Palmprint Recognition System Using Independent Component Analysis and Gabor Texture Descriptors

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Abstract- **PalmPrint is one of the forms of Biometric verification system. PalmPrints are considered as invariant over timer after a person becomes adult. Therefore it provides good biometric authentication system. PalmPrint scanners are quite costly. Therefore most of the past works have utilized standard PolyU database for developing and testing palm print recognition methods. In this work we propose a novel real time method to capture user's palm print from normal webcamera by segmentation technique. Such frames are low resolution images. Hence it is difficult to achieve high accuracy for such a system. The contribution of this work is to propose and successfully demonstrate the accuracy of the system with correspondence to current state of art by real time palm print capture from camera. We first segment the hand from the frames followed by ROI extraction of the PalmPrint. The ROI is filtered with Gabor Kernel and then ICA features are extracted. ICA features are classified using combination of neural network and distance based classifier. We also compare the system with state of art with PolyU database and show that our system is not only applicable for low resolution images but also for high resolution palm print images.**

Index Terms—— Gabor, ICA, KNN, Neural Network, PalmPrint.

I. INTRODUCTION

Many palm print verification systems scanners scan complete palm where as some scanner implements a palm segmentation in the hardware level. If the scanner does not come with segmentation technique than the segmentation needs to be implemented at the software level. This segmented area is also called PalmPrint ROI.

Most of the palm print recognition system identifies palm prints based on the location of the ridges in a low dimensional verification system. At a higher dimension statistical features can be acquired from the palm print or features like curvelet can also be used. These features acts like high dimensional descriptors for ridges.

Manuscript received June, 2015.
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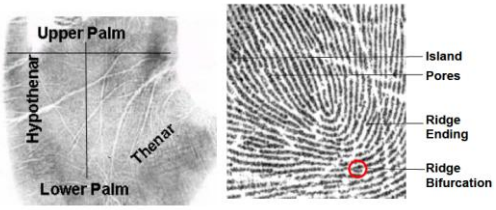
Palm print recognition can be viewed as having three types: matching based on minutiae, matching based on correlation with database palm print segments , and ridgelet based matching. In Minutiae technique, which is very popular, some critical points are marked on the palm image and their location, direction and other features are used. Correlation technique subtract a test segmented palm image with all other segmented images in the database for correlation. This suffers from direction, lighting variations. Ridgelet technique uses ridge patterns in palm like micropores, spatial features, and also geometric feature of prominent edges called ridges. This is considered to have better speed over the others and it overcomes limitations in minutiae extraction from poor quality images. Minutiae-matching produces better recognition rate.

Hence it is quite clear that all the low dimensional features depends upon image quality. Ours being real time system where the palm print images are guaranteed to be of low quality, we use high dimensional features. , a fingerprint or palm print appears as a series of dark lines and represents the high, peaking portion of the friction ridged skin while the valley between these ridges appears as a white space and is the low, shallow portion of the friction ridged skin. This is shown in Figure a.

(a)



(b)

Fig1(a) Finger print Ridges (Dark Lines) vs. Fingerprint Valleys (White Lines). (b)PalmPrint Minutieas and Characteristics.

II. EXISTING SYSTEM

K.Y.Rajput, Melissa Amanna, Mank Hushjagawat [2] proposed that, the palmprint is one of the most reliable physiological characteristics that can be used to distinguish between individuals. The primary objective is to present a palmprint recognition system using minimum resources. The system is implemented by means of the transforms used in image processing.

Xingpeng Xu and Zhenhua Guo, K P Shashikala and K.B.Raja proposed quaternion model is employed for multispectral biometrics system. Multispectral images are sampled by using DWT and PCA is used for features extraction. Features are matched by using Euclidean Distance proposed a hyper spectral palmprint image system which is used for correct feature band selection.

Bob Zhang, Member, Wei Li, Pei Qing and David Zhang proposed three global features for 3-D palmprint images: Maximum Depth (MD) at the center of the palm, Horizontal Cross-section Area (HCA) at different levels of the palm; and Radial Line Length (RLL) these cannot be extracted from 2-D palm prints and are not correlated with local features, such as line and texture features.

Mir A.H, Rubab S and Jhat, Z. A., Biometrics Verification Biometric verification refers to an automatic verification of a person based on some specific biometric features derived from his/her physiological and/or behavioral characteristics. A biometric verification system has more capability to reliably distinguish between an authorized person and an imposter than the traditional systems that use a card or a password. In biometrics, a person could be recognized based on who he/she is rather than what he/she has (ID card) or what he/she knows (password). Currently, biometrics finds use in ATMs, computers, security installations, mobile phones, credit cards, health and social services.

III.PROPOSED SYSTEM

We divide the work distinctively into three processes: Palm Image extraction, ROI segmentation and PalmPrint recognition.

3.1 PalmPrint Extraction

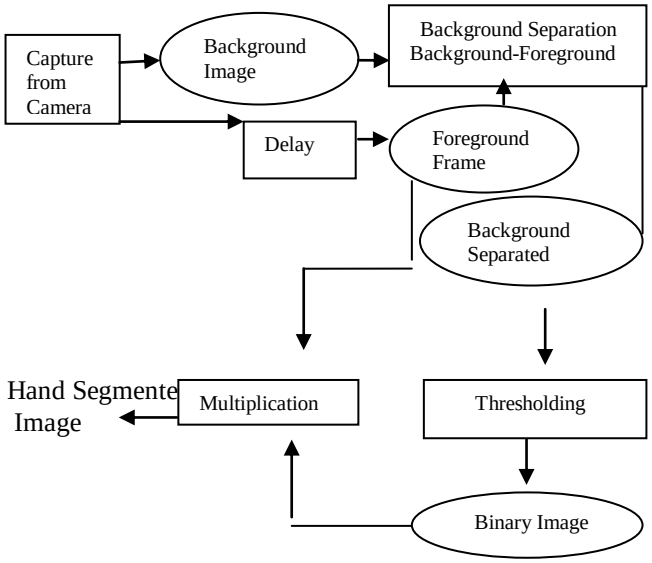


Fig2: Segmentation of Hand Part

In proposed methodology, First background frame is extracted. This acts like an background estimation. Then user presents his hand before the camera. Both these frames are subtracted to obtain background separated frame. This frame is binarized with threshold =50. Binary image is subjected to morphological hole filling for closing the entire contour. This image is then multiplied with actual image to obtain segmented hand image.

3.2 ROI Extraction

First the segmented hand image is blurred using low pass filter (Gaussian blur). This makes the image more homogenous. This image is binarized with adaptive thresholding and boundary of the image is detected. From boundary, center points are extracted. Now the image is rotated in the the step angle of 10’ and in column wise histogram is calculated. The angle at which the sum is maximum is considered to be ideal hand position. A rectangular area is extracted of the width and heigh equal to maximum width of the bounding box at region selection. The process is explained with figure 3.

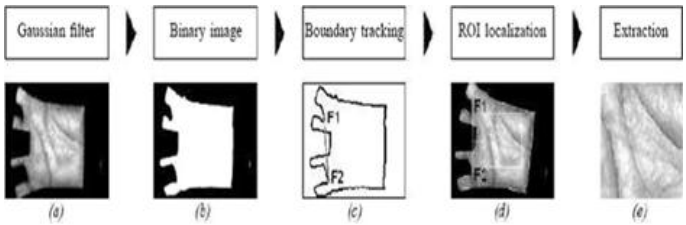


Figure 3. Palm print segmentation.

A Gaussian filter is a filter whose impulse response is a Gaussian function (or an approximation to it). Gaussian filters have the properties of having no overshoot to a step function input while minimizing the rise and fall time

A Binary image is a digital image that has only two possible values for each pixel. Typically the two colors used for a binary image are black and white though any two colors can be used.

Boundary tracing of a binary digital region is an important first step in the analysis of that region.

The method depends on calculating the summation of the difference between images of a specific slice that we work on it, then applying thresholding on the resulting image to get the Region of Interest.

When the input data to an algorithm is too large to be processed and it is suspected to be very redundant, then the input data will be transformed into a reduced representation set of features (also named features vector). Transforming the input data into the set of features is called feature Extraction.

3.3 Feature Extraction

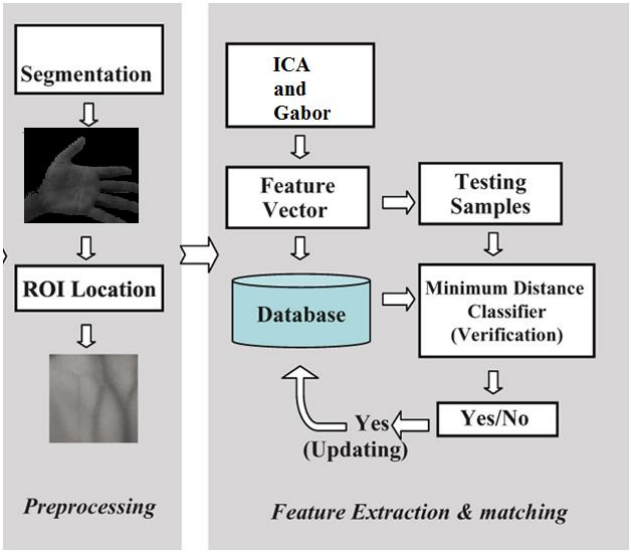


Figure 4: Segmentation Process

Preprocessing:

Preprocessing is used to correct distortions, align different palmprints, and to crop the region of interest for feature extraction. There are five steps
1.Binarizing the palm image
2. Boundary tracking
3.Key points detection
4.establishing a coordination system and
5.Extracting the central part.

Feature Extraction and Matching:

For matching the palmprints, we need to extract some features first. The extracted features are then used for matching. Some of the feature extraction and matching algorithms are line based, subspace based, statistical and coding based approaches.

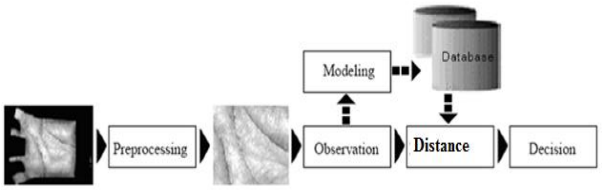


Figure 5: PalmPrint Matching Technique

Independent Component Analysis performs decomposition a multivariate vector into independent non-gaussian vectors. This is achieved by multiplying the vector with a random vectors and repeating the process till the independence is achived.

The components x_i of the training vector $x = (x_1, \ldots, x_m)^T$ are produced as a average of the independent components $s_k, k = 1, \ldots, n$:

$$x_i = a_{i,1}s_1 + \cdots + a_{i,k}s_k + \cdots + a_{i,n}s_n$$

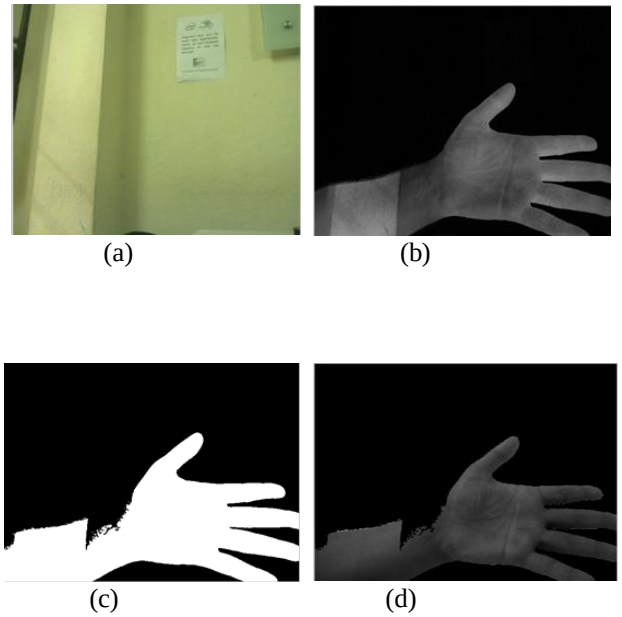
Here vector X is the matrix which combines average gabor filtered images of the segmented palm images of the same class. ICA helps reducing the dimension of the datavector by eliminating those variables which do not contribute to the identification of the palm prints or in simple words the features that can not distinguish between two different person's palm print are eliminated.

The Gabor filter is the process of decomposing an image with small filters having kernel with Gaussian properties.

$$\begin{aligned} G(x, y; f, \theta) &= exp\left\{\frac{-1}{2}\left[\frac{x'^2}{\delta_x^2} + \frac{y'^2}{\delta_y^2}\right]\right\} cos(2\pi f x'), \\ x' &= xsin\theta + ycos\theta, \\ y' &= xcos\theta - ysin\theta, \end{aligned}$$

Image generated by multiple Gabor convolve produces an image with different spectral coefficients which are then passed to ICA in order to generate the final feature vectors.

IV. RESULTS



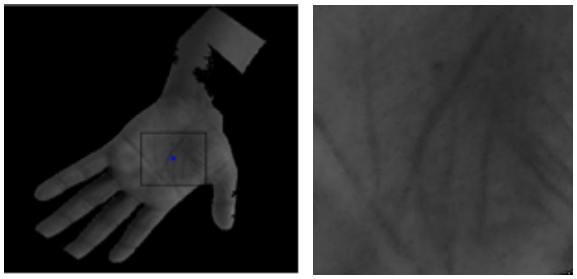
(a) (b)

(c) (d)

(e)

Figure 6: Hand Extraction

Initially, acquire the palmprint, when we run the menu a window will appear, wait for sometime until a blank screen appears as shown in (b) keep the hand when black screen appears, it is going to take approximation of the hand, whole background image is segmented. From background segmented image it generates a binary mask and it will extract a hand image as shown in fig c,d,e.



(a) **(b)**

Figure 7: ROI Extraction

From the extracted hand image, rotate the image in different angles,
inorder to bring all the angles into constant angles, then extract the region of interest. The extracted ROI or cropped image are stored in the crop folder called database.

Now Train and Test by Gabor and ICA method.

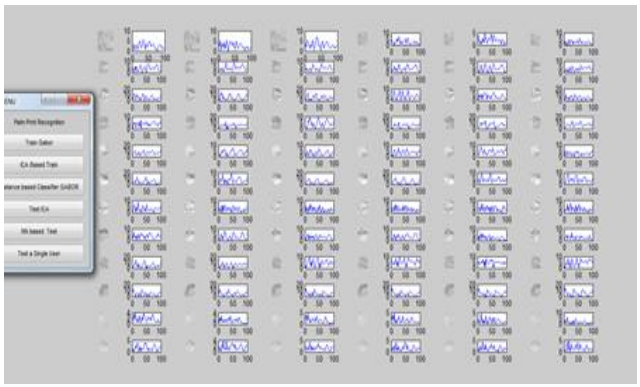


Figure 8: Training with Gabor

From Menu, initially train the entire database with gabor features, then test using distance based gabor classifier, it gives the accuracy by giving the number of users and the number of features.

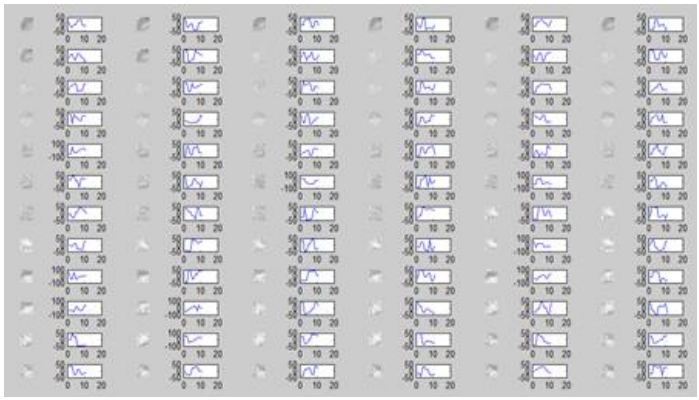


Figure 9: Training with ICA

Then train the database with Independent Component Analysis method and test the accuracy. The accuracy is obtained from the ICA method is high compared with Gabor and Neural Network Method.
Accuracy is obtained by entering the number of user and features.
For every image ICA feature is extracted, while testing, number of features in ICA is less .In Neural Network, accuracy is less when compared to both methods.

To authenticate a user, test a single user, by selecting a single user from the cropped images.

From the obtained accuracy from Gabor and ICA , enter the values in table.

In Real Time Palmprint Recognition system, few palmprint images are collected and tested by giving a single test user, in the same way, by training either of Gobor method or the ICA Method, while testing can choose an image from the database or cropped database or PolyU database, test for that will get an appropriate authentication of an user.

	Gabor +KNN	Gabor + ANN	ICA + KNN	ICA+ ANN	GABOR +ICA+ KNN	GABOR + ICA+ ANN
Accuracy	**82.1**	**87.3**	**89.2**	**91.5**	**92.7**	**94.3**

CONCLUSION

In this work we present a novel technique for real time palmprint recognition from camera. We have used a background segmentation that is independent of hand pose and the lighting condition. The hand segmentation is then used to extract palm ROI. We have tested the system with both PolyU database as well as by capturing palm images of twenty users. The aggregated result in result section shows that the system performance with proposed ICA based technique is much better than non dimension reduction technique. Also it is seen that neural network performs better than distance based classifier for palm print recognition.

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