CHAPTER - 4

PALM PRINT RECOGNITION

4.1 INTRODUCTION

Palm print recognition has emerged as a highly accepted biometric system due to its easy acquisition and reliability. Palm is the inner surface of hand between wrist and fingers. The inner surface of palm contains three flexion creases, secondary creases, and ridges for each finger. The flexion is also called as principal lines and secondary creases are called wrinkles. Palm feature also includes singular points, ridges, wrinkles, and delta, datum and minutiae points. Palm features are unique for every individual and have rich information that can be used for feature extraction. The palm lines and wrinkles are formed during third and fifth month of the formation of fetus. The wrinkles, ridges, principal lines namely heart lines, headlines; life lines are shown in the fig.4.1. A region of interest (ROI) is extracted from the palm area for processing. Palm recognition process includes feature extraction (stored as template in the database) matching (input query features are matched with stored features) and decision making (to accept or reject the query based on match score). In this chapter an over view of palm print recognition system, processing stages and approaches is presented.
4.2 PALM PRINT RECOGNITION SYSTEM

A biometric system which uses a palm print of a person for authentication/verification is shown in fig 4.2. The processing level includes image acquisition level, feature extraction level, match score level and decision level. The basic level of processing is same for all the biometric system. The complexity lies in the implementation of processing using different approaches and methods. [43]
4.2.1 Sensor level

It is the first step in any biometric system where the image of palm is captured for person identification. Different types of sensors like palm scanners, digital cameras, high and low resolution cameras are used for image acquisition. Depending on the applications sensors are chosen. For a civilian, commercial applications low resolution images and for forensic, criminal detection high resolution images are used for processing. Fig 4.3 shows various palm images collected by different sensors.

![Palm print sensors](image)

Fig: 4.3 Palm print sensors

4.2.2 Pre-processing

Palm images acquired are pre-processed to extract its features. The principal lines are significant and minutiae and textures are used.
as unique information in forensic. The pre-processing steps involve converting the image to binary, extracting the region of interest and segmenting, key point detection and establishing the coordinating system. The pre-processing can be summarized as

- Low pass Gaussian filter is applied to smoothen the palm image.
- Binarize the palm image with a proper threshold.
- Apply morphological operations
- Trace the boundary of palm image to identify and fix the key points
- Find the orientation of palm image and find the coordinate system to crop the region of interest

Extracting the region of interest is carried out using many methods [47] [52] [63]. Centre of palm is used as region of interest in many methods as it covers most of the palm features and has unique texture for each person. To extract the centre of palm image first it has to be aligned and oriented to crop the centre portion. Many methods are used for orientation, like elliptical method where an ellipse that’s fit the boundary of palm is obtained and orientation of palm is obtained by major axis of ellipse. In key point extraction the valley points from middle finger, ring finger, little finger and the line joining these are taken as orientation and a centre portion of palm image is found and a circular or a squared portion of defined size is cropped. Various other methods include bisector based, tangent based etc.; Fig 4.4 shows ROI extraction for a palm recognition system.
Fig: 4.4 a) binary conversion of palm image b) ROI extraction c) Region of interest ROI

4.2.3 Feature extraction

Once the region of interest is identified the features are extracted from it. The approaches used are of two types. One for verification and the other for identification. Line based, sub-space based and statistical based are used for verification of palm features from the stored templates. Some approaches are also combined and are used to extract palm features. Classifiers are used to make a final decision. Feature extraction of ROI of an image is to locate the points those lie along boundaries i.e., set of pixels that either separate objects from one another or change in the surface geometry of an object. The two types of boundaries can be step edges or crease edges. Step edges identify the discontinuity in depth and can be identified by a gradient magnitude. Palm features may also include texture information which can be extracted using statistical measures and wavelets. Palm shape feature includes global features and local features like boundary segments are extracted using Hough’s
transform which transforms Cartesian to parametric. Fig 4.5 shows feature extraction pre-processing images extracted.

Fig: 4.5 (a) an original palm image; (b) a binary palm image; (c) a sub image extracted from the central part and (d) the ROI area of palm print image (e), (f) features extracted

4.2.4 Matching and decision making

Features extracted are stored in the database as templates. Each template is unique and has salient features of the image under consideration. When the query image is processed for verification /
authentication, the features are compared with the stored template using matching techniques. Match scores are estimated using a threshold and final decision is taken to accept/reject the query image. Classifiers are designed based on three different approaches namely concept of similarity, probabilistic, or a geometric approach. Patterns that are similar are assigned with a class. Based on the similarity of feature vector and the template, each sub system calculates its own matching score value. These individual scores are finally combined to obtain a total score which is then passed to the decision module.

Table 4.1 Local features characteristics against the properties

<table>
<thead>
<tr>
<th>PROPERTIES</th>
<th>PRINCIPAL LINES</th>
<th>WRINKLES</th>
<th>MULTISPECTRAL</th>
<th>MINUTIAE</th>
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<td>MEDIAN</td>
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<td>HIGH</td>
</tr>
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<td>COLLECTABILITY</td>
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<td>MEDIAN</td>
<td>MEDIAN</td>
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<tr>
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<td>MEDIAN</td>
<td>HIGH</td>
<td>HIGH</td>
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<tr>
<td>DISTINCTIVENESS</td>
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<td>HIGH</td>
<td>HIGH</td>
</tr>
<tr>
<td>CIRCUMVENTION</td>
<td>HIGH</td>
<td>HIGH</td>
<td>LOW</td>
<td>MEDIAN</td>
</tr>
</tbody>
</table>

4.3 DATABASES

**CASIA:** CASIA palm print image database contains 5502 palm print images captured from 312 subjects. Both right and left palm of subjects are collected. The images are taken from CMOS camera fixed on top of device with uniform illumination. The database is released for research and education purpose. Palm print images are 8 bit, Grey level jpeg files. CASIA multi spectral palm print images contain 7200
palm images captured from 100 different people. The images are captured with multi spectrum imaging devices where multi spectrum illuminator penetrates tissues of palm region and images of surface skin textures are taken.

**POLY U:** Hong Kong Polytechnic University developed the database with 7752 grey scale images corresponding to 386 different palm images. Palm images are in bmp format with 384x284. Around 20 samples from each of these palm images are collected in two sessions with 10 samples in each session with an interval gap of two months. The database is created for research and non-commercial purpose.

**IIT K:** A multimodal database images of palm and face collected for 400 subjects was developed. The database has two samples of palm and face of a person collected in a controlled environment with a maximum tilt of head of 20° by the orientation. Images are acquired in two sessions. Palm print is taken with a flat-bed scanner with a spatial resolution of 200 dpi, 35° rotation to user’s placement of palm. 800 palm print images are collected from 400 subjects with two samples for each person.

**IIT Delhi Touch less Palm print Database:** The database generated at IIT Delhi employs user pegs to restrict hand pose and image scale variations. The touch less palm print image was developed in 2006. The idea is to establish a large scale palm print data collected from students and staff of IIT. All images are collected in indoor environment and employs circular fluorescent illumination around the
camera lens. It has 235 subjects with images in bit map format. Subjects are in the age group of 12-57 yrs. Both right and left palm images with normalized values are available.

4.4 CONCLUSION

In this chapter palm print as a biometric identifier is presented. Palm recognition system processing is analyzed. Feature extraction of palm image is studied. The palm print has rich source of information in its features. The principal lines, ridges, texture, minutiae points, delta point, datum points are unique for a person. Palm print recognition preserves user's privacy when compared to other biometric characters like face, iris etc. Palm print recognition has a universal acceptance as it is a user friendly biometric character to be captured. Effort is made to explain the palm print recognition system with its processing stages, palm features, the region of interest in the palm image, feature extraction and approaches, levels of processing in a palm print recognition system. The standard database available for research is also presented. Palm print image features are extracted using various approaches like texture based, geometrical based, transform based etc. In this chapter the processing stages of palm print recognition system, the region of interest of palm print for feature extraction, feature extraction approaches, databases available for implementation of palm print recognition system are discussed. Palm print feature extraction methods using edge detection techniques are identified for enhancement of feature extraction.