

Palm Print Recognition System Using 2-D Gabor and SVM as Classifier

HEENA SHERAWAT

P.G Student

Department of Electronics & Communication Engineering,
 SKITM Engineering College,
 Bahadurgarh, Haryana, India

SUMIT DALAL

H.O.D.

Department of Electronics & Communication Engineering,
 SKITM Engineering College,
 Bahadurgarh, Haryana, India

Abstract— From security point of view, Palmprint recognition has become a powerful means in person identification due to rich information in palmprint. Palmprint recognition typically consists of five stages: palmprint acquisition, preprocessing, feature extraction, database and matching. In this project for texture analysis and feature extraction, 2-D Gabor filter is used on segmented images of the sample. For pattern matching, Support Vector Machine (SVM) classifier is being used. The performance of the system is evaluated. Out of the total test images the system has shown 98.15% recognition rate. Thus, the system efficiency of 98.15 percent is obtained. This paper discusses proposed work for palmprint recognition of an individual using segmented parts of palmprint image. The experiment was carried out using MATLAB software image processing toolbox.

Keywords- Gabor; Palm-print; SVM

I. INTRODUCTION

To create a biometric template, Biometric systems are usually using an enrollment process to capture a biometric image, extract the desired features and then encode. Then this template is being stored in a database against which comparisons can be made in the future. For verification purpose, when the biometric is used (e.g., access control), it confirms the validity of the identity claimed. When biometric is used for identification purpose, it compares biometric of a specific person with the stored biometric database to see if it matches or not. The database must be reasonably comprehensive and precisely accurate for biometric technology to be effective. Our palm's inner surface normally has three flexion creases, secondary creases and ridges. The flexion creases are also known by principal lines and the secondary creases by wrinkles. Experimentally, it has been found that identical twins have different palm prints. These are non-genetically deterministic and complex patterns that are considered to be very useful in personal authentication. Palm print identification is categorised into two classes- low resolution or high resolution images. For commercial and civil applications such as access control low resolution images are more suitable whereas for forensic applications such as criminal detection high resolution images are suitable. High resolution images have Points and minutia points as features while in low resolution images principal lines, texture and wrinkles are generally extracted. Initially palm print research was based on high-resolution images but now for civil and commercial applications almost all research is done on low resolution images. The design of a biometric system takes into account five objectives: computation speed, accuracy, cost, security and

user acceptance and environment constraints. Speed can be increased by reducing accuracy. Example: hierarchical approaches. Accuracy can be improved by reducing user acceptance. For instance, users have to provide more samples for training. Security can be enhanced by increasing cost. In some of the applications, environment constraints like power consumption, memory usage, size of devices and size of templates are to be fulfilled.

II. SYSTEM DESIGN

A typical palm print recognition system is made up of five parts: palm print scanner, preprocessing, feature extraction, matcher and database as shown in Fig.1.

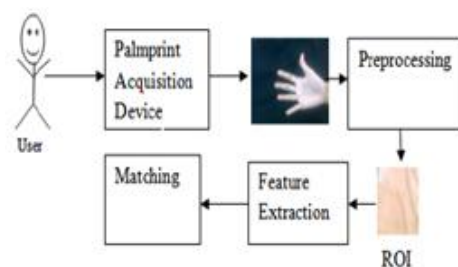


Figure 1. Proposed Model for Palmprint Recognition System

The palm print scanner is used to collect images of palm print. To collect palm print images, researchers nowadays use four types of sensors, digital cameras, CCD-based palm print scanners, video cameras and digital scanners. CCD-based palm print scanners are capable of capturing palmprint images of high quality and then align palms accurately because the scanners have pegs to guide the placement of hands. Preprocessing is used to set up a coordinate system which aligns

palm print images and then segments a part of palm print image for extraction of feature. Effective features from the preprocessed palm print images can be obtained by Feature extraction. 2D-Gabor filter is used to extract the features of palm. Features can be extracted for matching after the palm print image is segmented. Support Vector Machine (SVM) classifier is used to match palmprint images with the trained images located in database.

III. 2-D GABOR FEATURE EXTRACTION

To obtain localized frequency information, Gabor filters are a traditional choice[1]. The best simultaneous localization of frequency and spatial information is offered by them. However they suffer two main drawbacks. The maximum bandwidth that a Gabor filter can have is approximately one octave and if one requires spectral and broad information with spatial localization which is maximum then Gabor filters are not optimal. A log-Gabor filter proposed by Field in 1987 is an alternative to the Gabor filter. Field says that natural images can be better coded by filters that have transfer functions of Gaussian form when seen on the logarithmic frequency scale. (Gabor filters have transfer functions of Gaussian form when seen on the linear frequency scale). On the linear frequency scale, the form of the transfer function of the log-Gabor filter is:

$$G(w) = e^{(-\log(w/w_0)^2) / (2(\log(k/w_0))^2)} \quad (1)$$

where w_0 is the centre frequency of filter. The term k/w_0 must be held constant for varying w_0 to get constant shape ratio filters.

Two components are considered for construction of filters.

1. Radial component, which controls the frequency band to which the filter responds.
2. Angular component, that controls the orientation to which the filter responds.

To construct the overall filter, the two components have to be multiplied together.

Some of the parameters have to be decided, of which several are interdependent.

- The minimum and maximum frequencies to be covered.
- The filter bandwidth to be used.
- The number of filter scales to be used.
- The scaling between centre frequencies of successive filters.
- The number of filter orientations.
- The angular spread of each filter.

A. Filter Bandwidth

The ratio of the standard deviation of the Gaussian describing the transfer function of log Gabor filter

in the log-frequency domain to the center frequency of filter is used to determine the filter bandwidth. The parameter sigmaOnf is used to set the filter bandwidth.

B. Maximum Frequency

The wavelength of the smallest scale filter is used to determine the maximum frequency. The parameter minWaveLength controls it.

C. Minimum Frequency

The wavelength of the largest scale filter is used to determine the minimum frequency. It is defined by the smallest scale filter wavelength, the filter scales number used (nscale), the scaling between successive filters' centre frequencies (mult).

D. Scaling Between Centre Frequencies

After setting the filter bandwidth, the scaling between centre frequencies of successive filters (mult) has to be decided.

E. The Angular Spread of Each Filter

The number of filter orientations is used to fix the angular interval between filter orientations. The spread in the angular direction of 2D log-Gabor filter is a Gaussian function with respect to the polar angle around the centre in the frequency domain. The ratio of the angular interval between filter orientations and the standard deviation of the angular Gaussian spreading function is used to control the angular overlap of the filter transfer functions. The parameter dThetaOnSigma is used to control this ratio within the code.

F. The Number of Filter Orientations

This, together with the angular spread of each filter, is used to determine the resolution of the orientation information obtained from the filters.

IV. SVM PATTERN MATCHING

To match palm prints, a matching score between two palm prints is computed according to the points of their palm lines. To represent the whole palm print, the sample image, which is 256x256, is then segmented into four images each 128x128. The translation and rotation of the palm prints captured from the same palms can be greatly reduced by such preprocessing. SVM (Support Vector Machine) is used for matching of palm. The Support Vector Machine (SVM) is a classifier which is used widely. And yet, to obtain the best results with SVMs, an understanding of their workings and the various ways by which a user can influence their accuracy is required. Due to its high accuracy, ability to deal with high-dimensional data like gene expression, and flexibility in modeling diverse sources of data [2], the SVM classifier is widely used in biometrics. SVMs belong to the general category of kernel methods [4, 5]. A kernel

method refers to an algorithm which depends on the data only through dot products. In this case, the dot product can be replaced by a kernel function which then computes a dot product in possibly high dimensional feature space. The SVM RBF (Radial Basis Function) kernel is used for classification. It has two advantages: First, using methods designed for linear classifiers it has the ability to generate non-linear decision boundaries. Second, by the use of kernel functions the user can apply a classifier to data that have no fixed-dimensional vector space representation. In bioinformatics, the main examples of such data are sequence, either DNA or protein, and protein structure. For using SVMs, an understanding of how they work is selectively required. When working with an SVM one needs to make a number of decisions: how the data has to be preprocessed, what kernel has to be used, and finally, setting the parameters of the SVM and the kernel. Uninformed choices can result in severely reduced performance [6].

V. RESULTS & DISCUSSION

The image shown in Fig. 2 is the sample image taken as a dataset for the palm print recognition system implementation.



Figure 2. Sample Image



Figure 3. Segmented Images

The dataset image is first divided into four parts as shown in Fig. 3 above, then the feature extraction process using 2-D Gabor filter is applied on all the four segmented images separately.

The gabor magnitude, kernel and phase are displayed in Fig. 4.

For each sample and in each segment of that sample Gabor magnitude, phase and orientation is calculated. The complete feature analysis of 54

samples with each sample having 16 features is shown in Fig. 5.

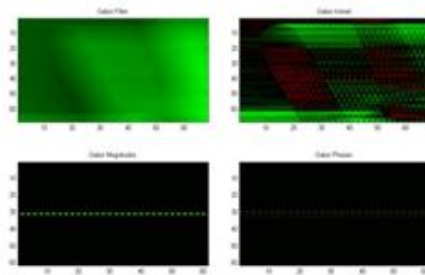


Figure 4. Gabor Analysis



Figure 5. Training Dataset

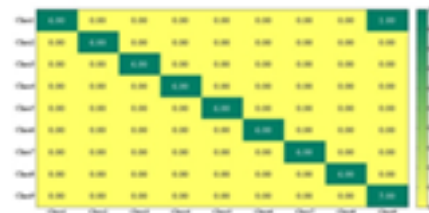


Figure 6. Confusion Matrix

Using the 6 test sample of each user total of 9 users we have total of 54 samples and the system performance is evaluated. Out of the total test images the system has shown 98.15% recognition rate. So for total 54 images selected for testing, the system has identified 53 images correctly except one. A confusion matrix in Fig. 6 is showing the visible results where all the samples are recognized correctly except the first user one sample, having system efficiency of 98.15 percent.

VI. CONCLUSION & FUTURE SCOPE

In this paper we proposed a new technique for feature extraction using Gabor texture analysis on the segments of images. Template matching is implemented using SVM classifier. The SVM RBF kernel function is used for classification and Gabor 2D filter analysis is used for feature extraction. The total overall system recognition rate is 98.15percent.

In future, the research work can be done on a larger set of database with more palm images where the images of the sample could be identified of certain

age group and whether the applied sample is of men or women.

VII. ACKNOWLEDGMENT

The author is grateful to Mr. Sumit Dalal sir for enlightening discussions and for help in developing the knowledge for this paper.

VIII. REFERENCES

- [1]. D. Zhang and W. Shu, "Two novel characteristics in palmprint verification: datum point invariance and line feature matching," *Pattern Recognition*, vol. 32, no. 4, pp. 691-702, 1999.
- [2]. N. Duta, A. K. Jain, and Kanti V. Mardia, "Matching of Palmprint", *Pattern Recognition Letters*, vol. 23, no. 4, pp. 477-485, 2002.
- [3]. A.K. Jain, S. Prabhakar, L. Hong and S. Pankanti, "Filterbank based fingerprint matching," *IEEE Transactions on Image Processing*, vol. 9, no. 5, pp. 846-859, 2000.
- [4]. J. You, W. Li and D. Zhang, "Hierarchical palmprint identification via multiple feature extraction", *Pattern Recognition*, vol. 35, no. 4, pp. 847-859, 2002.
- [5]. W. Shu and D. Zhang, "Automated personal identification by palmprint," *Optical Engineering*, vol. 37 no. 8, pp.2,659-2,362, 1998.
- [6]. W. Li and D. Zhang, "Palmprint identification by Fourier Transform", To appear in *International Journal of Pattern Recognition and Artificial Intelligence*, 2002.
- [7]. D. Zhang (ed.), *Biometrics Resolutions for Authentication in an E-World*, Kluwer Academic Publishers, USA, 2002.
- [8]. J. Daugman, "High confidence visual recognition of persons by a test of statistical independence," *IEEE Transactions on Pattern Analysis and Machine Intelligence*, vol. 15, no. 11, pp. 1,148-1,161, 1993.
- [9]. B. Duc, S. Fischer and J. Bigun, "Face authentication with Gabor information on deformable graphs," *IEEE Transactions on Image Processing*, vol. 8, no. 4, pp. 504-516, 1999.
- [10]. P.S. Wu and M. Li. "Pyramid edge detection based on stack filter", *Pattern Recognition Letters*, vol. 18, no. 4, pp. 239-248, 1997.