FT-PCA Offline Palmprint Recognition Model

[1]Pratibha, [2]Satnam Singh, [3]Bhanu Gupta
[1]PG Student, [2]Assistant Professor and Head of Department, [3]Assistant Professor
[1]Department of ECE,
[1]SSCET (IKGPTU), Pathankot (Punjab), India

***Abstract*— By increasing the security of parson's authentication (identification and verification) the palmprint modality played most important trait compare with another biometrics trait (physiological or behavioral) and it is active research which made more attention for the researcher who interest in biometrics fields. In the recent years, there are numbers of technologies were developed related to biometrics authentication system but the palmprint get less development depend on reliability and cost. The palmprint approach can be classified into two categories depend on the palmprint image data type such as grayscale, 3D and multispectral. There are many of researchers working in gray scale image compare with the less researcher working in 3D and multispectral palmprint images. Recently the multispectral data are used in many areas such as face, iris and palmprint. As a definition of palmprint which defines as a small area of palm surface, which containing more information which is useful for person authentication system, in additional it has a unique feature (uniqueness means no two people has same this feature) also it called permanence it will not change in all period of time in the life. For this reason, palmprint are reliable and confident modality between the same categories of palmprint like fingerprint and face etc. Regarding palmprint features, it has rich of features some of this feature is similar to fingerprint line minutiae feature that contain ridge ending and ridge bifurcation. Also, it has many features namely Geometry feature, Delta point feature, principal lines feature and finally the wrinkles feature. All these features are extracted with different methods. Also, this feature can be captured by different resolution devices (low or high) resolution this one of advantages of palmprint which is there is side effect by devices used to capture the palm image. Another advantage is it has a small area with a lot of information to extract compare with another, also it has high acceptance. The proposed work will be developed in MATLAB and tested on different databases available for palmprint recognition. Also the comparisons of the tested results are made for achieving accuracy and efficiency for its versatility of operation over a global population.**

***Index Terms*— Palmprint, Fourier Transforms, PCA, MATLAB.**

I. INTRODUCTION

The Palmprint is a hand-based biometric, rich of information presented in friction ridge impression. It provides information of the raised portion of the epidermis (the outermost layer of skin) containing ridge structure, ridge characteristics and ridge flow details. Due to its uniqueness and permanence characteristics, like fingerprint, it is also used for over a century as a trusted media for user identity proof. But due to the restrains in live-scan technologies and its computing capabilities, it is automated slowly than other competing biometric measures. A palm print can be either an online image or offline image taken with paper or ink respectively. Palmprint recognition uses the palm region of a person as a biometric for identifying or verifying identity of the person. The palm is the inner surface of our hand from the wrist to the root of fingers.

The biometric computing-based approach is concerned with identifying a person by his/her physiological characteristics, such as iris pattern, retina, palmprint, fingerprint, and face, or using some aspect of his/her behavior, such as voice, signature, and gesture. Fingerprint-based personal identification has drawn considerable attention over the last 25 years. However, workers and elderly may not provide clear fingerprint because of their problematic skins and physical work. Recently, voice, face, and iris-based verifications have been studied extensively. As a result, many biometric systems for commercial applications have been successfully developed. Nevertheless, limited work has been reported on palmprint identification and verification, despite the importance of palmprint features. There are many unique features in a palmprint image that can be used for personal identification. Principal lines, wrinkles, ridges, minutiae points (patterns from the finger region), singular points, and texture are regarded as useful features for palmprint representation. Various features can be extracted at different image resolutions. For features such as minutiae points, ridges, and singular points, a high-resolution image, with at least 400 dpi (dots per inch), is required for feature extraction. However, features like principal lines and wrinkle scan be obtained from a low-resolution palmprint image with less than 100 dpi. In general, high-resolution images are essential for some applications such as law enforcement, where ridges, singular points, and minutiae points are extracted and matched in latent prints for identification and verification. Some companies, including NEC and PRINTRAK, have developed automatic palmprint identification and verification systems for law enforcement applications. For civil and commercial applications, low-resolution palmprint images are more suitable than high-resolution images because of their smaller file sizes, which results in shorter computation times during preprocessing and feature extraction. Therefore, they are useful for many real-time palmprint applications. The palmprint provides large quantity of information and have many advantages.

It deals with more~ stable physical characteristics and hence more stable biometric. It is mostly an acceptable biometric due to its permanence and uniqueness. Even identical twins have different principle lines, wrinkles, minutiae, datum point features and texture images.

However, the palmprint has a serious disadvantage also. The palmprint may undergo changes depending on the type of work the person is doing over a long duration of time. A palmprint basically shows certain skin pattern of a palm, composed of many physical characteristics like lines, points, and texture of the skin. The palmprint epidermis may be as thick as 0.8 mm comparing to other part of our body which is 0.07 to 0.12 mm thick. In response to continuous pressure and friction after birth, the epidermis gradually becomes thicker. Palm in general contains three flexion creases which are genetically dependent:

(i) Permanent creases (principal lines)
(ii) Secondary creases (wrinkles)
(iii) Ridges

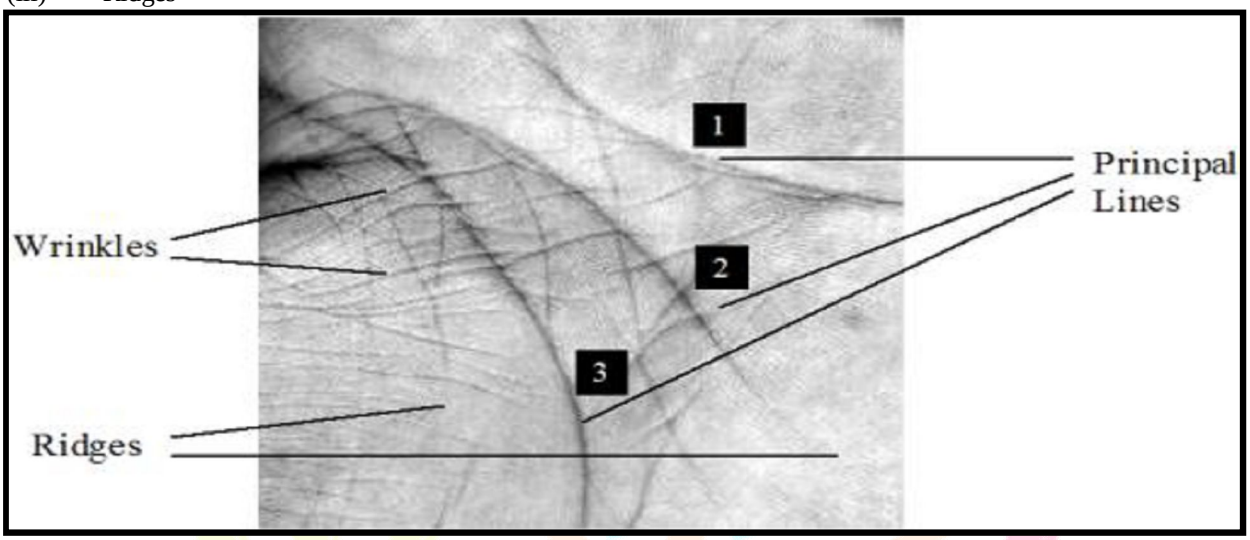

Fig.1 Palmprint Principal Features [1]

Automatic palmprint identification systems can be classified into two categories: online and offline. An online system captures palmprint images using a palmprint capture sensor that is directly connected to a computer for real-time processing. An offline palmprint identification system usually processes previously captured palmprint images, which are often obtained from inked palmprints that were digitized by a digital scanner. In the past few years, some researchers have worked on offline palmprint images and have obtained useful results. The widespread use of information technology in our daily lives demands reliable, stable and user friendly mechanism to authenticate individuals. Personal authentication using palmprint has emerged as a promising biometric approach. However, most of the multi-biometrics approaches impose burden on capturing hardware, computation, and cost. Palmprint images with an abundance of features such as principal lines, wrinkles, ridges and minutiae provide good discriminating ability for accurate authentication. The Palmprint features are shown in the figure below [1]. Gait Database for testing can be used according to availability. Some of the Gait Databases are CASIA Palmprint Database, PolyU Palmprint Database and IIT Delhi Palmprint Database.

II. LITERATURE REVIEW

In the past decade palmprints has been investigated by various researchers. Some of the recent researches are referred here.

Abdu Gumaei et. al. (2018) proposes that multispectral palmprint recognition system (MPRS) is an essential technology for effective human identification and verification tasks. To improve the accuracy and performance of MPRS, a novel approach based on auto-encoder (AE) and regularized extreme learning machine (RELM) is proposed. The proposed approach is intended to make the recognition faster by reducing the number of palmprint features without degrading the accuracy of classifier [2].

Mouad M.H. Ali et. al. (J018) publishes the methods to extract the Region of Interest (ROI) of palmprint image by using appropriate methods and to improve the accuracy of palmprint recognition system. This work illustrates Methods/Statistical Analysis which is primarily addressing the different mechanisms for extracting ROI area. The techniques like Competitive Hand Valley Detection (CHVD), and Euclidean Distance (ED) were applied as the part of pre-processing, while the Feature Extraction mechanism LBP was utilized to extract the texture feature from different type of ROIs of palmprint image [3].

Imad Rida et. al. (2018) proposes a simple and effective ensemble learning method for palmprint identification based on Random Subspace Sampling (RSS). To achieve it, system relies on 2D-PCA to build the random subspaces. As 2D-PCA is an unsupervised technique, features are extracted in each subspace using 2D-LDA. A simple 1-Nearest Neighbor classifier is associated to each subspace, the final decision rule being obtained by majority voting rule [4].

Ashish Kumar Malviya (2018) publishes that main goal of edge detection algorithm is to produce a line and extract important features and reduce the amount of data in the image. Edge detection is one of the most important steps in image processing. There are some techniques for edge detection such as Sobel, Preweitt, Roberts, LOG, and Canny. But it has some limitations like fixed edge thickness and parameter like threshold is difficult to implement. The fuzzy rule based technique does not have such limitation, as we can change the edge thickness simply by the changing the rules and output parameters [5].

Khushi Diccar (2018) provides the basic idea about palm print recognition using OpenCV libraries, principal component analysis (PCA) algorithm and Beagleboard XM: DM3730 platform, OpenCV library is having rich functionality for image processing [6].

Dexing Zhong et. al. presents a comprehensive overview of recent research progress of palmprint recognition as well as the basic background knowledge for it. In addition, it mainly focuses on data acquisition, database, preprocessing, feature extraction, matching and fusion. Ultimately, they discuss the challenges and future perspectives in palmprint recognition for further works [7].

Deepali Koul (2018) uses PCA, Gabor Filter and KNN for the aim of classification and matching. The work show palm print authentication system operates in 2 ways in which first is enrolment and the second is verification [8].

Ravindra G et. al. (2017) deliberates a novel and efficient method for the palmprint identification based on Gabor wavelet by using multi-block local binary patterns. Proposed method is further supervised through our proposed multi-layer feed-forward neural network for more accurate and computationally efficient recognition. Gabor wavelets efficiently filter the pre-processed image for getting optimum texture features through MB-LBP. Due to accurate feature representation of palm images through proposed LBP, anticipated MLFFNN training rate is high and we are getting much accurate results comparatively [9].

III. SYSTEM DESIGN & METHODOLOGY

The palmprint recognition system includes preprocessing followed by ROI (Region of Interest) 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. It is important to define a coordinate system that is used to align different palmprint images for matching. To extract the central part of a palmprint, for reliable feature measurements, we use the gaps between the fingers as reference points to determine a coordinate system. To extract texture features from low-resolution palmprint images and auto-thresholding procedures to handle palm replacement during data sampling. Given two data sets, a matching algorithm determines the degree of similarity between them. The proposed work will be tested on different international databases available for palmprint recognition. Also the comparisons of the tested results are made for achieving accuracy and efficiency for its versatility of operation over a global population.

The main objectives are:

- To binarize the palm image
- To initiate Boundary tracking
- To achieve Key point detection
- To establish a coordination system
- To extract the central part of Palm
- To segment the central part of palm to detect ROI.
- To use SBA (Subspace based Approach) which is PCA to extract features from ROI.
- To use Fourier Transform (FT) to enhance extracted palm features.
- To use Line based Approach for calculating matching matrix (Euclidean/Hamming Distance)
- To determine the match and record results for accuracy and efficiency.
- To do comparative analysis of the model for versatility over a global population.

The process is performing of two phases: Database Creation (Enrollment) and Testing (Recognition). During the training phase (Enrollment) each palm is captured by biometrics sensor or reader to generate a digital image. This image is used as training data, then pre-processing apply to training data for removing unwanted data, noise, reflection etc. The pre-processing is used to increase the clarity of image and extract Region of Interest (ROI). The output of pre-processing is passed to the Feature extraction stage for each training data, the feature data can be extracted and stored in the database .In the case of the testing stage (Recognition) the same process as in training stage, in addition, the matching steps between the training features and testing features, the result is match or non-match or recognized or not recognized. The palmprint recognition system is shown below.

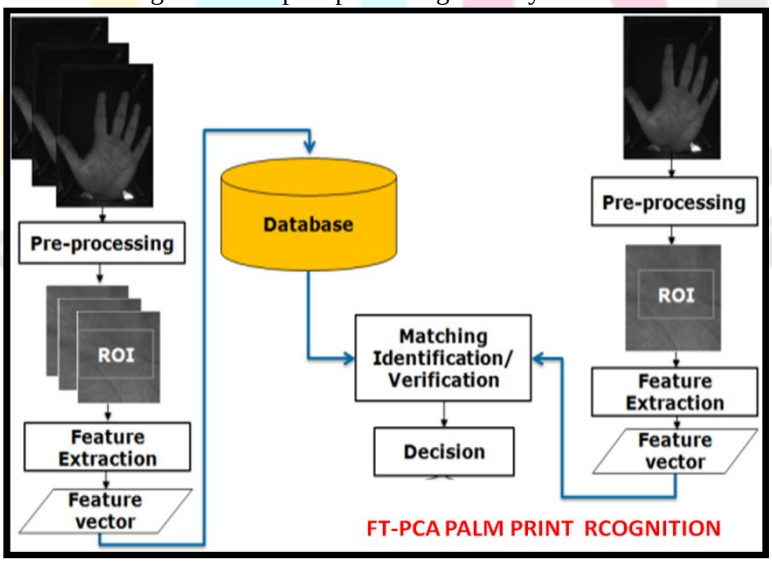

Fig.2 Palmprint Recognition Process

The ***proposed modification*** is that the system will be applying Fourier Transforms (FT) and Principal Component Analysis (PCA) combination for palmprint feature enhancement and recognition Palmprint recognition aims at finding out the palmprint template from the database, which is from the same palm as a given palmprint input. Feature extraction plays an important role in the recognition process. In this work, proposed is a new feature extraction method by converting a spatial domain palmprint image into a frequency domain image using Fourier Transform (FT) and representing palmprint features in the frequency domain. The extracted features are used as indexes to the palmprint templates in the database and the searching for the best match is leaded by these features in a layered fashion. PCA features encompass the discriminating capabilities of these multiple features, hence, PCA feature extraction is a promising choice for palmprint recognition. The Euclidean Distance or Hamming Distance can be used as matching metrics for the system. The flow chart of the basic system is shown below.

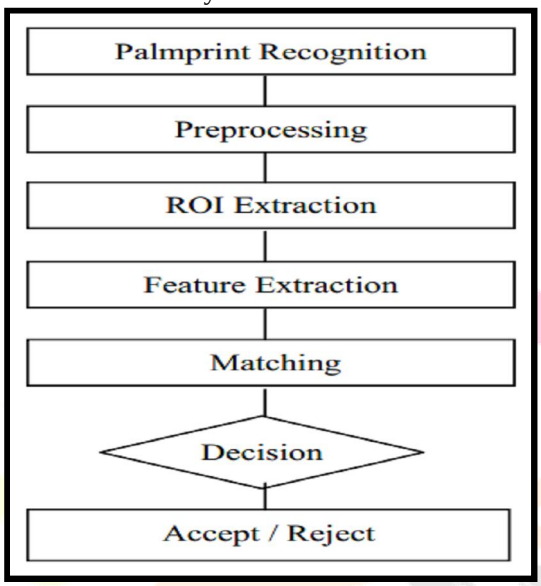

Fig.3 Flowchart of Palmprint Algorithm

IV. RESULTS AND DISCUSSIONS

The snapshot of Application Graphical User Interface for FT-PCA Palmprint Recognition System which was developed programmatically using MATLAB is shown in figure below. It consists of 10 buttons which have been assigned different functions to be performed by the application.

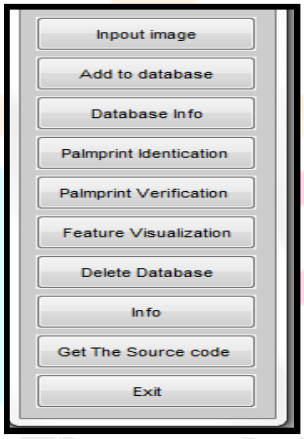

Fig.4 Palmprint Recognition GUI

Input Image: Select palmprint image. Region of Interest (ROI) will be segmented and feature vector will be encoded.
Add Selected Image to Database: Selected palmprint image will be added to database. An ID is required. ID is a progressive non-negative integer number associated to palmprint.
Database Info: Show information about all images present in database and the corresponding IDs.
Palmprint Identification (1: N Match): Selected image is compared with all palmprint images present in database. Code returns the ID of recognized image. Database has to include at least one image.
Palmprint Verification (1:1 Match): Just select two palmprint images. Selected images will be compared and code will return if they match or not.
Feature Visualization: Select an input image. Code will visualize original image, ROI image, encoded feature vector and mask.
Delete Database: Remove database and all saved images.
Info: View this file.
Get the Source Code: View the source code of the application in read only format.

Exit: Exit the Application GUI.

The palmprint image inputs from different databases namely CASIA, PolyU and self created are shown below.

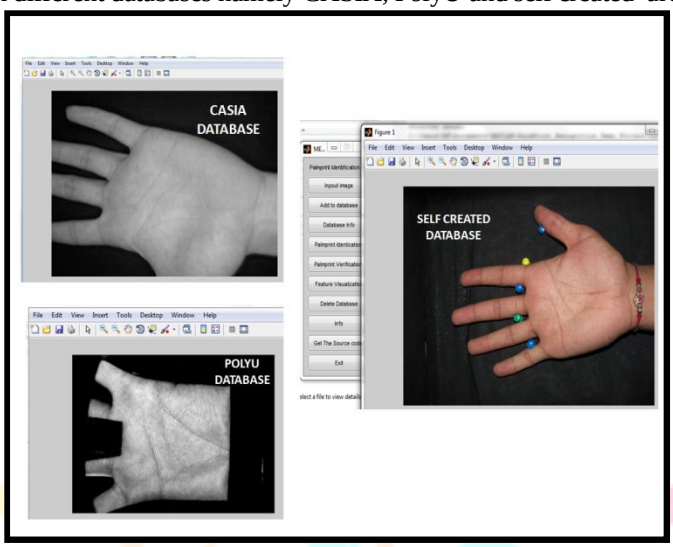

Fig.5 Palmprint Input Images from Different Databases

The feature extraction output from CASIA Database, PolyU Database and self database are shown below.

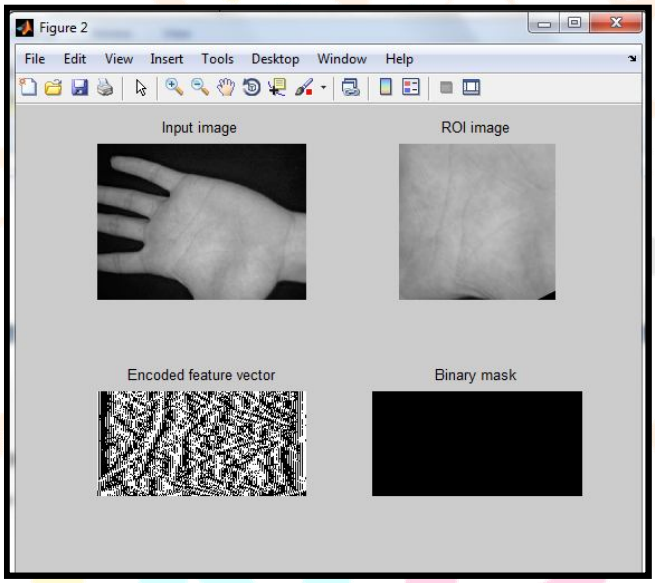

Fig.6 Palmprint Feature Extraction (CASIA Database)

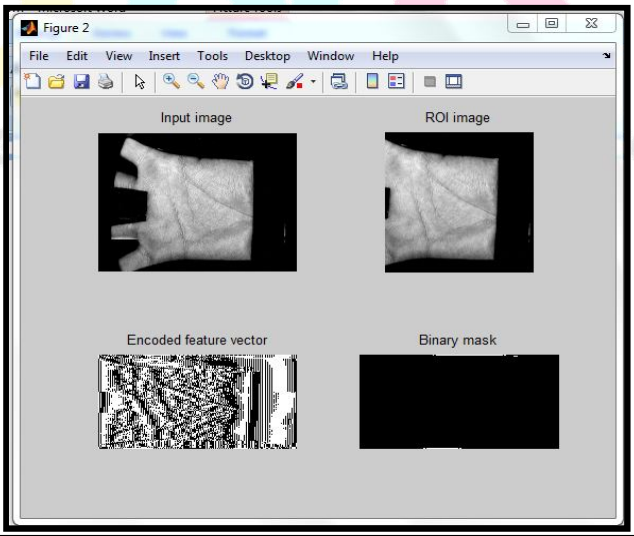

Fig.7 Palmprint Feature Extraction (PolyU Database)

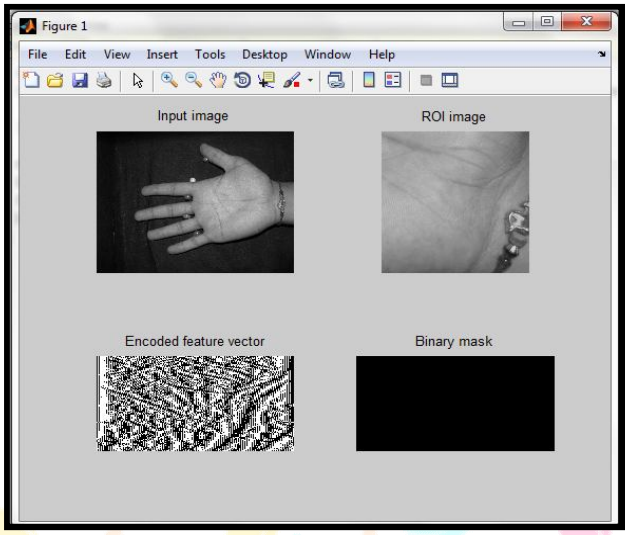

Fig.8 Palmprint Feature Extraction (Self Database)

V. CONCLUSION

The Application GUI for the Palmprint Recognition System has been developed along with initial stages of Palmprint Image Acquisition, Palmprint Image Pre-processing and Palmprint Image Feature Extraction. The application is to be tested on different databases for accuracy and performance and analytical comparisons are to be made on basis of testing.

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