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Palmprint Recognition System

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Abstract: Palmprint recognition being one of the important aspects of biometric technology is one of the most reliable and successful identification methods. In this paper, several existing palmprint recognition algorithms have been studied and analyzed. A simple approach to preprocessing and roi extraction has been discussed. The available databases have also been analyzed and the most efficient of all will be used for the development of the proposed system.

Keywords: Palmprint, Biometrics, CASIA, PolyU, IITD, Preprocessing, Feature extraction, matching.

I. INTRODUCTION

Palmprint recognition is one of the biometrics available at the present. Biometric systems are used to authenticate the identity by measuring the physiological and/or behavioral characteristics. So, the two main categories of biometrics are ‘physiological’ and/or ‘behavioral’. The physiological category includes the physical human traits such as palmprint, hand shape, eyes, veins, etc. The behavioral category includes the movement of the human, such as hand gesture, speaking style, signature etc. The measurement of these traits helps in authentication using the biometric systems. One of the most successful biometric systems is the palmprint recognition system. This system recognizes on the basis of the palm print of a person. It is reliable due to the fact that the print patterns are always unique, even in the monozygotic twins. The interesting part is that the ridge structure is permanent. This ridge structure is formed at about the thirteenth week of the embryonic development. This formation gets completed by the eighteenth week. The palmprint recognition system has advantages over the other physiological biometric systems. Some of the advantages are fixed line structure, low intrusiveness, low cost capturing device, low resolution imaging.

Thus palmprint recognition is a very interesting research area. A lot of work has already been done in this area, but there is still a lot of scope to make the systems more efficient. Here, we have tried to analyze the already existing systems and thereby propose a new approach.

II. LITERATURE REVIEW

In order to provide an accurate and efficient authentication system, there has been substantial research in the area of palmprint recognition system. For this, a number of relevant papers have been reviewed. Tee Connie et al’ have proposed an automated palmprint recognition system [1]. In its proposed approach, they have used Principal Component Analysis (PCA), Fischer Discriminant Analysis (FDA) and Independent Component Analysis (ICA) for the feature extraction from the roi images. Patprara Tunkpien used the approach of compact extraction of principle lines from the palmprint images by using filtering operations consecutively [2]. Here, the image is first smoothed and then worked upon. For this, the palmprint images are passed through several filters. Palmprint recognition with PCA and ICA [3] have been presented by Tee Connie et al. K.Y. Rajput et al used the Kekre Fast Codebook Generation [4] algorithm for the feature extraction. I Ketut Gede Darma Putr and Erdiawan have used the two dimensional Gabor [5, 7] for the development of a high performance palmprint identification.

Sina Akbari Mistani et al proposed an approach which makes use of the multispectral analysis [6] of the hybrid features to improve the performance of the palmprint recognition system. David Zhang et al have proposed an online palmprint identification system [8]. This system was developed to make authentication possible in the real time also. Hafiz Imtiaz et all have proposed a novel preprocessing technique for DCT domain palmprint recognition [9] in which the task of feature extraction is carried out in local zones using 2 dimensional Discrete Cosine Transform (2D-DCT). A survey of all the palmprint recognition systems [10, 11] has also been studied.

An automated palmprint recognition system [1] evaluated the results in terms of correct recognition rate and verification rate. Correct recognition rate is the percentage of people that can be identified by the system. Verification rate can be calculated by using False Acceptance Rate (FAR), False Rejection Rate (FRR), as well as Equal Error Rate (EER). FAR is the percentage of accepted not genuine claims over the total number of not genuine accesses. FRR is the percentage of rejected genuine claims over the total number of genuine accesses. ERR is the system threshold value when FAR is equal to FRR. For a biometric to work effectively, FAR and FRR must be as low as possible. Total Success Rate (TSR) is the verification rate of the system. Principal Component Analysis (PCA) [3] is used for dimensionality reduction. It is useful as it decreases the dimension of the images and scales the dimensions according to their importance. It makes use of

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Eigen palms. Independent Component Analysis (ICA) [3] has the ability to deal with higher orders unlike PCA and FDA which can handle only up to second order. In ICA, the palmprint images are considered as the mixture of an unknown set of statistically independent source images. Gabor filters are widely applied to image processing, computer vision and pattern recognition. 2D Gabor filter is used for palmprint feature extraction. It provides robustness against varying brightness and contrast of images.

III. DATABASES AVAILABLE

Three palmprint image databases available for the research purpose are . These are CASIA palmprint database, PolyU palmprint database and IITD palmprint database.

CASIA palmprint database contains 5502 palmprint images captured from 312 subjects. For each subject, the left and right palm images have been captured. All the palmprint images are 8 bit gray level JPEG files. These have been captured by their self-developed palmprint recognition device. In this device, there are no pegs to restrict the postures and positions of the palms. Some of the palmprint images captured by the CASIA palmprint recognition device are shown in the figure.

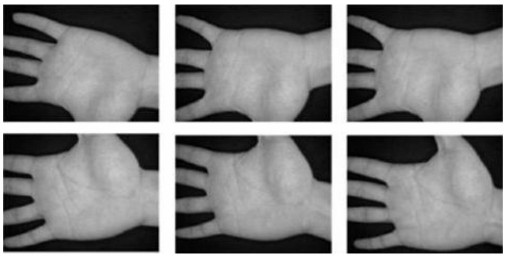

Fig. 1 CASIA Palmprint Database

PolyU palmprint database consists of 6000 images from 500 different palms for one illumination. The images were collected from 195 males and 55 females in two separate sessions. The volunteers ranged from 20 to 60 years of age. In each session, 6 images were captured for each palm. The next session was held after about 9 days from the first session. This database employs user pegs to restrict the hand orientation. This helps in achieving significantly higher performance. Therefore, this database is used widely.

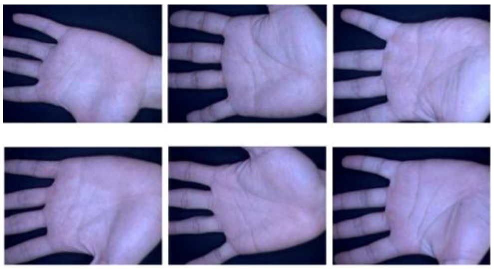

Fig. 2 PolyU Palmprint Database

IITD palmprint database uses a touchless imaging setup. It was acquired from the staff and students of IIT Delhi during July 2006 – June 2007. The available database is of 235 users. Each image is of bitmap (*.bmp) format. 7 images were captured of both the palms, leaft and right each from each user in varying hand pose variations. The touchless imaging results in higher image scale variations. The resolution of the captured images is 800 X 600 pixels. Along with the cpturd images, the 150 X 150 pixels cropped and normalised images are also available. The database is acquired in the indoor environment with a circular fluorescent illumination around the camera.

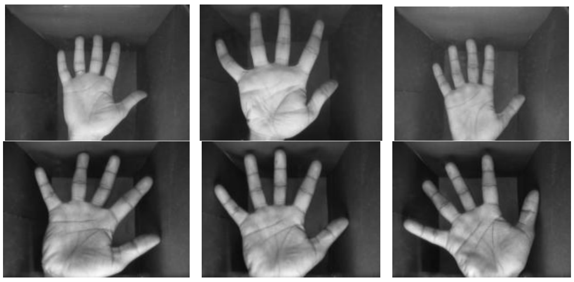

Fig.3 IITD Palmprint Database

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IV. PROPOSED SYSTEM

The palmprint recognition system includes preprocessing followed by roi extraction. After roi extraction, features are extracted using the feature extraction algorithms. Then matching is done on the basis of the extracted features. The palmprint is then accepted or rejected. All these processes have been studied and reviewed. On the basis of the review, the proposed system has been described. Each step has been studied in detail. The proposed palmprint recognition system has been depicted in figure 4 which is a flowchart of the palmprint recognition system. Each step is further described below in detail.

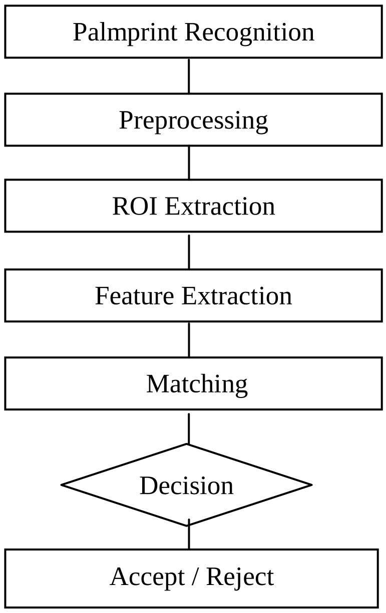

Fig.4 Flowchart of Palmprint Algorithm

A. Preprocessing

To reduce the overhead, instead of directly using the palmprint images, preprocessing needs to be done. Preprocessing is used to remove distortion, align the palmprints and to crop the region of interest. This cropped ROI is used for feature extraction. This is done in five steps:

a. Binarizing the palm image
b. Boundary tracking
c. Key points detection
d. Establishing a coordination system
e. Extracting the central part

The third step can be accomplished by two approaches, tangent based and finger based. The tangent based approach is preferred. This approach considers the edges of the 2 finger holes on the binary image to be traced. The common tangent of the two finger holes is considered to be the axis. The key points for the coordination system are calculated as the midpoint of the two tangent points.

B. ROI Extraction

The central part of the palm image is segmented after the preprocessing. Different algorithms segment circular, half elliptical or square regions for feature extraction. The square region is the easiest and widely used. The cropped image is then passed through a low pass filter (LPF), which blurs the image. In this blurred image, the minor lines get suppressed. The major lines are also affected, but they are prominent. These are then used for feature extraction.

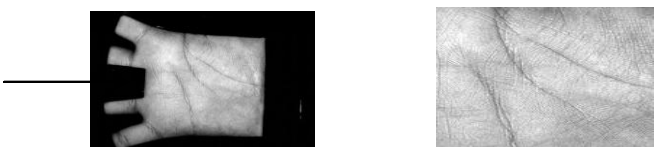

Fig.5 ROI extraction

C. 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.

1) *Line based approach:* This approach develops edge detectors and makes use of the magnitude of the palm lines. The magnitudes of the palm lines are projected in x and y coordinates forming histograms. After this, the first and second order derivatives of the palm images are calculated. The first order derivative is used to identify the edge points and corresponding directions. The second order derivative is used to identify the magnitude of lines. Then the Euclidian distance is used for matching.
2) *Subspace based approach:* This approach makes use of Principal Component Analysis (PCA), Linear Discriminant Analysis (LDA) and Independent Component Analysis (IDA). The spatial coefficients are considered as the features used for matching. This approach does not need any prior knowledge of the palmprints.
3) *Statistical approach:* These are of two types, local and global. The local approach transforms the image in another domain. This transformed image is then divided into several regions such as mean and variance of each region. The global features include moments, center of gravity and density. The global approach is applied on the whole palmprint image. This is the only difference between the local and global approach. The local approach is applied on the segments of the palmprint image whereas the global approach is applied on the whole image.
4) *Coding approaches:* This approach uses a single Gabor filter to extract the local phase information of palmprint. This extracted phase information is used by the palmprint recognition systems to reduce the registered data size and to deal with non-linear distortion between palmprint images. This approach has very low memory requirement and fast matching speed.

D. Accept / Reject

The users are authenticated by the palmprint recognition systems. These accept the users, who are authenticated, i.e. whose palmprint match with a palmprint present in the database. If the user is not authenticated, then the user is rejected. This process of accepting and rejecting the user is done on the basis of the matching algorithm. This matching is done on the basis of the extracted features. Classification is the basis for the palm images to be accepted or rejected. Similar samples are grouped in the same class. Some of the similarity measures are Mahalanobis, Euclidean and Manhattan distances. Another classification approach is the construction of decision boundaries. This can be achieved by the use of techniques such as Artificial Neural Networks (ANN).

V. CONCLUSION & FURTHER WORK

Several existing methods have been reviewed for palmprint recognition. In the proposed approach, instead of using the whole palmprint image at a time, dominant spectral features have been extracted such as the major lines. This approach helps in increasing the performance and accuracy of the system. A lot of work has to be done with the feature extraction algorithms as well as the matching algorithms. The aim of working on the palmprint recognition system is to develop a system with increased speed and accuracy.

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