FEATURE EXTRACTION USING HISTOGRAM OF RADON TRANSFORM FOR PALMPRINT MATCHING

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ABSTRACT

This paper presents principle line based palm print matching model as principle lines are easily extracted in even in low resolution images. This paper proposes use of histogram of Radon transform (HRT) to extract the features of palm. However the HRT is sensitive to the rotation and scaling due to normalization process. Therefore here logarithm is employed while discarding the normalization process and its histogram is utilized as feature vector. To compare the palm prints, the calculation of correlation coefficient of this logarithm histogram is proposed in the paper. The proposed model is applied to polyU database and results are analyzed in terms of receiver operating characteristic.

KEYWORDS: *Palmprint, Matching, Radon Transform, Histogram*

I. INTRODUCTION

Biometric plays major role to get one's identity. One of the example of biometric are fingerprint [1] as it is hardly possible to find the similar fingerprint for any two individual. One of the crucial properties required for identity is inimitability. Other equally important aspect is being present in all individuals for life time. They must be easy to extract. Similar biometric characteristics are iris, palm, retinal structure, face and hand writing. Out of these, palm based identification have been intensively developed because of its crucial advantage over other features.

Palm region can be identified even in low resolution images. In such cases, the distinguishable features rely on palm lines and textures patterns. High resolution image also contains ridges and wrinkles which can be utilized as classification and matching features. The main objective of this paper is to proposed identification system based on palm print feature matching.

Different palm print methods can be been classified according to the process they utilized. Preprocessing step involves the cropping of region of interest (ROI) form hand geometry. Second step involves the feature extraction method. Third step is feature reduction from extracted features and finally classification step is involved for individual's identity. Numbers of algorithms have been proposed using different combination of each of above defined stage like in [2], wavelet based line orientation information are extracted. Along with orientation, energy of sub bands also has been utilized to describe the palm. Zernike moments based feature extraction method was proposed by Pang et al. [3], where higher order moments were compared for identification. Feature extraction method associated with its spatial location exhibit better performance, i.e. principle line based approach. In most of the method, the ROI is cropped [4, 5] and corresponding feature extraction is

performed on ROI. If the coordinate systems are well aligned for different images then corresponding to palm area, comparison between the feature vectors is meaning full with regards to spatial information. Present approach in this paper utilized ROI area from aligned palm print images along same coordinate system. To extract the principle lines, wavelet and directional context modeling based algorithm was proposed in [6]. Similarly integration of kernel based edge detection and morphological model also have been proposed in [7]. Similarly, H B Kekre et.al [20] presented the efficiency of various wavelet transform for palm print recognition. Other wavelet based model can be find in [17, 18]. In both the model, the features size is large and it needs to be reduced. Radon transformation has been utilized in [8] to extract the principle lines. In [8], a filter based approach based on Radon transform is implemented to detect lines. Superposition is used to match palmprints. In [22], Wei Jei et.al proposed a novel orientation based scheme, in which three strategies, the modified finite Radon transform, enlarged training set and pixel to area matching, have been designed to further improve its performance. In [21], author proposed the local binary pattern (LBP) based model where LBP descriptor is applied to the energy or direction representation of palmprint extracted by MFRAT.

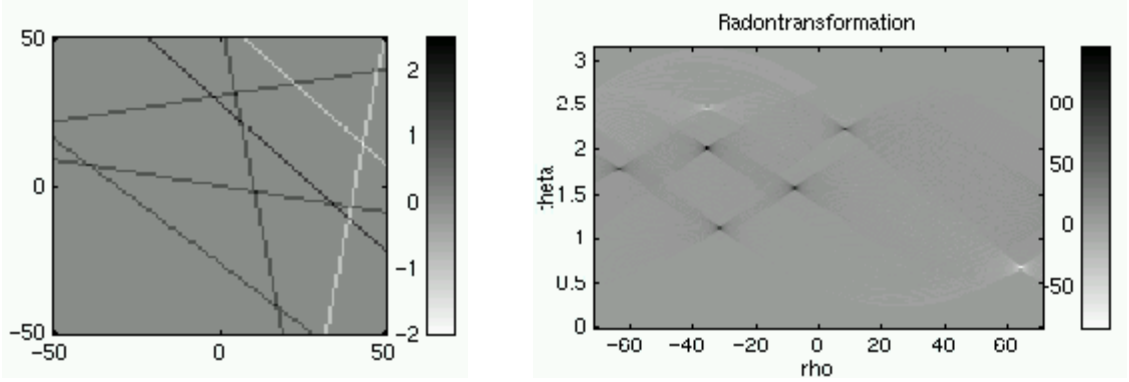
As principle lines are most robust and unique features and due to easiness in extraction from ROI, this paper also present line extraction based model for palmprint matching. In this paper, palm print database from polyU [16] is utilized which provides the extracted palm ROI from the hand. Thus paper is more devoted to the palm print matching than the extraction of ROI. In all literature the radon transform is combined with other model and then similarity model is employed in terms of Euclidean distance. While this paper presents a novel approach to characterize the palmprint using histogram of radon transforms only. The histogram of radon (HRT) is widely utilized to represent the shape of an object [10]. This is most robust toward the scaling and rotation of object. Therefore this paper proposed a model to extract the rotation and scaling invariant feature extraction method using HRT.

Rest of paper is organized as follows: Section-II discusses the proposed model implementation where first part is explain the histogram of Radon based feature extraction method and second part explain the matching process. Based on that in section-III corresponding results are explain and accuracy of model is presented in term of false acceptance and false rejection ration. Finally conclusion and feature work is proposed related to proposed model.

II. PROPOSED MODEL

2.1 Radon transform based lines' feature extraction:

In palm ROI, the principle lines can be considered as a straight line. To extract the straight lines radon [19] is widely utilized as it is able to transform two dimensional lines into possible line parameter. Thus each line in the 2-D domain generates maximum value at the corresponding line parameters in radon domain. Another strong capability of radon transform is able to extract the lines from vary noisy environment. Another useful property of radon is that each peak in radon domain reflects the value of individual lines. i.e. from the radon transform shown in figure 1(b), the crossing lines makes no problem in separation of peaks.



(a) (b)

Figure 1: Image having cross lines and corresponding radon transform.

Based on that so many algorithms [9-11] have been presented to extract the palm features using radon transform. Thus in [10], finite radon transform is applied to extract the lines features and wavelet transform is utilized to extract the corresponding point from radon domain. Similarly in [11] the author modified the radon transform with consideration of energy and direction to extract the palm lines. In [12], modified radon transform is utilized along with iterative closet point method for line based feature extraction. Thus in all radon based approach, the radon domain is integrated with other model to extract the features. In this paper, use of histogram of radon domain is proposed to extract the lines features.

2.2 Feature extraction using histogram of radon transform:

Presently histogram of radon transform (HRT) plays vital role in shape analysis as introduced by S. Tabbone [13]. The HRT represents the shape length at each orientation. It is also translation and rotation invariant. Thus HRT gives similar response to the palm having either rotation or translation. This is the most advantage in compared to finite radon or modified radon transforms presented [11, 12].

In [13], normalization of radon image and histogram is utilized to achieve scaling invariance. This is highly sensitive to the noise. Therefore in [14] logarithm conversion and phase correlation is utilized by avoiding the normalization process. This LHRT (logarithm HRT) is invariant to the noise. Therefore this paper utilized this property to extract the features of palm lines using LHRT.

Let I(x,y) be an binary image (after extraction of palm ROI). Its radon transform is defined as:

$$R(\theta,\sigma)=\iint I(x,y)\delta(x\cos\theta+y\sin\theta-\rho)dxdy \tag{1}$$

Where $\delta(\cdot)$ is Dirac delta function, $\theta\in[0\ \ 2\pi]$ and $\sigma=[-A/2, A/2]$, A is the size of image diagonal. Thus radon gives summation over the line defined at angle θ. The radon transforms are shown in figure 1. Then logarithm is applied on equation 1.

$$R_f(\theta,\sigma)=\ln R(\theta,\sigma) \tag{2}$$

Corresponding HRT is calculated as

$$LHRT(\theta,y)=H(R_f(\theta,\cdot))(y) \tag{3}$$

Where H is histogram of radon in direction θ. During the calculation of H normalization process is avoided to make it translation and rotation invariant.

The features of palm are obtained by calculating the phase correlation of the obtained LHRT. Where the Fourier transform of LHRT is calculated and corresponding correlation function is calculated for the identification process. The detail of matching process is explained in coming section.

2.3 Palm Matching:

To match the two images, phase correlation [14] is utilized. The correlation function is defined as:

$$C=\sum\sqrt{G(u,v)_1 * G(u,v)_2} \tag{4}$$

Where G (u,v) is inverse Fourier transform of LHRT, subscript 1 indicate query palm image features and 2 indicates palm features from the database . To match two palms, this correlation function is compared with specified threshold. If C is higher than the defined threshold then we can say that two palms are same.

III. EXPERIMENTAL RESULTS AND DISCUSSION

To evaluate the performance, Polyu [16] database is utilized, which provide palm images. For local hand images, it is required to extract the ROI (palm) and to correct the rotation, The proposed model have been implemented on Pentium – IV processor with 1GB RAM, 2.8 GHz PC under MATLAB

environment. There are so many algorithms have been suggested in various literature surveys [14, 15]. To get the features, following steps are performed:

Step:1 Calculate the radon coefficients.

Step:2 Obtain the logarithm of radon coefficients.

Step:3 Calculate histogram of radon coefficients.

Step: 4 for matching purpose calculate the correlation function using equation 4 and compare it with defined threshold.

As shown in figure 2, palms images of two persons are shown, where first row shows the palm images of single person having variation in intensities, containing noise and small rotation. Similarly second row is the palms images for another person.

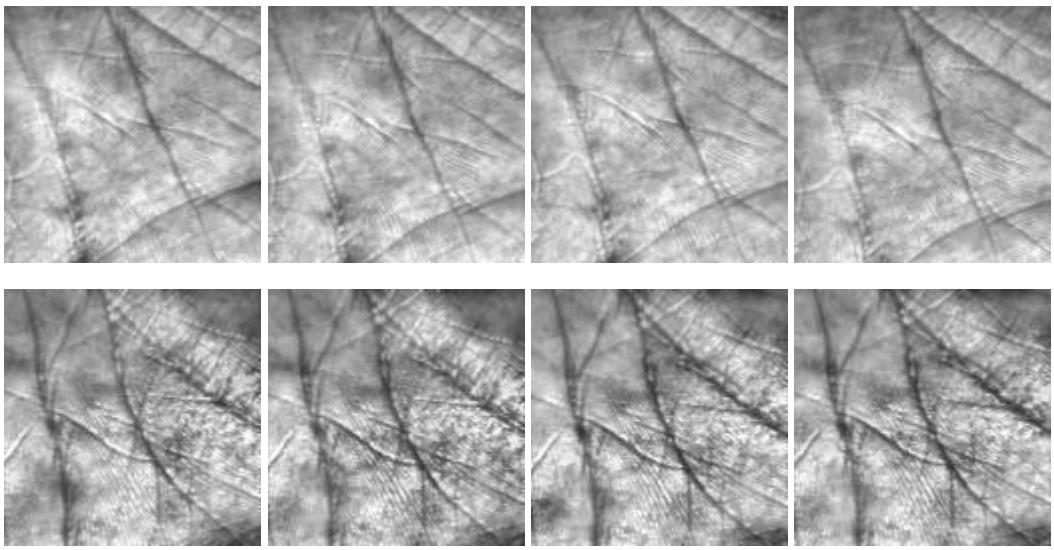


Figure 2 Palm images from utilized database

The proposed model is executed using MATLAB version 6.3 on P-IV, 1.2 GHz computer. As earlier said, radon transform is obtained on binary image of palm. Binary image of palm gives principle line. As discussed in section 1, in most of radon based model, the radon coefficients are combined with other features. While proposed model requires calculation of histogram only and obtained histogram is utilized as feature vector for comparison. The performance of model is tested on 30 X 4 palm images, where 4 images are of single person.
The following table shows the comparison of palm image with each other. In table 1, it can be seen that when palm image 1 is compared with its sub images, correlation coefficients values is nearer to 98, while the correlation coefficients for palm image 1 with other palm image is less than 97.

Table 1: Palm image correlation coefficients values

Plam Image	**1**	**2**	**3**	**4**
1	100	98.24	98.43	98.29
2	95.24	94.86	95.27	95.26
3	96.38	95.77	95.25	95.28
4	96.30	95.91	95.85	95.85

This performance is evaluated using receiver operating characteristic. This consists of false rejection rate and false acceptance rate. These FAR and FRR can be measured at different threshold. For every possible combination the model has been tested to calculate FAR and FRR as shown in figure 3.

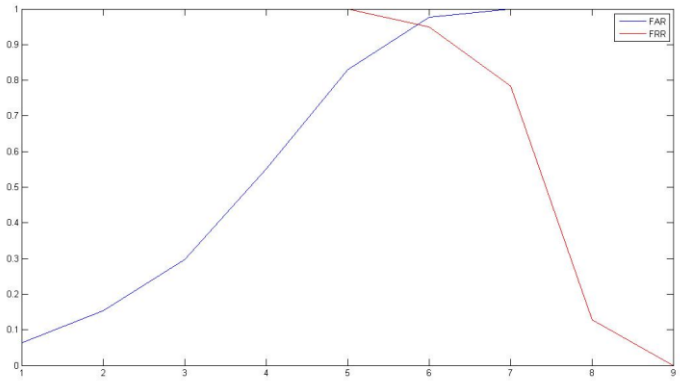


Figure 3 Performance evolution

IV. CONCLUSION AND FUTURE WORK

Novel approach for palmprint matching is proposed in this paper. The proposed model is based on principle line as this principle line can be easily extracted even in low resolution images. This principle lines can be considered as small lines therefore radon transform is utilized which have capability of extracting lines even in noisy and overlapping lines images. The histogram of radon is not much utilized as a feature vector generation and less attention is given in term of shape identification only. This paper proposed the use of HRT to extracts the features of palm lines. Again to make histogram scale and rotation invariant, normalization is avoided and logarithm is calculate before histogram calculation as suggested in [14]. The performance evolution in terms of receiver operating characteristic is obtained to shows the accuracy of proposed model. Again in compared to other radon based model, the proposed model is computational less as it requires calculation of radon coefficients and its histogram. The proposed model gives promising result but still it requires computation of accuracy by comparing the proposed model with other radon based model. Similarly in proposed model, extraction of radon coefficients is highly sensitive to the principle line identified in spatial domain. So the proposed model can be integrated with the model which is able to extract the principle line in more robust way.

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