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PALMPRINT RECOGNITION

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Abstract

Palmprint is an example of physiological characteristics of an individual, which can be easily captured by using some types of sensors and cameras. The palmprint has many nature compositions, which contain rich features that mainly used for distinguishing such as, wrinkles, ridges, principal lines, singular, and minutiae points. These make a palmprint as one of a unique biometric and reliable for human recognition. In this work have used multiple correlation filters per class for performing palmprint classification algorithm.
Keywords: Palmprint, Recognition, Biometric and Features.

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1. Introduction

Biometrics is the science of establishing the identity of an individual based on a vector of features derived from a behavioral characteristic or specific physical attribute that the person holds. The behavioral characteristic includes how the person interacts and moves, such as their speaking style, hand gestures, and signature, etc. The physiological category includes the physical human traits such as fingerprints, iris, face, veins, eyes, hand shape, palmprint and many more. Evaluating these traits assists the recognition process using the biometric systems [1].

2. Literature Review

2.1 Jadhav, S. B, Raut, M. S. D, Humbe, V. T, and Kartheeswaran, T in 2016 [5] proposed a method to recognize a person based on texture measurement by using the low-cost contactless palmprint device. By using texture features of palms such as a filled area, a palmprint recognition system was formed. Furthermore, high resolution web camera was used. It was a low cost device as compared to other implemented biometric systems and also being contactless too. The texture measurements that were calculated of palmprint images were found to be distinct. The result and analysis performed 100%success rate of the experiment.

2.2 Dubey.P. and Kanumuri.T in 2015 [4] proposed a new Palmprint recognition method based on Anisotropic Filters (AFs) and Gabor Filters. Varying illuminations in image cause high complexity and need large storage requirement when using Gabor Filters extensively. After applying Anisotropic Filters, Local Binary Pattern (LBP) also must be applied, what is known as (OLdirBP) Optimal Local Direction Binary patterns to decrease feature size. Low complexity computation and robust to noise system were achieved by applying the proposed method.

2.3 Dai and Zhou in 2012 [3] proposed a novel technique for palmprint recognition based on extraction of multiple features. Such as density, minutiae, principal lines and orientation are considered extract features. Both, Radon-Transform-Based Orientation Estimation and DFT were used for orientation estimation. For ridges enhancement according to the local ridge direction and density in minutiae extraction, Gabor filter is used. Using the composite algorithm, density map is calculated, Gabor filter, Hough transform. Also Hough transform is applied to extract the principal line features.

2.4 D. Huang, W. Jia, and D. Zhang in 2008 [2] proposed a novel method for the automatic classification of low-resolution palmprints. First, based on the position and thickness of palm, principal lines of the palm are found. The proposed method recognizes these palmprints with accuracy rate96.03%.

3. Introduction to Palmprint Recognation

The palmprint recognition system is considered one of the most successful biometric systems that is reliable and effective. This system identifies the person based on his palmprint. Studies and research have proven that a palmprint acquired from any person is unique, so it can be reliable as a biometric trait.

The interesting feature of palmprint is that the ridge structure is fixed and invariant. At the third month of the embryonic growing, the ridge structure is formed and completed by the eighteenth week.

3.1 Advantages of Palmprints

Some of the advantages of the palmprint recognition compared with other biometric traits systems are:

- Invariant line structure.
- Low intrusiveness.
- The low cost of capturing device.
- Require low resolution image.

A lot of work has already been done about palmprint recognition, since it is a very interesting research area. But, still more needs to be researched and more effort given to make the systems more efficient. [6]

Due to low cost, user friendly, high speed, and high accuracy, based on the previous merits of palmprint recognition, it can be considered as one of the most reliable and suitable biometric recognition system.

3.2.Palmprint Identification Techniques

There are three groups of marks, which are used, in palmprint identification: [9]

1. Geometric features, such as the width, length and area of the palm. Geometric features are a coarse measurement and are relatively easily duplicated.
2. Line features, principal lines and wrinkles. Line features identify the length, position, depth and size of the various lines and wrinkles on a palm. While wrinkles are highly distinctive and are not easily duplicated, principal lines may not be sufficiently distinctive to be a reliable identifier in themselves.
3. Point features or minutiae point features are similar to fingerprint minutiae (Figure 1) and identify, amongst other features, ridges, ridge endings, bifurcation and dots.

In order to understand the previous recognition concept, first, physiology of the valleys and ridges of a palm or fingerprint must be understood.

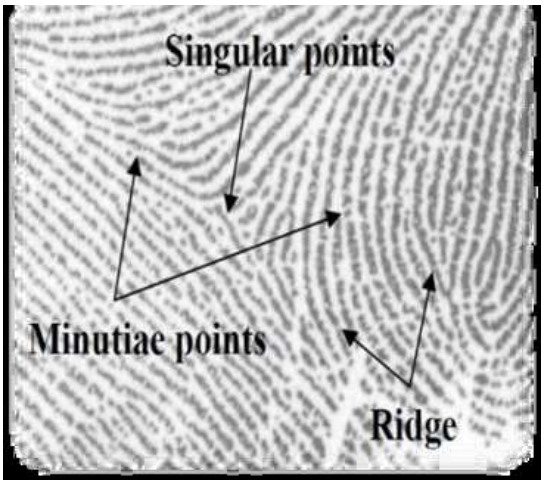

Figure 1: Palmprint Features [9]

The captured palmprint or fingerprint appears as a black line, which represents the peaking, the valley among the dark lines appears as a white line and is the shallow, low portion of the friction ridged skin. See Figure 2.

Figure 2: Ridges and Valleys of Fingerprint. [8]

Minutiae are limited to the direction, orientation, and location of the endings of ridge and bifurcations along a ridge path.

The images in Figure 3 presents a pictorial representation of the regions of the palm, examples of other detailed characteristics, and two types of minutiae used during the minutiae extraction and automatic classification processes. [8]

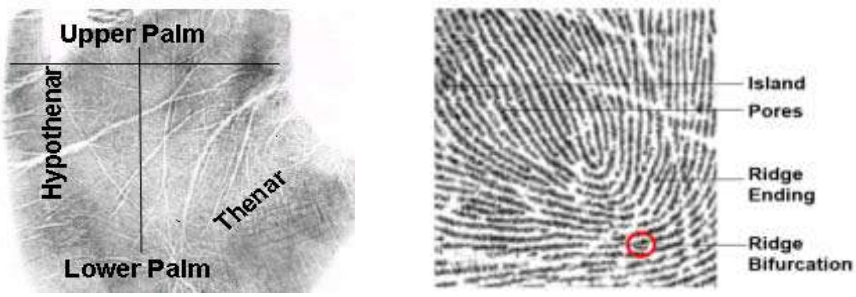

Figure 3: Close-up Showing of Minutiae for Palmprint [8]

3.2.1 Palmprint Acquisition

Many methods are available to capture the palmprint image, digital scanners; Researchers use video camera, CCD-based scanners, and tripod to capture palmprint images.

A high resolution image of palmprint can be captured by using a CCD-based scanner, also a palm image can be easily aligned accurately because CCD-based scanner has pegs for guiding the user where to put his hand. A CCD-based scanner is shown in Figure 4. [10]

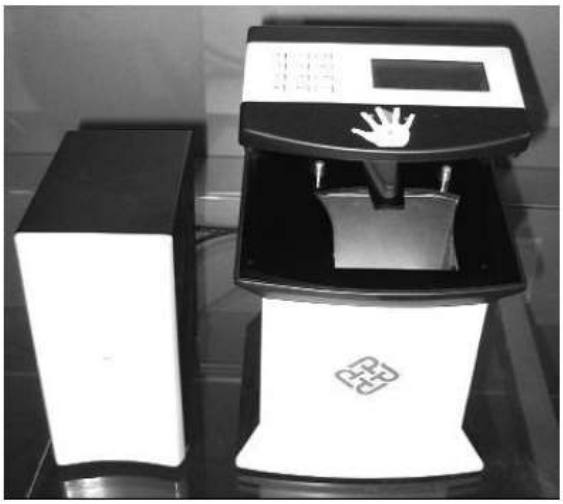

Figure 4: CCD Based Scanner [10]

3.2.2 Preprocessing Operations

Correction distortions, aligning different palmprints, and cropping the Region Of Interest (ROI) for feature extraction are important steps before applying the feature extraction and matching process, these steps are implemented as pre-processing operations. The most commonly pre-processing steps that researches focuses on are:

- Palm images binarizing.
- Boundary tracking.
- Key point identification.
- Constructing a coordination system.
- Extracting the middle part.

Two approaches are used to accomplish the third step:

1- Tangent based approach.
2- Finger based approach.

As shown in Figures 5& 6 the tangent based method considers the edges of the two holes of the finger to be traced. The common tangent of the both holes of the finger represents the axis. The main points in the coordination system are considered as the center point of the two points on the tangent. This approach is the best comparing with finger based approach. [10]

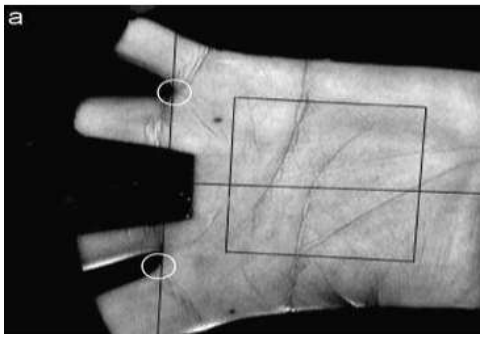

Figure 5: Key Points and Coordinate System [10]

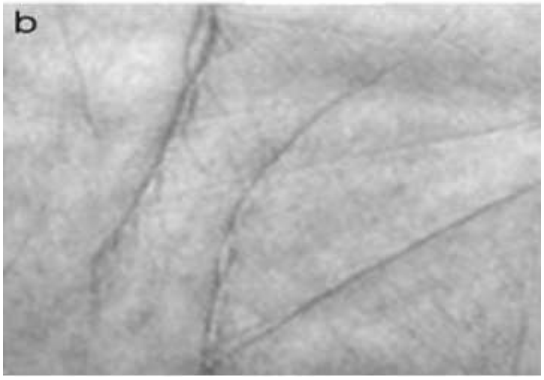

Figure 6: ROI Extraction [10]

3.2.3 Region of Interest (ROI) Extraction

During pre-processing operations, a segmentation process to detect the central region of the palm image should be implemented. For feature extraction, different algorithms such as square regions, half elliptical or segment circular. The easiest and most widely used is a square region. Then, a low pass filter applied to the cropped image, in order to blur the image. The secondary lines get suppressed in the blurred image, and the basic lines are also affected, but they are distinguished. Then, they can be used for process of feature extraction [10].

3.2.4 Region of Interest (ROI) Location:

P1, P2, P3, and P4 which represents the holes must be obtained (Figure7), and then a line is connected between P2 and P4. After that, as shown in Figure 7, a square is drawn below the line. The drawn square represents (ROI) the region of interest of the palm. Depending on the experiment results, the required time (average time) for locating and identifying the ROI was less than 1ms [7].

ROI segmentation of palmprint is to reliably and automatically divide a small portion from the palmprint image, and palmprint extraction is to separate the palmprint from a ROI. This is one of the important steps in these four steps because it greatly influences the overall verification accuracy and processing speed of the complete system. It is important that to take the ROI at the same position for distinct palmprint images to guarantee the stability of the segmented palmprint features to provide fast processing speed and genuine recognition rate. In fact, a palmprint is frequently surrounded by noise; a novel palmprint segmentation scheme must separate the palmprint by removing all of these features that classified as noise [7].

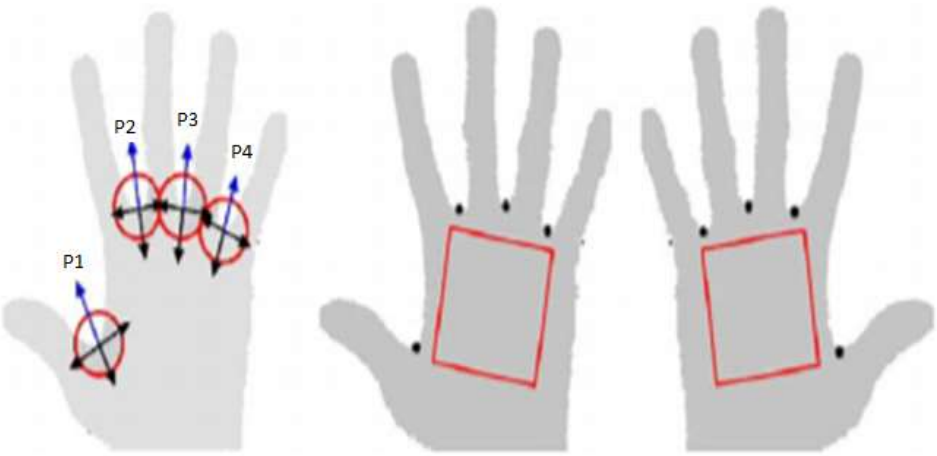

Figure 7: The ROI Detection Technique

4. Features Extraction and Matching

The purpose of these steps is to allow for the correct user to recognize and to prevent another who is not authorized from using the privileges of other people. In identification mode, the system recognizes the users by checking the all the stored samples of individuals in the DB for matching [10].

Palmprint Acquisition, Preprocessing, Feature Extraction and Matching are summarized in Figure 8.

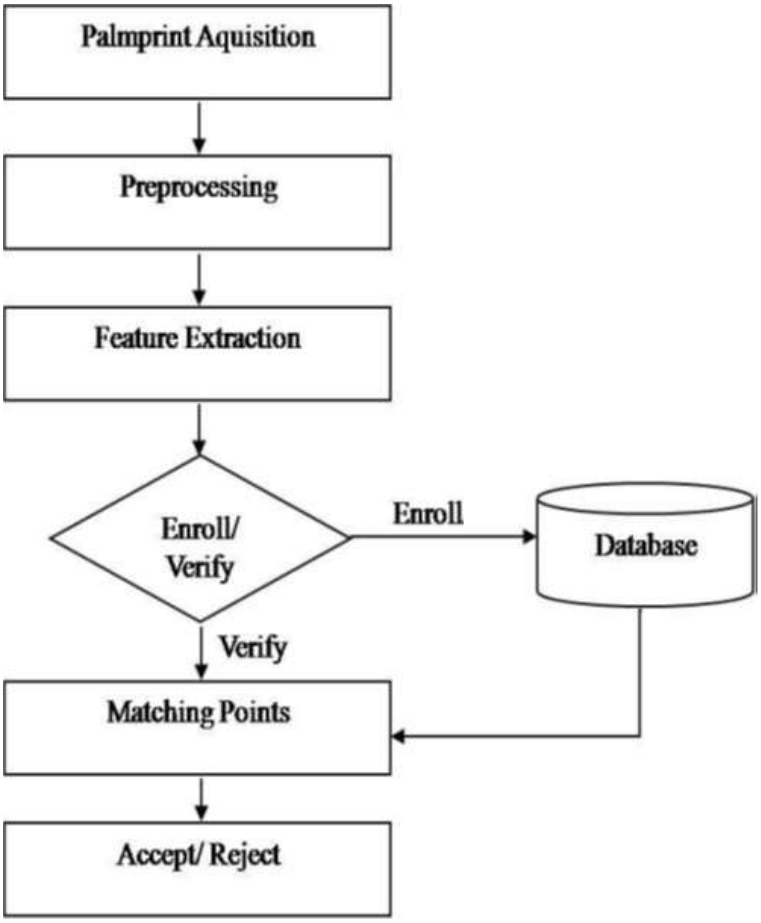

Figure 8: Flowchart of Palmprint Recognition [10]

5. Problems in Palm Recognition

Following problems considered as the main reasons that lead to shortage of the accuracy rate of [7]:

1- Skin distortion: since the size of the palmprint is large and contains many joints comparing with the finger tip, the distortion is quite famous when comparing between different impressions that are captured from the same palm, so skin distortion of the fingerprint is less crucial than the distortion of palmprints. Figure 9 shows an example of distortion of palmprints.

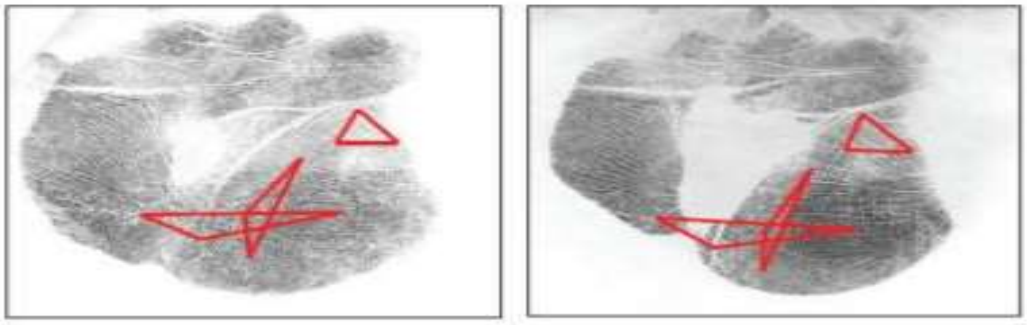

Figure 9: Example of Skin Distortion of Palmprint [7]

2- Diversity of different palm regions: Capturing of palmprint may produce different regions of palmprints; different region of the same palm may cause varying quality and distinctiveness.
3- Computational complexity: Algorithms that are used for fingerprint recognition are not efficient to match palmprint, because of fingerprints have not minutiae as much as palmprint. And since the database of palmprints is not placed in a common coordinate system, matching algorithm that based on minutiae need to try all possible translations and spinning or correlation of minutiae.

6. Conclusion

Palmprint is the accessibility of large space for extracting biometric features. In general, palmprint images should be standardized and oriented before feature extraction. Palmprints hold extra distinctive features such as wrinkles and principle lines that can extract from low-resolution images. By joining all features of palm and fingerprint such as ridge and valley features, principle lines and wrinkles, it is possible to provide a highly accurate biometric system. Palm and finger biometrics denoted by the information is presented in a friction ridge impression.

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