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Feature Extraction Technique Based On Circular Strip for Palmprint Recognition

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Abstract: Recently, biometrics recognition has attracted a lot of research works and is reported in many fields. Biometrics technology is used to identify people from their physical or behavioral characteristics. These characteristics have three major specificities; they must be distinctive to differentiate each people, to be stable in the course of time and to be defined without a lot of constraints for users. So, various technologies were developed based on fingerprints, iris, face, voice, signature, gait or hand. Hand biometrics present many advantages compared to other biometrics technologies. Its characteristics are relatively stable and present a lot of discriminating features such as principal lines, wrinkles, ridges or hand shape. In addition, they present high user acceptability and the hand can be obtained from low-resolution images with cheaper devices. The motto of this project is to present the three stages: the image acquisition, preprocessing and image enhancement.

I. INTRODUCTION

A biometric system is essentially a pattern recognition system that operates by acquiring biometric data from an individual, extracting a feature set from the acquired data, and comparing this feature set against the template set in the database.

A. Modules

A biometric system is designed using the following four main modules [1]. They are used commonly in all the biometric systems. They are as follows:

1. Sensor module
2. Feature extraction module
3. Matcher module
4. System database module

All the four modules are the general modules for every palmprint recognition system. In this paper a technique called circular strip is used for feature extraction module.

II. PALMPRINT RECOGNITION SYSTEM

A typical palmprint recognition system consists of five parts: palmprint scanner, preprocessing, feature extraction, matcher and database illustrated in figure 1. The palmprint scanner collects palmprint images [2]. Mostly CCD-based scanners are used. CCD-based palmprint scanners capture high quality palmprint images and align palms accurately.

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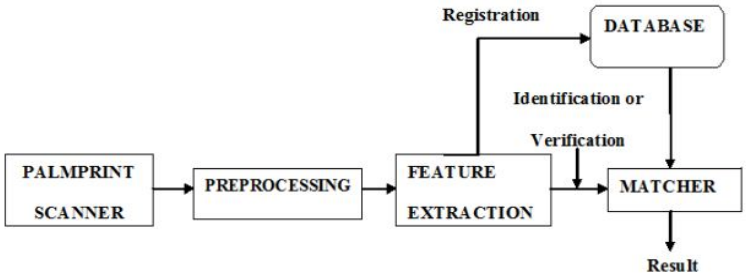

Figure 1: A typical palmprint recognition system

Preprocessing sets up a coordinate system to align palmprint images and to segment a part of palmprint image for feature extraction [5]. Feature extraction obtains effective features from the preprocessed palmprints. A matcher compares two palmprint features and a database stores registered templates.

III. IMAGE ACQUISITION

A. Image Sensors

The main goal of the image sensor is to convert EM energy in to electrical signals that can be processed, displayed, and interpreted as images [4]. The way this is done varies significantly from one technology to another. A CCD sensor is used for image acquisition.

B. Camera Optics

A camera uses a lens to focus part of the scene on to the image sensor. Two of the most important parameters of a lens are its magnifying power and light gathering capacity. Magnifying power can be specified by Magnification factor (M), which is the ratio between image size and object size:

$$M = U / V \quad (1)$$

where U is the distance from an object to the lens and

V is the distance from the lens to the image plane.

C. Flatbed Scanner

In computing, a scanner is a device that optically scans images, printed text, handwriting, or an object, and converts it to a digital image [7]. A flatbed scanner is usually used. Images of the palm are taken for further processes.

IV. PREPROCESSING AND PALMPRINT ENHANCEMENT

A. Preprocessing

Preprocessing [3] is the name used for operations on images at lowest level of abstraction-both input and output are intensity images. Palmprint image is preprocessed for removing the non uniform brightness.

Contour Tracing Algorithm and Hand Image Classification

Contour tracing algorithm is applied to extract the contour of the hand image from binarised hand image. Four valley points (V1, V2, V3, and V4) between the fingertips are determined using local minima on the contour of hand image. Figure 2 shows the reference points detected on contour of right hand and left hand images.

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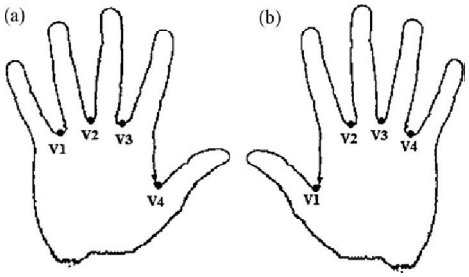

Figure 2: Contour and valley points on (a) right and (b) left hands

It can be seen from figure 2(a) and (b), that the valley points V1, V2, V3 and V4 on right hand correspond to V4, V3, V2 and V1 respectively on left hand [10]. So the obtained hand image for enrolling or verifying can be classified.

$$\text{HAND} = \begin{cases} \text{RIGHT HAND if } ||V1 - V2|| < ||V3 - V4|| \\ \text{LEFT HAND} \qquad \text{Otherwise} \end{cases} \tag{2}$$

where: ||a-b|| is the Euclidean distance between the points a and b.

Region of Interest Extraction

The square area inside palm region of the hand image is considered as palm-print or region-of-interest (ROI) [6]. Extraction of palm-print is based on the classification of the hand image. If the hand image is classified as a right hand image, two reference points C1 and C2 are determined on the contour of hand image as shown in figure 3 and M1 and M2 are the mid points of line segments C1-V1 and V3-C2 and viceversa for left hand image and it is shown in figure 4.

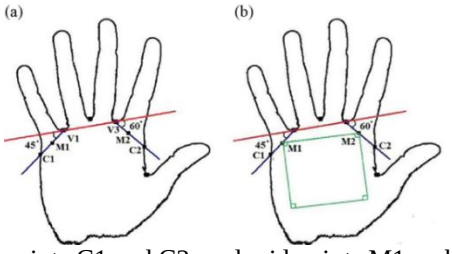

Figure 3: (a) Reference points C1 and C2, and mid points M1 and M2 (b) ROI- right hand image

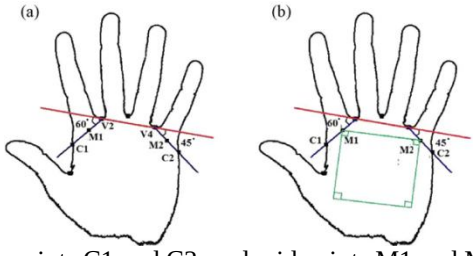

Figure 4: (a) Reference points C1 and C2, and mid points M1 and M2 (b) ROI- left hand image

B. Palmprint Enhancement

Once the binary image is obtained the image is given to the image enhancement unit. Histogram Equalization is performed to enhance the image [8]. The histogram of the enhanced palmprint image is used to correct the non- uniform brightness of the image.

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V. SEGMENTED CIRCULAR STRIP

The objective of any palm-print feature extraction technique is to obtain good inter-class separation in minimum time. Features should be obtained from the extracted palm-print. The local variation of instantaneous-phase of circular-strips is used to extract features from palm-print [9]. The extracted and enhanced palm-print is segmented into overlapping circular-strips. A circular-strip which is the circular region of inner radius Ri and outer radius Ro as shown in figure 5, is the basic structure used to extract features of the palm-print in the proposed system.

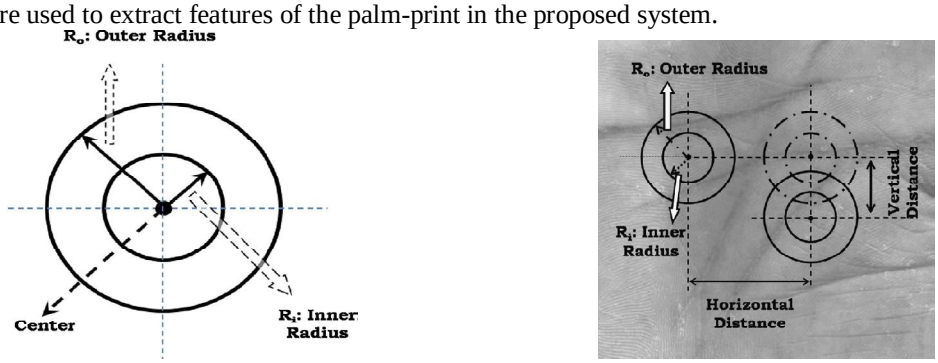

Figure 5: Basic structure of the circular strip

VI. RESULTS

Database consists of 45 hand images obtained from 15 users with the help of a low cost flat bed scanner. Out of 45 hand images one left hand image is taken.

Figure 7: Grey Scale Image & Gradient Magnitude Image

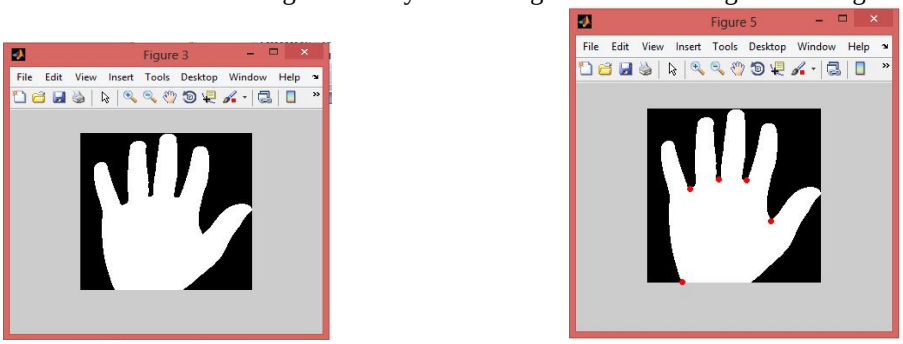

Figure 8: Thresholded Image & Valley Points Marking

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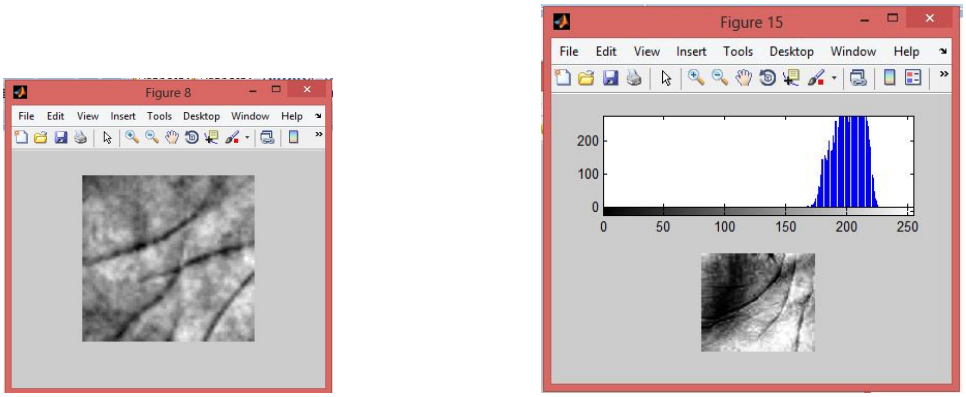

Figure 9: ROI Extracted Palmprint Image & Histogram Equalized and Enhanced Images

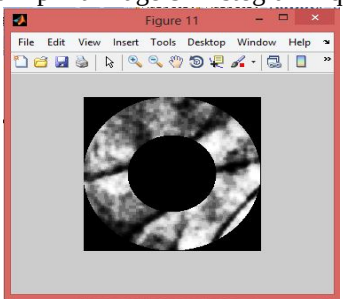

Figure 10: Circular Strip

Palmprint region is extracted and is enhanced and normalised to a size of 100× 115 pixels.

VII. CONCLUSION

In this project, the image acquisition, preprocessing and feature extraction modules of palmprint recognition system are presented. A novel approach to extract palm-print features called Circular strip is introduced. A technique to classify hand image into either right or left hand is presented. This classification technique is based on the distance between valley points adjacent to index finger and ring finger. A procedure to extract palm-print from the classified hand image of a user is presented. Extracted palm-print is based on the stable valley points between fingers. Thus, the extracted palm-print is found to be invariant to orientation and translation of palm on scanner which makes the system robust to orientation and translation of placing hand on scanner.

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