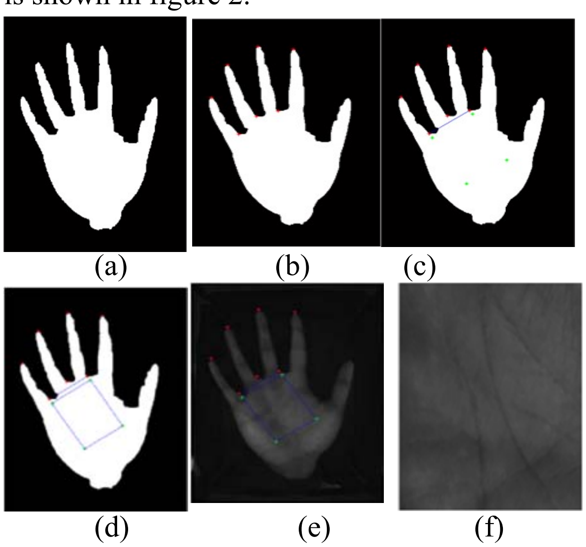
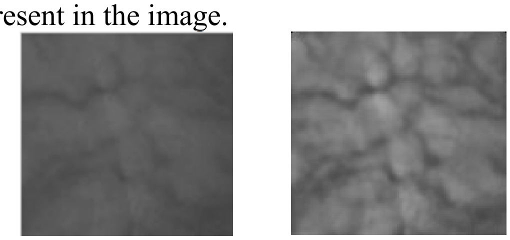


Figure 2. ROI Extraction steps.(a)Binary image(b)Finding tips & valley points. (c) Line from 1st & 3rd Valley point.(d) Rectangle(128x128) (e) Overlapping of rectangle on original palm.(f)Extracted ROI

III. Image Enhancement:

Cropped image is enhanced by using first applying medfilt2 Median filtering is a nonlinear operation often used in image processing to reduce "salt and pepper" noise. A median filter is more effective than convolution when the goal is to simultaneously reduce noise and preserve edges. Then low pass filtering (wiener) an intensity image that has been degraded by constant power additive noise. It uses a pixel-wise adaptive Wiener method based on statistics estimated from a local neighbourhood of each pixel. Contrast enhancement is performed using adaptive histogram equalization. It enhances the contrast of images by transforming the values in the intensity image. It operates on small data regions (tiles), rather than the entire image. Each tile's contrast is enhanced, so that the histogram of the output region approximately matches the specified histogram. The neighbouring tiles are then combined using bilinear interpolation in order to eliminate artificially induced boundaries. The contrast, especially in homogeneous areas, can be limited in order to avoid amplifying the noise which might be present in the image.



(a) (b)

Figure 3. (a)Palm vein image (b) Enhanced image

IV.FEATURE EXTRACTION

We propose a new scheme named Directional Coding method to extract the palm print and palm vein features.These hand features contain similar textures which are primarily made up of line primitives. For example, palm prints are made up of strong principal lines and some thin wrinkles, whilst palm vein contains vascular network which also resembles line-like characteristic. Therefore, we can deploy a single method to extract the discriminative line information from the different hand features. The proposed Directional Coding technique aims to encode the line pattern based on the proximal orientation of the lines. We first apply Wavelet Transform to decompose the palm print images into lower resolution representation. The Sobel operator is then used to detect the palm print edges in horizontal, vertical, +45o, and -45o orientations. After that, the output sample, Φ(x, y) , is determined using the formula,

$$\Phi(x, y)=\delta(\arg\max_{f}(\omega_{R}(x, y)))$$

where Rw(x , y) denotes the responses of the Sobel mask in the four directions (horizontal, vertical, +45o, and -45o), and δ ε{1,2,3,4} indicates the index used to code the orientation of Rw(x , y). The index, δ, can be in any form, but we use decimal representation to characterize the four orientations for the sake of simplicity. The output, Φ(x, y), is then converted to the corresponding binary reflected Gray code. The bit string assignment enables more effective matching process as the computation only deals with plain binary bit string rather than real or floating point numbers. Besides, another benefit of converting bit string to Gray code representation is that Gray code exhibits less bit transition. This is a desired property since we require the biometric feature to have high similarity within the data (for the same subject). Thus, Gray code representation provides less bit difference and more similarity in the data pattern.Figure 4. a to 4.d shows the gradient responses of the palm print in the four directions.Figure 5. a to 4.d shows the gradient responses of the palm vein in the four directions.

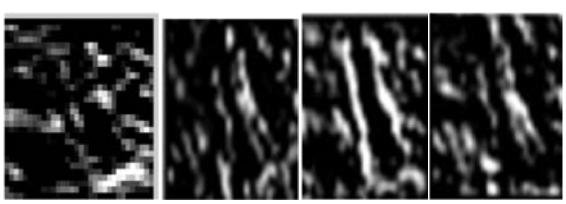


Figure 4. Example of Directional Code applied on palm print image.

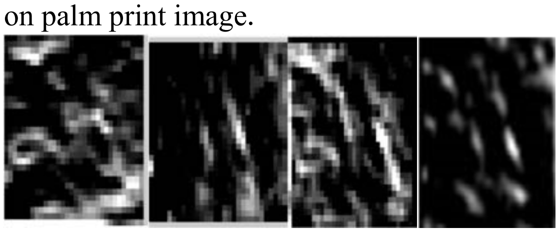


Figure 5. Example of Directional Code applied on palm vein image.

V. Biometric Performance Measurements Criterion: The proposed system can be seen as a two class problems: whether a person should be claimed as a true client or an imposter. In order to evaluate the success of the system, a standard measurement is used to verify the acceptance errors and rejection errors. They are defined as follows: False Reject Rate (FRR) – The percentage of clients or authorized person that the biometric system fails to accept. It will increase proportionally to the security threshold. When the security threshold increases, more users (including the authorized person) will be rejected due to the high security level. FRR is defined as

$$FRR= \frac{\text{Number of rejected clients}}{\text{Total number of client access}}\times 100\%$$

False Acceptance Rate (FAR) – The percentage of imposters or unauthorized person that the biometric system fails to reject. It rises when the security threshold (matching confidence) is lowered. More formally, FAR is defined as

$$FAR= \frac{\text{Number of accepted imposter}}{\text{Total number of imposter accesses}}\times 100\%$$

Equal Error Rate (EER) – is an optimal rate where FAR is equal to FRR. Graphically, EER is recognized as the crossing point between FAR and FRR. It is commonly used to determine the overall accuracy of the system and serve as comparative measure against the other biometric systems. These three performance measures, namely FAR and FRR will be used to testify the proposed algorithms in the subsequent sections.

VI. Identification: After extracting feature vector all feature vectors are stored in database. Test palm sample is processed same as previous. The comparison is done with data base and the decision is made about the person identity. Nearest neighbour search algorithm is used for this. Test feature vector of each individual is compared with all database feature vector & minimum Euclidian distance is found. Based on minimum distance criteria identification result is displayed as test sample is matches with database sample.

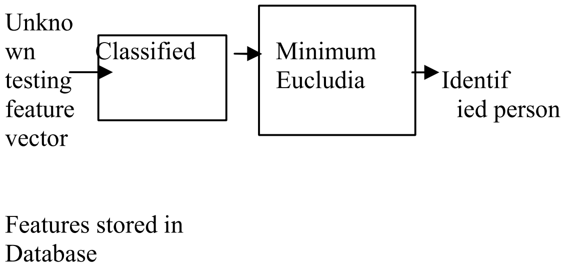


Figure 6. Classifier structure

The matching of unknown person is performed by measuring the dissimilarity between the features of unknown person to the features of database person, The best matching person is vector that minimizes the dissimilarity measure.

$$C._{best} = \arg \min_{1 \le i \le N} \{D_E (X, C_i)\}$$

Euclidean Distance metric, D_E between the test features and the database features is found as given below:

$$D_E = \sqrt{\sum_{i=1}^{n} Ts_i^2 - Tr_i^2)}$$

where,
Ts = Testing feature vector
Tr = Database feature vector
n = total number of features

VII. Result

- Training Database-100 Peoples 5 samples of each
- Testing Database-100 Peoples

Figure 7 shows FAR & FRR plotted against different threshold for palmprint alone, figure 8 shows FAR & FRR plotted against different threshold for palm vein alone and Figure 9 shows FAR & FRR plotted against different threshold for fused palmprint & palm vein feature . This figures gives optimum value of threshold to be select for finding values of FAR & FRR.

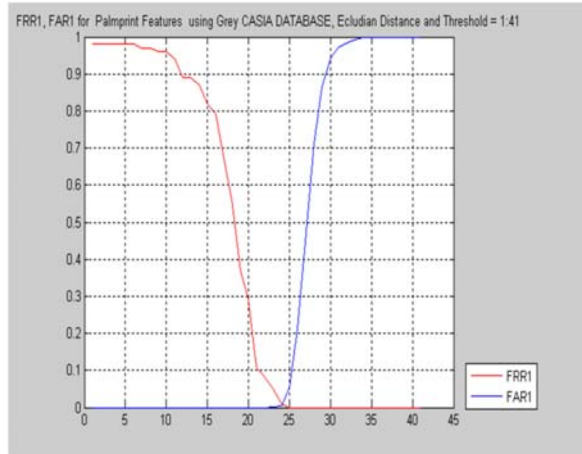


Figure 7. FAR & FRR of Palmprint for different threshold

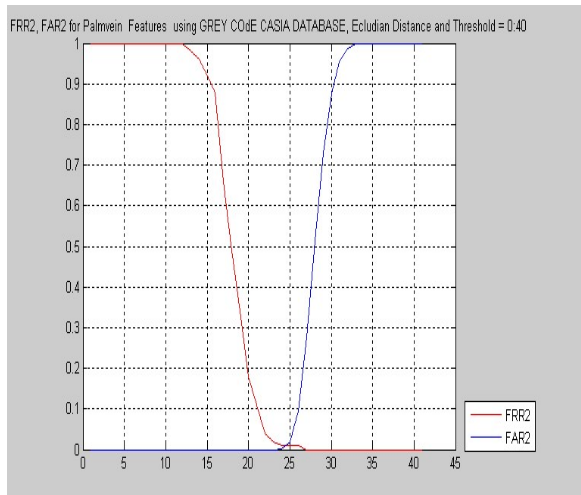


Figure 8. FAR & FRR of Palmvein for different threshold

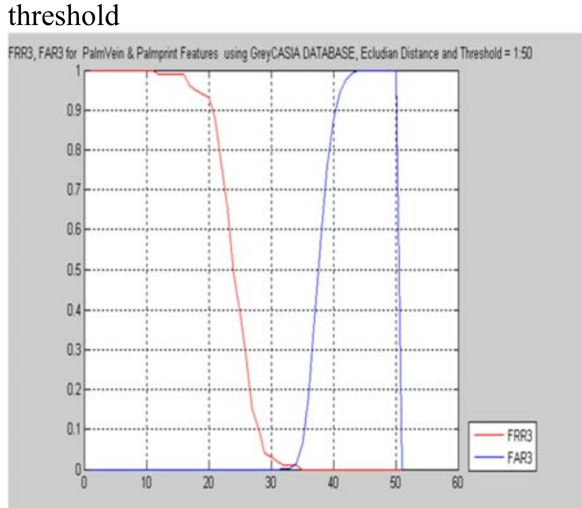


Figure 9. FAR & FRR of Palmprint & Palmvein for different threshold

Palmvein		Palmprint		Decision level Fusion		Feature level Fusion	
FRR	FAR	FRR	FAR	FRR	FAR	FRR	FAR
1%	1.89%	1%	0.56%	1%	0.7%	1%	0.2%

Table 1. Result of palmprint, Palmvein ,Decision & feature level fusion

VIII. Conclusions

Result shown are clearly indicates that performance parameters of individual biometric are improved using fusion techniques. Moreover FAR & FRR of feature level fusion are better than decision level fusion. Proposed feature extraction method i.e. ordinal code gives lower FAR& FRR.

IX. Future work:

It is proposed to design own data acquisition system & create own data base. The system will be make real time by using proposed algorithm.

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