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Biometric Security System Using Palm print

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ABSTRACT- Biometrics as a method for identification systems has been widely used for its robustness; one of its used is based on human palm. Palm has unique characteristics to be used in personal identification because of it features. In this paper the palm features are extracted using Discrete Cosine Transform energy features, Wavelet Transform energy features and Sobel Code to obtain feature vectors and the extracted features are matched individually using similarity measurement methods such as Euclidian distance and Hamming distance.

KEY WORDS-Palmprint Identification, Discrete Cosine Transform, Wavelet Transform, Sobel Code,
Similarity Measurement**.**

I.INTRODUCTION

The Biometrics is a science of technology used for the purpose of authentication using their characteristics. Two types of characteristics are measured in biometric technology namely, physiological characteristics and behavioral characteristics. Physiological characteristics measure human body parts while behavioral characteristics measure the actions produced by human such as sound, signature, or posture. Behavioral characteristics are more vulnerable to change than the physiological characteristics strategies have to be experimentally developed as the degree of correlation among these features varies, since; these multiple features are extracted from the same palmprint image. Several types of physiological characteristics used in biometric are appearance of face, hand geometry, fingerprint, iris and palmprint. Palmprint biometric has advantages over other types of biometric system. The palmprint acquisition device costs lesser than the iris-scanning device. Palmprint geometry features include palm area, palm length and palm width. Since these geometry features are not distinctive enough to differentiate individuals, they are usually used in hierarchical palmprint biometric or combined with finger geometry features to form hand geometry biometric system [3]

Palmprint texture features are the representation of palmprint image in different transform space so that the targeted feature is emphasized in its transform space. Some of the extracted texture features are using Fourier transform [7], Discrete Cosine Transform [8] and Wavelet Transform [5].

II.IMAGE ACQUISITION AND PREPROCESSING

The image is acquired from the scanner. The fingers are required to spread apart and the hand is lean against the background. Two different types of background namely, black and dark blue color backgrounds are used in this work. Selection of different background color is to test the robustness of the algorithm to differentiate the hand image from the background when the background changes. No pegs are used to align the hand and no lighting arrangements are made in this setup compared to the earlier works in [7].

The hand image is represented using Red-Green-Blue (RGB) format. Since the skin of the hand contains reddish color, the red channel is selected for image segmentation. The red channel of the hand images is separated from its background using Otsu's method [6]. Otsu's method calculates the suitable global thresholding value for ever y hand image according to the variances between two classes. One of the classes is the background while the other one is the hand image.

Fig.2.1 Original palm image

1. *ROI*

A variable size of mask is created to crop the Region-of-Interest (ROI). By referring to the distance between the two key points, the location of the palmprint area is estimated. Distance between two key points, A is calculated using following equation:

$$A = \sqrt{(KP1_x - KP2_x)^2 + (KP1_y - KP2_y)^2} \quad (1)$$

where (x, y) is the coordinate for the key points KP1 or KP2 in the image.

A consists of two finger roots and some gaps between fingers. The width of the fingers is approximately 0.5 times of A. To avoid the ROI mask inserted the background between thumb and index finger, only half of the finger width is considered. Thus, the max extension at the end of the line connecting KP1 and KP2, Line

KP is 0.25 times of A. In this work, B is defines as 0.2 to ensure that the entire ROI mask will be situated within the palmprint area. The length for each side of the square is calculated using

ROI_Length=(1+B+B)*A (2)

Since the palm lines are located below the finger roots. The ROI mask is lowered P pixels parallel with the Line KP where P is 0.2 times of A.

2. *FEATURE EXTRACTION*

Palmprint image contains various types of features. Since texture features and line features required low-resolution image and can distinguish people effectively, these features are investigated in this study. The extracted features are represented in feature vector for easy comparison in later stage.

Three types of feature extraction and representation, Discrete Cosine Transform (DCT) energy feature, Wavelet Transform (WT) energy feature and Sobel Code are investigated in this work. DCT energy feature analyze the texture information of the palmprint image in 4 x 4 blocks where each block is 16 x 16 pixels. WT energy feature analyze the palmprint in multi-resolution level, where every different resolution level aims at specific types of palm lines. For each of the detail coefficient, 4 x 4 blocks are applied and its energy feature is calculated. Thus energy features in six-decomposition level are used to represent every single block. Since the line features on the palmprint image are unique, Sobel Code that extract line features in specific direction is also tested in this study. Sobel Code represented the palmprint image pixels by pixels using a resized version of the palmprint image.

III DCT

Discrete Cosine Transform (DCT) is a Fourier-related transforms that is equivalent to roughly twice the length of Discrete Fourier Transform but operating on real data with even symmetry. After the palmprint image is extracted, the palmprint image is enhanced to improve its contrast. The palmprint image is in RGB color format. In [5], for each of the color channel of the palmprint image, the histogram of the image is adjusted to the full 256 bins. Then, the palmprint image is converted to grayscale intensity image. The enhanced image is resized to 256 x 256 pixels to normalize the size of all the palmprint images. For every 16 x 16 pixels block of normalized palmprint images, DCT is applied. The DCT coefficient obtained in every block is separated into four sub-regions. DCT coefficients in each sub-region is squared and summed to obtain the DCT energy. The DCT energy feature is arranged to form feature vector. It is observable that the DCT energy features for different individuals are different in both magnitude and location.

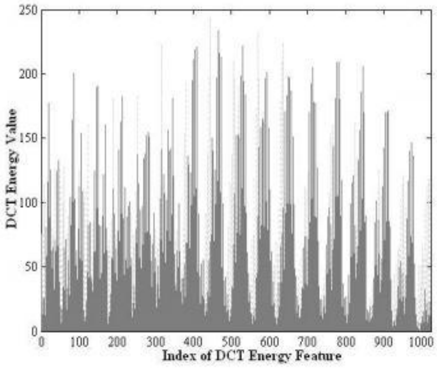

Fig.4.1 DCT Energy features of different individuals

IV.WAVELET TRANSFORM

In Discrete Cosine Transform, the palmprint image is analyzed in single resolution. Since the palm lines, such as principal lines, wrinkles and ridges can only be acquire in different resolution, multi resolution analysis using Wavelet Transform is proposed. Multi resolution wavelet transform can extract different types of line in different resolution level. Level one decomposition allows the extraction of ridges information. When the decomposition level increases, larger palm lines such as wrinkles and principal lines are extracted.

The palmprint image is in RGB format. In [8], the palmprint image is converted to grayscale intensity image before its histogram is adjusted to full 256 bins. The enhanced image is decomposed into six level of Haar Wavelet decomposition.

Let D represents horizontal (H), vertical (V) or diagonal (D) details coefficients. For every cD, the wavelet coefficient image is separated into 4 x 4 blocks. For every coefficient blocks, the wavelet coefficients are squared and summed to obtain its energy value. The wavelet energies in different decomposition levels are combined and normalized before arranging it to form the feature vector. Fig. 4.1 shows the feature representation method discussed earlier.

V. EDGE DETECTION SOBEL:

Besides analyzing palmprint image in different texture features, palmprint image can also be compared using line features as in SobelCode. In [7], four different Sobel operators, 0, 45, 90 or 135 degrees Sobel operator is used to extract the line details of the palmprint image in the selected direction. Each of the RGB channel in palmprint images are adjusted to the full 256 bins before converted to grayscale intensity image. Then, the enhanced images are resized to 60 x 60 pixels. Sobel operator of 0, 45, 90 and 135 degrees are applied to the resized palmprint images. Fig. 3.2 shows the Sobel operators.

The Sobel results are threshold according to the value sign is the resized enhanced palmprint images for the same individual while (c) is the resized enhanced images for another user. Fig. 3.2 shows the Sobel Code for the resized enhanced image.

Figure 3.2 Feature extraction by sobel edge detection method on palmprint image

3. MATCHING

In similarity measurement, the likeliness between two feature vectors is calculated. Some of the similarity measurements are Euclidean distance and Hamming distance. In this paper, DCT energy features and wavelet energy features are matched using Euclidean Distance while the Sobel Code is matched using Hamming Distance. This is because the Sobel Code is consists of only ones and zeroes (logical data).

Euclidean distance calculates the summation of squared differences between two feature vectors while Hamming Distance calculates the total differences between two feature vectors in terms of pixels. Hamming Distance tends towards one if both of the feature vectors are approximately the same while tends towards zero if both of the feature vectors are different. This is just inverse of Euclidean Distance where zeros represent both of the feature vectors are the same (no different) while the greater th e Euclidean distance value, the more dissimilarity between both of the feature vectors. The general equation for Euclidean distance is

$$E\_Dist = \sqrt{\sum_{l=1}^{k} (FV_{i,l} - FV_{j,l})^2} \tag{3}$$

where Fvil = Feature vector i with length k.

There are ten sets of hand image in this work. Each set of the hand image contains one hand image from 101 different individuals. From the Euclidean distance calculation for five sets of the hand images, a threshold point is calculated. This threshold point is used in the

Euclidean distance for the remaining of five sets hand image to separate the genuine user with the imposter.

The feature matching for SobelCode using Hamming distance is as follows. Firstly, the central 56 x 56 pixels of SobelCode x are cropped out. The cropped SobelCode x is compared with the SobelCode x stored in the database using sliding window method. Fig. 19 shows the sliding window method used to find the Hamming distance.

The Hamming distance is defined as

$$HDy = \sum_{h=0}^{4}\sum_{i=1}^{56}\sum_{j=1}^{56}(FV_1(i,j) \oplus FV_2(i,j)) \quad (4)$$

where h = {0, 45, 90, 135 degrees}, i and j is the row and column of the feature vector, y = number of hamming distance and $\oplus$ = exclusive OR operation. A total of 25 hamming distance can be obtained using the sliding window method between two different SobelCode.

The minimum of the 25 hamming distance is:

$$HD = \min(HD_y) \quad (5)$$

where y = hamming distance from 1 to 25. The minimum hamming distance is then normalized to range 0 and 1 using the following formula:

$$HD = 1 - \frac{HD}{56 \times 56 \times 4} \quad (6)$$

where 56 x 56 is the size of the cropped Sobel Code x and 4 is Sobel Code in different directions.

VI.RESULT AND ANALYSIS

The results of the Table 2 are obtained from the same database with 1000 hand images (10 right hand images for 100 different individuals). From Table 2, it is shown that the Sobel Code can achieve higher accuracy than DCT energy feature and WT energy feature. The enhanced palmprint images (E1 to E4) can achieve higher accuracy compared to the original grayscale palmprint images. The histogram equalized methods work better in Wavelet Energy and Sobel Code methods. Histogram equalized palmprint image(A) can achieve higher accuracy than the histogram equalized individually adjusted palmprint image.

TABLE 6.1 PALMPRINT RECOGNITION RESULTS

Features	SM	A	B
DCT	ED	94.40%	94.38%
WT	ED	93.90%	93.48%
SOBEL CODE	HD	97.30%	97.32%

VII. CONCLUSION

The right hand image of 101 different individuals is acquired using a digital camera. The hand image is taken without pegging or lighting illumination. Then, the hand image is segmented and its palmprint area is extracted using a square ROI mask. From Figures It is shown that the extracted palmprint image is unique in different individuals. The palmprint images are enhanced and resized to a predefine size. DCT energy feature, WT energy feature and SobelCode information is extracted from the resized enhanced palmprint image. The feature vectors are compared using similarity measurement and neural network. From the study, DCT energy features can obtain the highest accuracy compared to wavelet energy and Sobel Code. An accuracy of 96.41 percent can be obtained using the DCT energy features method using neural network. For similarity measurement, SobelCode can achieve an accuracy of 94.84 percent compared toDCT energy feature (94.62 percent) and WT energy feature (91.52 percent). All of the feature extraction method can achieve more than 91 percent of accuracy.

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