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Palm Feature ANN-FTPCA Optimization for Palmprint Recognition

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ABSTRACT: The proposed work aims to enhance the features of palms using ANN optimization in MATLAB and will be tested on 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. By increasing the security of person'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. 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.

KEYWORDS: MATLAB, ANN, Palmprint Recognition, Palm Features.

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. 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.

The basic advantages of using palmprint as a promising biometric are:

1. High distinctiveness
2. Permanence
3. High performance
4. Non-intrusiveness
5. Low-resolution imaging
6. User-friendliness
7. Low price palmprint devices
8. High stability

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

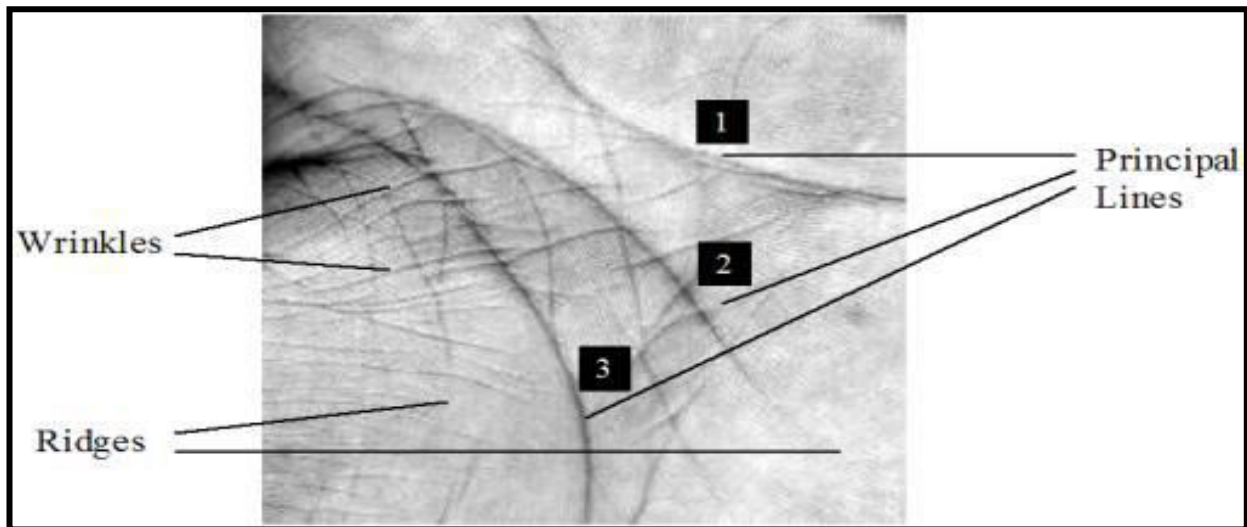


Fig. 1 Palmprint Principal Features [1]

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. Palmprint Database for testing can be used according to availability. Some of the Palmprint Databases are CASIA Palmprint Database, PolyU Palmprint Database and IIT Delhi Palmprint Database [1].

II. RELATED WORK

Abdu Gumaiei et.al. propose 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].

Ali et.al. publish 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].

I. Rida et.al. propose 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 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, Prewitt, 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 [5].

Khushi Diccar 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. present 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 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 Gupta et.al. deliberate on 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. 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. The ANN is used for feature optimization as a proposed modification to existing statistical model. Then matching is done on the basis of the extracted features. The palmprint is then accepted or rejected. The palmprint recognition system is shown below.

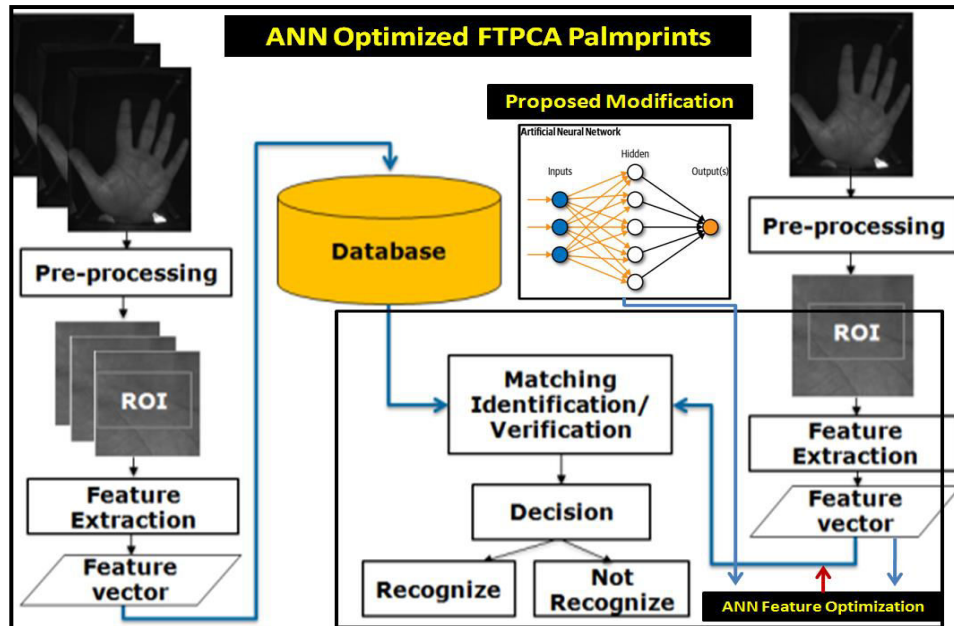


Fig. 2 ANN Optimized FTPCA Palmprint Recognition Process

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 ANN 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 *proposed modification* is that the system will be applying Fourier Transforms (FT), Principal Component Analysis (PCA) and Artificial Neural Network (ANN) Optimizer 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 but further enhancement of Eigen features are proposed using ANN in order to decrease the rate of 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.

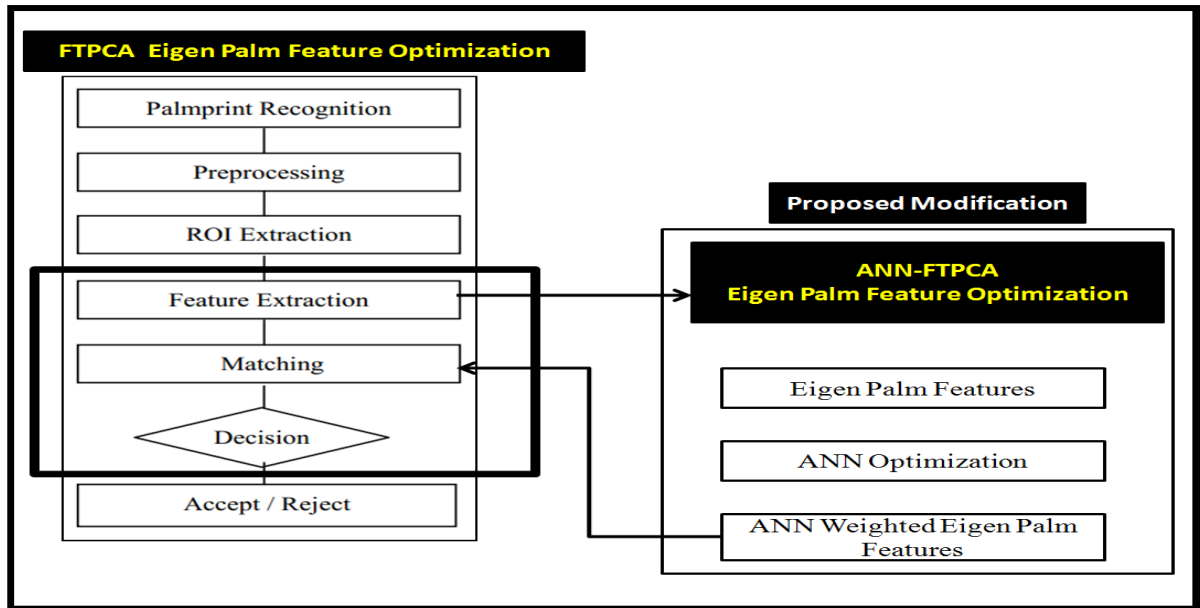


Fig. 3: Flowchart of Palmprint Algorithm with Proposed Modification

ANN Optimization is obtained using an **Artificial Neural Network (ANN)** which uses back propagation neural network, where the feature is captured and presented to the user in an image format. There are several algorithms that can be used to create an artificial neural network, but the Back propagation was chosen because it is probably the easiest to implement, while preserving efficiency of the network. Backward Propagation Artificial Neural Network (ANN) use more than one input layers usually 3(input layer, output layer and hidden layer).

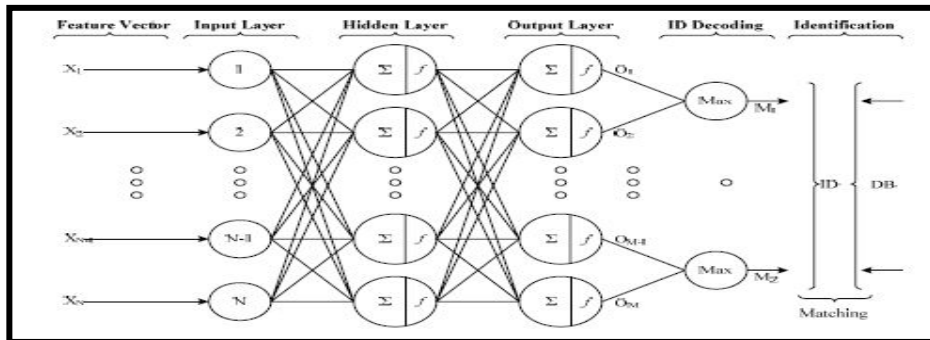


Fig.4 Two Layer Neural Network

The non-linear property of multi-layered neural networks is useful for analysis of complicated feature variable relationships which have traditionally been difficult to model analytically. Hence, an enhanced back-propagation algorithm for training multi-layered neural network, based on selective retraining and a dynamic adaptation of learning rate and momentum, is employed to recognize the feature. An automated pattern recognition system minimally contains an input subsystem that accepts sample pattern vectors and a decision-maker subsystem that decides the classes to which an input pattern vector belongs. If it also classifies, then it has a training phase in which it learns a set of classes of the population from a sample of pattern vectors, namely, it partitions the population into the subpopulations that are classes. As described above, a multi-layered feed-forward neural network is employed here to train and recognize the human feature. Figure 3 shows the network architecture used within this study. In the figure, \mathbf{X} is the input feature vector with N elements, and \mathbf{O} is the output vector with M elements. The neural network has one hidden layer of sigmoid nodes followed by an output layer of linear nodes To train the network, the enhanced back-propagation algorithm is used. Also, the nodes of output layer are divided into two groups, and information about a maximum output node of each group is used to decode the output to an identification code of feature.

IV. EXPERIMENTAL RESULTS

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.

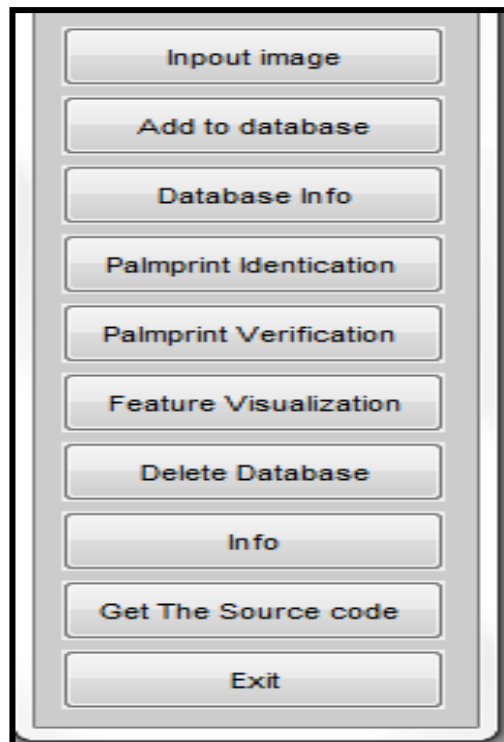


Fig.5 Palmprint Recognition GUI

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.

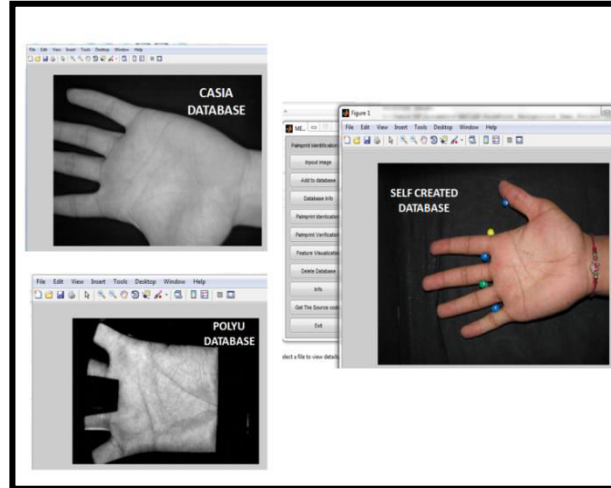


Fig.5 Palmprint Input Images from Different Databases

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

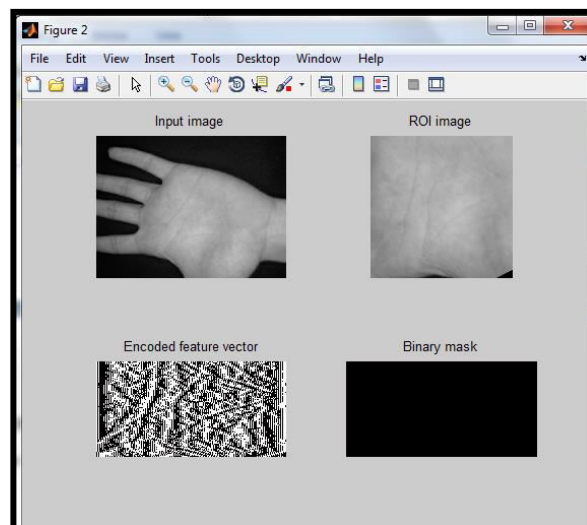


Fig.6 Palmprint Feature Extraction (CASIA Database)

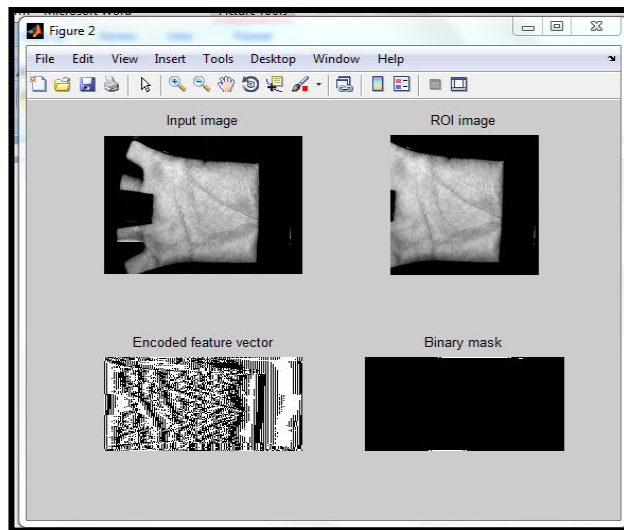


Fig.7 Palmprint Feature Extraction (PolyU Database)

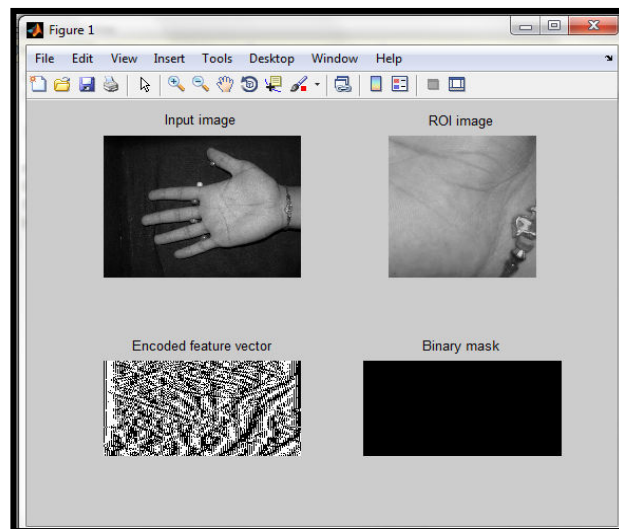


Fig.8 Palmprint Feature Extraction (Self Database)

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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