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Person Identification Using Palm Image Fusion Using Hybrid Wavelet Transform with PCA and EHD

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Abstract: Many biometric based personal identification systems have been developed, and palm print identification is one of the emerging technologies. Recently, biometric technologies are used to solve security problems in the information area. Authentications of a person by the physiological or behavioural characteristics have attracted researcher's attention. Proposed method uses Hybrid Wavelet Transform of DCT and Walsh from which best results are obtained. EHD (Edge Histogram Descriptor) and PCA (Principal Component Analysis) are using for filtering and pattern identification respectively. The hybrid wavelet gives far better performance as compared to the individual component transforms in various applications. Further, proposed method also uses PCA algorithm which is applied to reduce dimensionality of data matrix and enhance pattern identification.

Keywords: Image Fusion, Hybrid Wavelet Transform, PCA, Palm biometric

I. INTRODUCTION

Biometric image fusion at sensor level or low level refers to a process that fuses multi-spectral biometric images, captured by identical or different biometric sensors. This fusion produces an image in spatially enhanced form which contains intrinsic, richer and complementary information. Biometric verification systems seek considerable amount of improvement with respect to their accuracy and reliability.

Palm is one of the reliable and more convenient biometric. Image fusion of palm print increases its quality, recognition and resolution. Multi-spectral imaging is used effectively in the fields of computer vision and human verification to analyses information captured from several bands of the electromagnetic spectrum. Recently researchers focus is on getting more information for fused images and also try to reduce cost of the system with more accurate results. Hybrid wavelet transform for feature extraction and for multi-spectral palm image fusion is the current algorithm, generating more useful information which is passed on to image fusion algorithm. PCA augments the process of identifying patterns in data, and helps in presenting the data in such a way so as to highlight the similarities and dissimilarities in the features [17][18].

Palm print authentication system can be online or offline. Online systems captures palm print images using a sensor, which is directly connected to a computer for real time processing and online systems use previously captured inked images from a scanner. The processing of palm print involves enrollment and identification. The enrollment process consists of scanning image samples and then extracting and storing the required feature in a data base as a digital or binary image pattern template. Each image is identified by an identification number. The identification process consists of extracting the features from the test sample. Matching is arrived by means of finding the error distance between the newly extracted feature and the stored template [15]. In some image fusion technique, hybrid features are used [3].

Edge in the image is considered an important feature to represent the content of the image. Histogram is the most commonly used characteristic to represent the global feature composition of an image. It is invariant to translation and rotation of the images and normalizing the histogram leads to scale invariance. Exploiting the above properties, the histogram is considered to be very useful for indexing and retrieving images [19] [20].

II RELATED WORK

Image fusion has been used in various application areas. Numerous fusion applications have appeared in medical imaging like simultaneous evaluation of CT, MRI, and PET images. Fusion of images is a process of identifying useful information content and combining them efficiently to make the final image more meaningful for a particular application. In applications relating to remote sensing and astronomy, multi-sensor fusion

is used to achieve high spatial and spectral resolutions, by combining images from two sensors, one of this has high spatial resolution and the other one high spectral resolution. Plenty of applications which use multi-sensor fusion of visible and infrared images have appeared in security, military and surveillance areas [1][2].

The multi-band wavelet can be considered as a more generic case of the two band wavelet transformation, and can also be considered as a branch of wavelet analysis. The multiband wavelet has been a topic of interest in wavelet research fields in recent years [7]. Both theoretical research and application studies of multi-band wavelet have been carried out. Complex wavelet transform for palm print verification, where Zhang et. al. extracted the complex wavelet structural similarity index for matching[4].

Image fusion sometimes refers to pixel level fusion, while a broad sense definition also includes feature level and matching score level fusion, but in many work, focus on pixel level fusion because it features minimum information loss. In the field of pixel level fusion, Multi Scale Decomposition (MSD), such as pyramid decomposition and wavelet decomposition, is often applied because it typically provides better spatial and spectral localization of image information and such décor relation between pyramid sub-bands allows for a more reliable feature selection[1][8][9].
Palm-print recognition is a challenging problem, mainly due to low quality of the patterns; large nonlinear distortion and computational complexity. Large images get more discriminative features which finally improve accuracy of recognition by combining information from more than one spectrum. It also helps to improve accuracy and reduce error rate. Each spectrum provides different information. A palm print is a unique and reliable biometric feature with high usability. Multi-spectral imaging has attracted considerable research attention as it can acquire more discriminative in formation in a short time. One difficult step in developing online multi-spectral palm print systems is determination of the optimal number of spectral bands and select the most representative bands to build the system [13][15].
Multi-spectral palm-prints have been identified using energy compaction of the hybrid wavelet transform coefficients [12]. The scores generated for each set of palm-print images under red, green and blue illuminations are combined using score level fusion using AND and OR operators [14].

III IMPLEMENTATION DETAILS

The proposed method have been implemented image fusion technique using Hybrid Wavelet Transform of DCT and Walsh and apply PCA algorithm to increase rate of correct identification. EHD reduces complexity and improves performance by classifying testing result. PCA is used for pattern recognition and identification. It expresses the data patterns as its distinct feature between their similarities and their differences, since the problem of pattern recognition can become increasingly difficult. In particular when the data (images) are of very great dimensions, PCA is very powerful tool to analyse the data as it operates by reducing their dimensions [18] [17].
The system architecture of proposed method is described in Figure 1 in which features are extracted using Hybrid wavelet transform and features which required to identification are selected using PCA algorithm. For matching the Euclidian Distance classifier is used.

A. System Overview

This system have following modules:
(1) Enrolment Phase: Converts image to 128*128 size, then performs feature extraction and saves feature vector for comparison in identification phase.
(2) Feature Extraction: Creates DCT and Walsh Transform. The properties of both DCT and Walsh transforms are incorporated in the new transform, which gives better results as compared to both the transforms used in isolation.

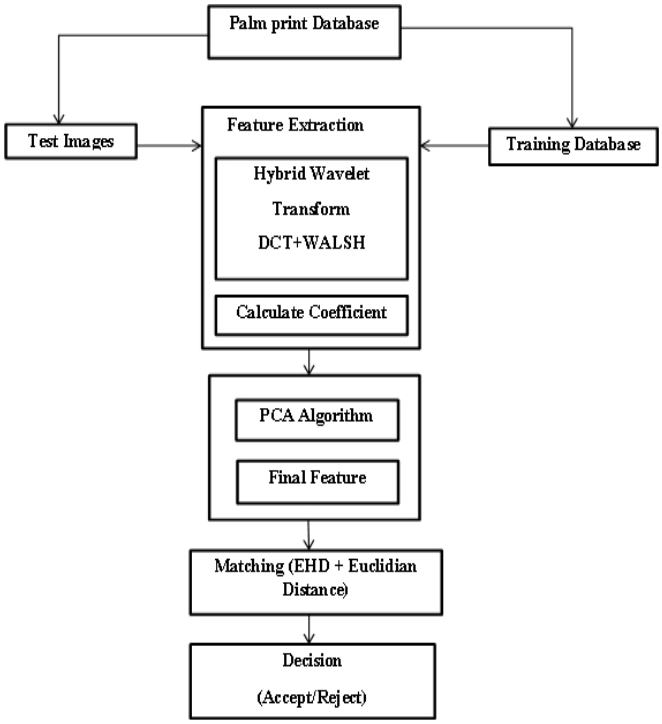

Fig 1: System Architecture

Hybrid wavelet transform Matrix: The hybrid wavelet transform matrix generate by using Kronecker product of DCT (8*8) and Walsh (16*16) [14]. Finally 128*128 Hybrid Wavelet Transform matrix generated.
(3) Feature selection using PCA: In proposed method PCA is used for feature selection which are helps to matching palm prints. Calculate the Covariance matrix. Then calculate the eigen vectors and eigen values for covariance matrix. Finally, we obtained feature vector matrix. This has to be saved in file for comparison purpose.
(4) Calculate EHD (Edge Histogram Descriptor): To compute edge histogram, a given image is first sub-divided into 44 sub-images and edge histograms for each of these subimages are computed. For the purpose of plam recognition, we tested our system not only dividing into 4-4 sub-images but also several number of sub-images. In MPEG-7 standard, edges are grouped into five categories: horizontal, vertical, 45 diagonal, 135 diagonal and non-directional edge. Thus, for each sub-images, calculate local histogram of five bins corresponding to the above five categories. If the is below the threshold value (35.00) then the images are matching else the images are not matching.
(5) Calculate Euclidian Distance for Matching: The process of measuring the distance between two points using Euclidian distance. The distance between the two features is found in vector space. If the distance is zero then the two features are from the same person. If not then the features are from a different person. Practically the distance is never zero, so select image which having minimum distance.
(6) Accept/Reject: The image which has minimum Euclidean distance is match with test image and will be accepted; if all values greater than threshold value then match not found.

B. Algorithm

Input: Palm print Dataset

Test palm image: Trained Dataset: Hybrid wavelet transform extracted Feature Matrix (128*128) and data is saved in text files

Output: Display matching image Tk or display message "Image not Found".

Steps

Step 1: Select image for testing of size (128*128).

Step 2: Create A[p][p]= DCT matrix (8*8), p=8 using following equation

$$DCT(i,j)=\frac{1}{\sqrt{2N}}C(i)C(j)\sum_{x=0}^{N-1}\sum_{y=0}^{N-1}pixel(x,y)COS\left[\frac{(2x+1)i\pi}{2N}\right]COS\left[\frac{(2y+1)j\pi}{2N}\right] \quad (1)$$

$$C(x)=\frac{1}{\sqrt{2}} \text{ if x is 0 else 1 if x>0} \quad (2)$$

Step 3: Create B[q][q]= Walsh matrix(16*16), q=16

Step 4: Generate Hw hybrid Wavelet transform matrix by,

$$H_w=\begin{pmatrix} A_p \otimes B_{q(0:i+1)} \\ I_{r0} \otimes (A_{p/r0} \otimes B_{q(i2+1:i3)}) \\ I_{r1} \otimes (A_{p/r1} \otimes B_{q(i2+1:i3)}) \\ . \\ . \\ . \\ I_{rn-1} \otimes (A_{p/rn-1} \otimes B_{q(in-2+1:in-1)}) \\ I_p \otimes (B_{q(in-1:q)}) \end{pmatrix} \quad (3)$$

Step 5: Apply PCA algorithm to Hw

- Covariance matrix is given as
  CM(p*q) = (A^T.AD)/(n-1)
  Where,
  AD=Adjusted data set
  A^T =Transposed data set
  n = No of observations
  =q= No of dimensions

Calculate the eigenvectors and eigen values for covariance matrix.

Denote eigen vectors as α and eigen values as λ

The CM-λI=0 will give the eigen values

The CM-λI .α=0 will give the eigen vectors

FV is Feature vector, which is constructed by taking the eigen vectors that we want to keep from the list of eigen vectors, and forming a matrix with these eigenvectors in the columns

FV = (eig_1 ,eig_2, ….. eig_n)

This is the final step in PCA we simply take the transpose of the vector and pre-multiply it with the Adjusted data set

$$FD = F^T \times A^T \quad (4)$$

Where, FD = Transformed data set

F^T = transpose of the F matrix containing the eigenvectors

AD is the transpose of adjusted data set

Step 5: Calculate EHD and compare with threshold value (35).

Accept Images having less value than threshold.

Accept Images = (Ta, Tb, Tc)

Step 6: If all values greater than threshold value **then**

Match not found.

If some values less than threshold value **then**

Match by Euclidian Distance

$$d(p,q)=\sqrt{(p_1-q_1)^2+(p_2-q_2)^2} \quad (4)$$

Display match image.

IV EXPERIMENTAL SETUP

For the experimentation work JAVA (NetBeans IDE 8.0) is used with Processor Pentium IV, RAM 1 GB & operating system Windows 7. MySQL server is used for storing path of trained images.

V RESULTS

A. Dataset

Proposed method is performed on the POLYU dataset, which consists of multi-spectral palm print images under R, G and B illuminations. Different features of palm print are captured at different wavelengths of light. This dataset comprises of three sets. First set consist of 5520 images (12 samples of 230 persons), ROI extracted palm print images of size 152 X 152, each under red, green and blue illuminations. Each of these sets is divided into 2 sets: 2760 (12 samples of 230 persons). 600 palm images of 100 persons which consist of 300 images of right hand and 300 images of Left hands are been trained.

B. Results

The results of the proposed method have been quantitatively evaluated using ER (Error Rate) and GAR (Genuine Acceptance Ratio). In previous system, if GAR increases FAR values also get increases. By applying PCA we reduce Error Rate and increase in rate of GAR. EHD removes non matching palm images and found nearly match images, which reduce number of comparison of test image with other trained images. Hence PCA and EHD helps to reject non matching images means reduce FRR (False Rejection Rate). Figure 2 shows result of proposed method.

Table 1: Result

Algorithm	GAR (%)	FAR (%)
HWT without PCA	92.71	10
HWT with PCA	95	7.5

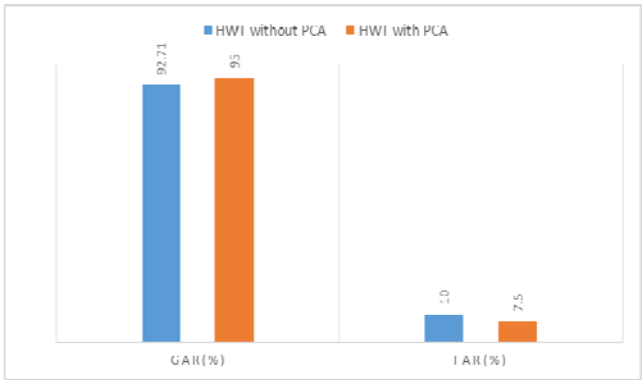

Fig 2: Comparison with existing algorithm

VI CONCLUSION

In this paper the transform domain technique is applied for palm- print identification. In proposed method, a hybrid wavelet is generated from Kronecker product technique, which is applied on orthogonal transforms, DCT and Walsh. Hybrid wavelet gives far better performance than DCT and Walsh wavelets used individually. It extracts the properties of both DCT and Walsh transforms. Proposed method gives better performance and increase the GAR without increase in Error Rate. PCA algorithm helps to identify pattern and reduce error rate of the system. EHD improve the accuracy and helps to reduce number of comparison. This system can be extended by using filters at testing and matching phase.

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