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# Combining left and right palmprint for enhanced security using discrete wavelet packet transform

**Komal Kashyap*** **and Ekta Tamrakar**
Department of Electronics and Telecommunication, Bhilai institute of technology, Durg, India
piakashyap04@gmail.com

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## Abstract

*The aim of present research work on palmprint recognition using discrete wavelet packet transform (DWPT) algorithm for palmprint feature extraction and ANFIS (Adaptive Neuro-Fuzzy Inference System) for palmprint matching. Biometrics based fingerprint, face, iris recognition has been investigated over many year. Palmprint recognition is an emerging technology in recent years due to the transaction frauds, security breaches and personal identification etc. compare to fingerprint, palmprint contain rich features like, principle line, wrinkles, ridges, and minute points, it provides high standard security. This paper developing multibiometrics using left and right palmprint images and gives higher accuracy then single biometrics system. Registered IITD palmprint database is collected from IIT Delhi, biometric research library. It consist 2600 images from both left and right hand. This experiment perform palmprint recognition for enhance security using IITD database. MATLAB have been used as the programming tool to implement and investigate the performance of the palmprint recognition system using image processing toolbox.*

**Keywords:** Biometrics, Multibiometrics, Left and Right Palmprint Image, Feature Extraction, Discrete Wavelet Packet Transform (DWPT).

## Introduction

Biometrics is an emerging technology in the field of various pattern recognitions. Biometric identification system used to deal with security problem and also identifying the physiological and unique behavioural characteristics of human. Many traditional automatic personal recognition methods such as: signature, user id, password and ID cards to provide security. At present day, these method are not appreciable because signature can be replicated, keys and passwords are difficult to forgot or lose. For such reason biometric system usually associate with the use of biological and physiological characteristic of people such as fingerprint, palmprint face, iris, gait, and voice for personal identification. Biometric refer two type of identity matching: Identification and Verification. In identification mode, system matches the single image or biometric samples against N image of previously stored sample whereas in verification mode, system matches one-to-one comparison between a previously acquired template of an individual's which we want to authenticate[1].

Palmprint identification method is best for individual identification and it has attracted more attention. Palm is the inside surface of our hand between the wrist and fingers. Palm contains various features such as principle lines, wrinkles, minutiae, datum point feature, and texture images. Palm area larger than fingerprint; hence more discriminative features we can captured[2]. Biometrics system based on single biometric characteristic are called unimodal biometric. These biometric cannot give as perfect identification and has various problems like noisy data, spoof attack, non universality and high error rate. To overcome this limitation by using multimodal biometrics system it gives higher accuracy than compare to unimodal biometrics system, so it gives high standard security. Combination of left palmprint and right palmprint perform multi-biometric and obtain better result than the single biometrics and increase to fraudulent technologies[3-4].

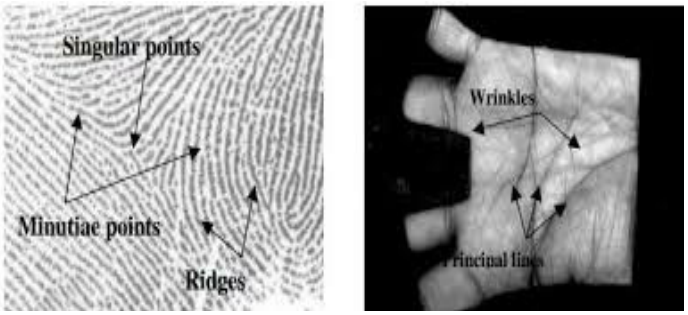


**Figure-1:** Palmprint Features.

## Methodology

Proposed methodology adopted for palmprint image feature extraction is shown in Figure-2. In this work discussion about collection of palmprint database, image preprocessing and segmentation, feature extraction using discrete wavelet packet transform (DWPT) and matching using ANFIS. The detail discussion of all steps in explained below.

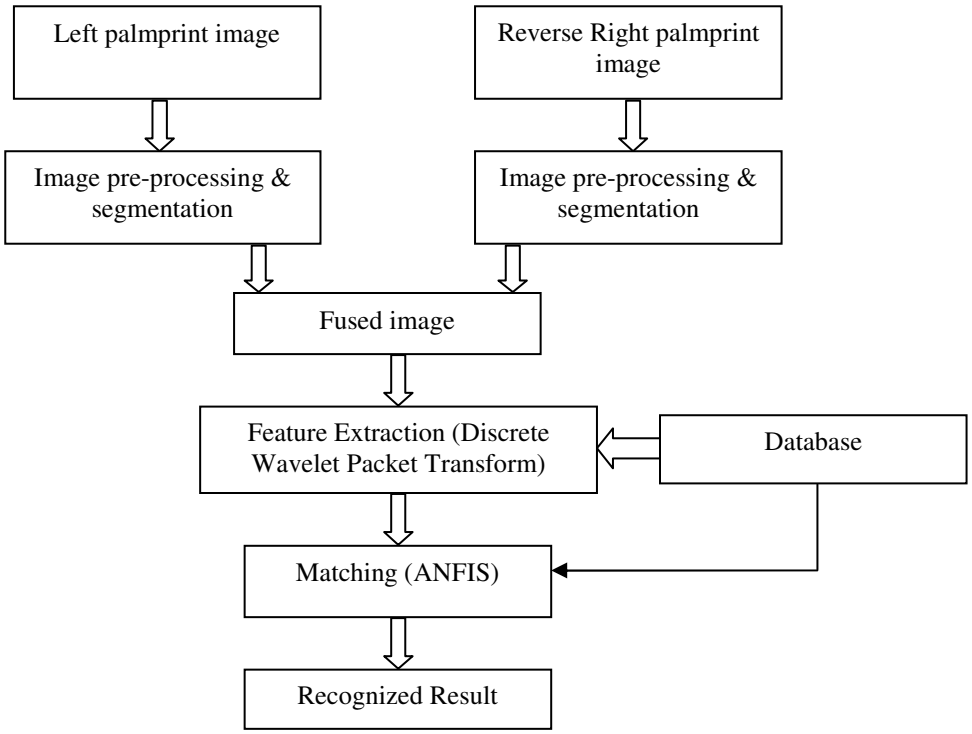


**Figure-2:** Block Diagram of Proposed Method.

**Step-I: Image Acquisition and database collection:** Image acquisition is a first step in palmprint identification system or biometric recognition system. Image acquisition is divided into two categories: offline and online. Recently work in online acquisition method, these can also divide into two types: touch based and touches less. Online palmprint image is captured by different sources like- digital scanner, digital cameras, video cameras, and CCD (charge-couple device) based scanner. CCD based palmprint scanner collect high quality palm images[5].

The proposed system collect palmprint image from public IITD database developed from staff member and student of IIT Delhi. These are contactless based palmprint database was captured in the indoor environment. This database collected in Biometric Research Laboratory during January 2006 to July 2007 using a CMOS camera. The IITD palmprint database consists of left and right hand 2600 image from 230 users. These are corresponding to 460 different palms in JPG image format. Each hand contribute at least 5 hand image sample in various rotation, translation and variation in pose. In additional segmented image of each sample are also available. These are 800 x 600 pixels in BMP format. In this paper we created segmented image using MATLAB R2016a. After image collection reversed the right palmprint image by using flip function[6].

**Step-II Image preprocessing and segmentation:** Image pre-processing is performed in second step. From the RGB image, the image processing will be performed. The original image from the database may be in JPG type of image. Image pre-processing is process of converting RGB image into Gray scale image. Pre-processing is also used to remove noise and distortion. When palmprint image are captured, some variation may occur such as translation, rotation and low image quality, cause recognition problem. Then central area of palm and region of interest (ROI) is cropped and rotated using segmentation process[7]. It involves five steps: i. Original palm image are converted into a binary image by using a threshold. ii. Track the boundary of palm.iii. Key point detection - Find two references point (P1 and P2) and three equidistant point pa, pb, and pc on the boundary make turning angle. iv. Establishing co-ordinate system, v. Crop and rotate the ROI.

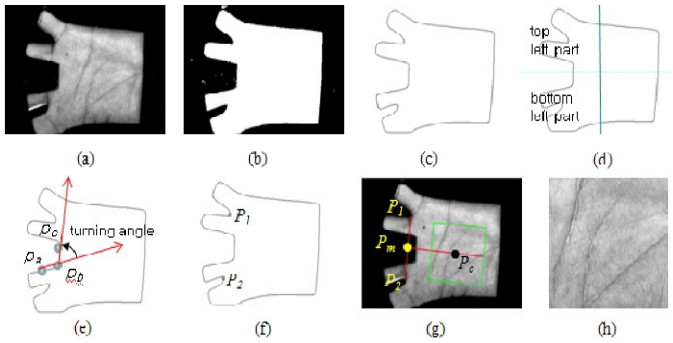


**Figure-3:** Pre-processing & segmentation steps; (a) original palmprint image; (b) Binary image; (c) boundary tracking; (d) top and bottom left part; (e) turning angle; (f) reference point selection; (g) central point and segmented ROI; (h) ROI extracted image.

**Step-III Feature Extraction:** In image processing application, discrete wavelet transform (DWT) is a mathematical tool applies image decomposition. Wavelet transforms works on both frequency and time domain. DWT works as a filter, it involve two types of filter such as "wavelet filter" and "scaling filter", which is associated with high pass and low pass filters respectively. The decomposition of the signal into different frequency bands is basically successive high pass and low pass filtering of the time domain signal.

Figure-4 shows the decomposition using DWT. After applying first level decomposition on original image, the original image can split into four sub-bands. The DWT separates an image into a lower resolution approximation image (LL) as well as horizontal (HL), vertical (LH) and Diagonal (HH) detail components. If we applying a second level of decomposition the approximation sub-band can again split into four sub-bands.the procedure can then be repeated to compute multiple scale wavelet decomposition. Applying inverse discrete wavelet transform (IDWT) in these sub-bands the original signal/image are reconstructed. It is the transform based on frequency domain. In DWT the decomposition of signal using discrete wavelet transform decomposed in two parts, approximated component and detailed component. Then approximated component again decomposed into two parts but further decomposition of detailed component is not possible[8].

Feature extraction is a most important process in image processing application. In this paper applying discrete wavelet packet transform (DWPT) algorithm for palmprint feature extraction. Before feature extraction DWPT is fused the Left and Reverse Right palmprint image. The DWPT is a generalization of DWT .In the decomposition of signal using wavelet packet transform first of all signal is decomposed into two part approximated component and detailed component then there are further decomposition of both component is possible. There is more data loss occur in discrete wavelet transform as compare to wavelet packet transform because of in DWT the further decomposition of detailed component is not possible where as in WPT further decomposition of detailed component is possible. In this work, after fusing the training palmprint images feature vector are calculated using DWPT and compare with testing data[9].

**Step-IV Matching:** Matching is a process to compared test sample feature vector to the feature stored in the database, and checked with that template from which maximum similarity is obtained. Next matching is successful if the defuzzified value obtained by ANFIS is greater than the threshold value otherwise unsuccessful match. Fuzzy logic has been applied to many biometric matching systems such as face, fingerprint, palmprint recognition and so on. In this paper we applied ANFIS for palmprint matching. The ANFIS combines both fuzzy logic principle and the neural networks concepts. ANFIS uses 2 membership function and we calculated 8 different feature vector value using DWPT. ANFIS created 256 (If-Than) rules on the basis of membership function and feature vector value i.e. $2^8$=256. When testing is performed, using the Fast Fourier Transform the Euclidean distance is calculated and is stored. Then this distance is compared with the threshold value decided, for matching the palm image. And the hence obtained image is either more or less then the threshold. Finally if, the obtained value is less than that of given threshold, then the result is recognized or else it is unrecognized[10-11].

## Results and discussion

For implementing proposed methodology we collect IITD database image from biometric research library. The simulation is performed in MATLAB R2016a software by using image processing toolbox. Below fig shows the palmprint recognition in different steps. Figure-5 (a) is input left palmprint image & their respected ROI image, Figure-5(b) Reverse right palmprint image & their respected ROI image, Figure-5(c) Feature Extraction of Fused image using DWPT, Figure-5(d) Matching using ANFIS, Figure-5(e) Recognized Result.

## Conclusion

This paper performs multibiometrics using combination of both left and right palmprint image because both palmprint images of the same person are somewhat similar. It gives better recognition rate with high standard security. The simulation of palmprint recognition is performing using MATLAB R2016a software. This paper represent discrete wavelet packet transform (DWPT) algorithm for palmprint feature extraction. Feature vector obtained using DWPT provides better segmented feature as compare to DWT. Matching is done using ANFIS, hence recognition of palmprint is accurate. But we cannot choose much input and much membership function as with the increase value of 2 huge amount of rules are created with overload the system and hence may result inappropriate functioning. In future can be analyze the proposed system using much no of membership function and one can do hardware implement of the proposed system.

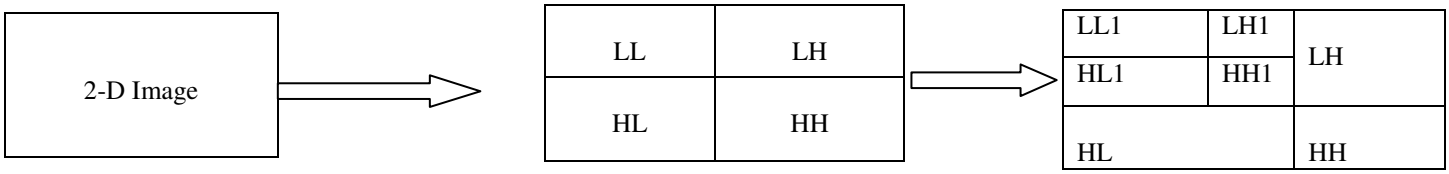


**Figure-4:** Basic Decomposition Steps for Image.

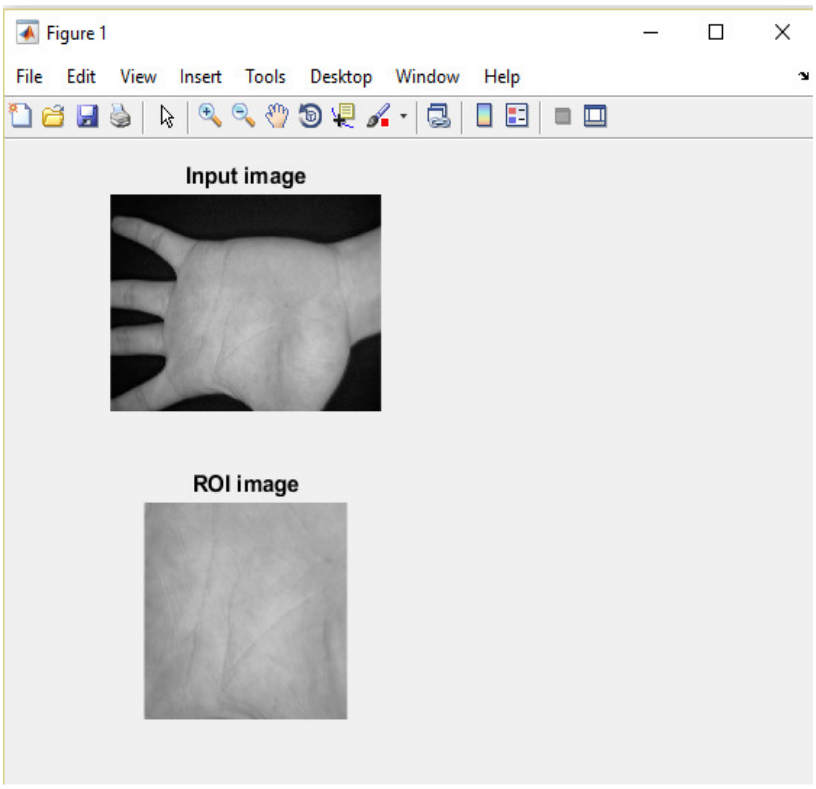


**Figure-5(a):** Left palmprint image & ROI image.

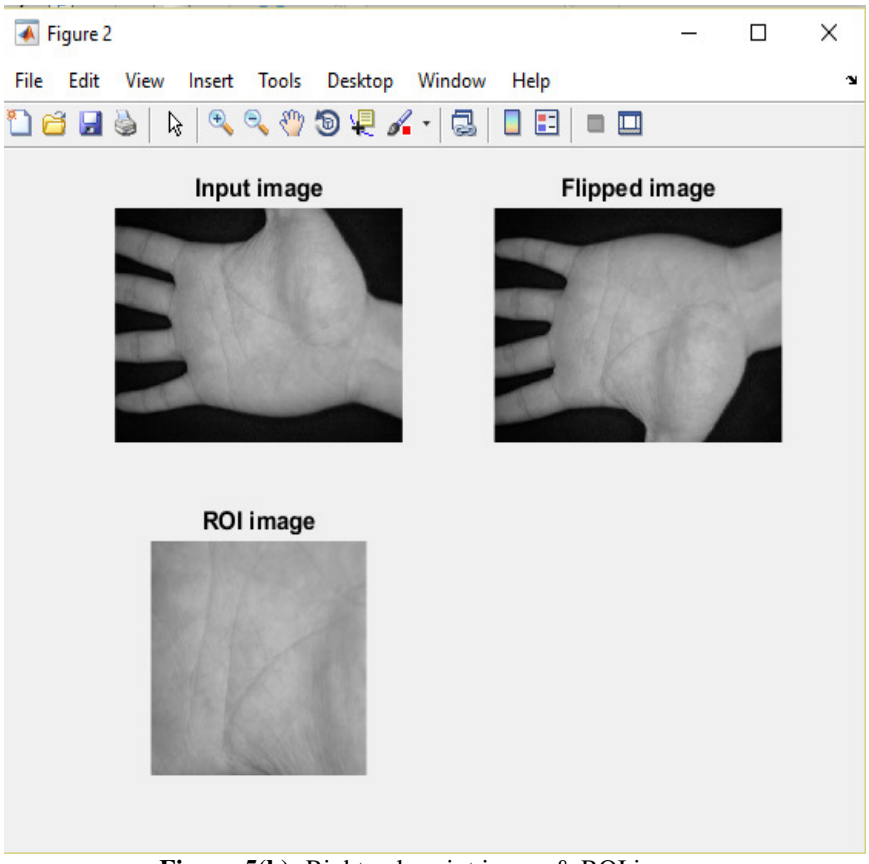


**Figure-5(b):** Right palmprint image & ROI image.

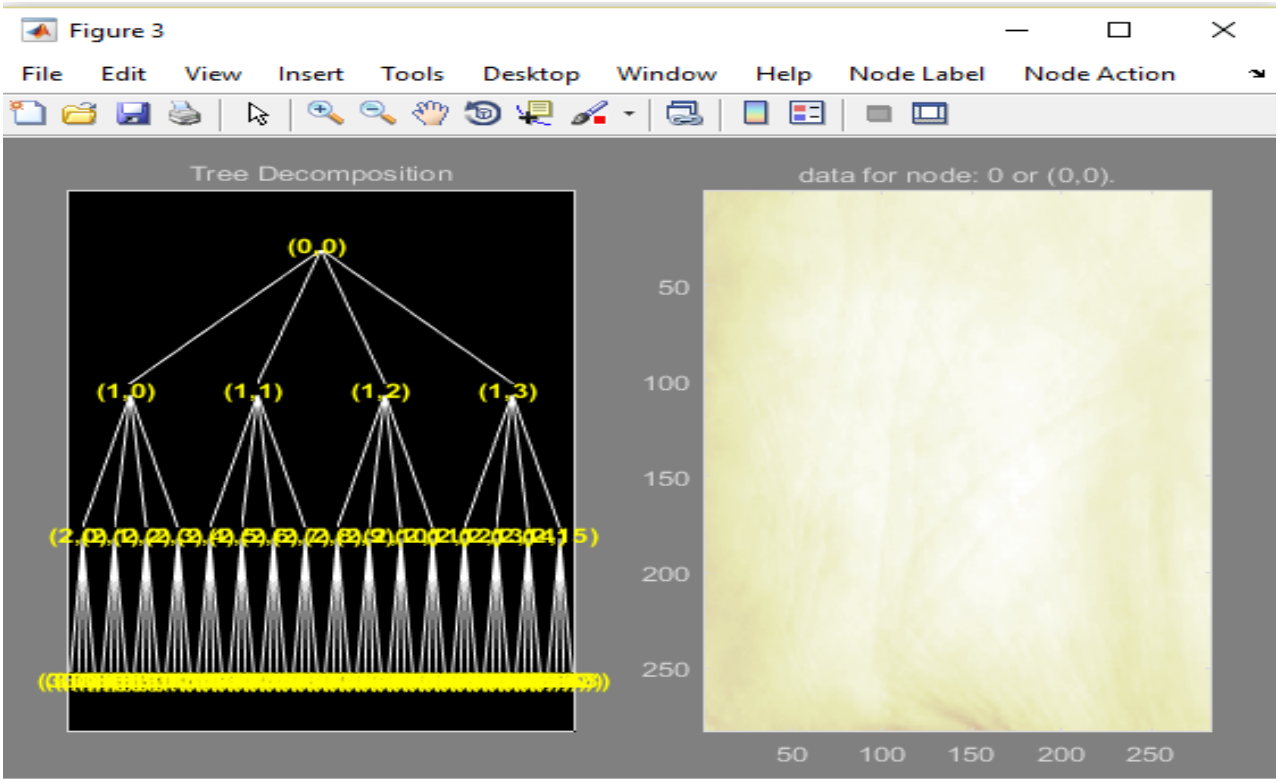


**Figure-5(c):** Feature Extraction of Fused image using DWPT.

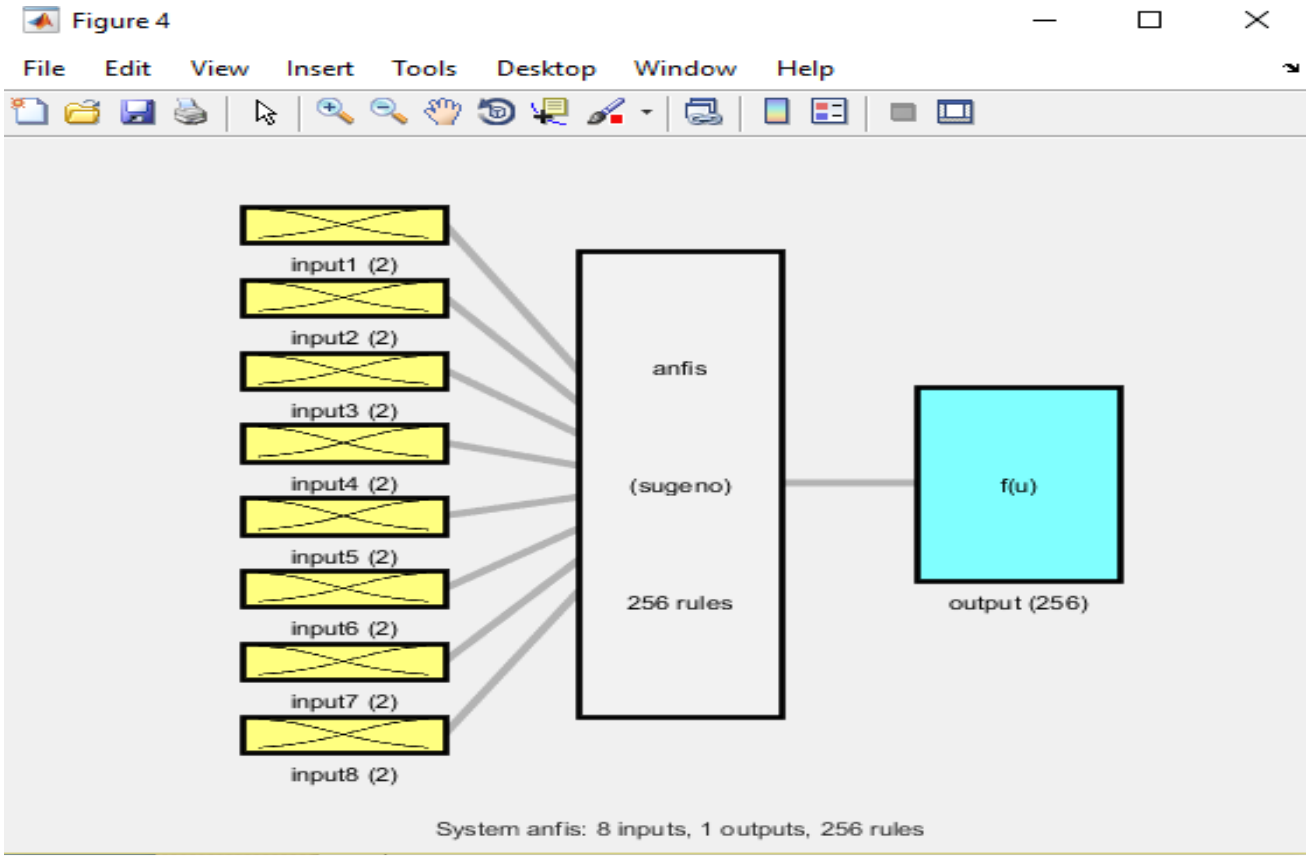


**Figure-5(d):** Matching using ANFIS.

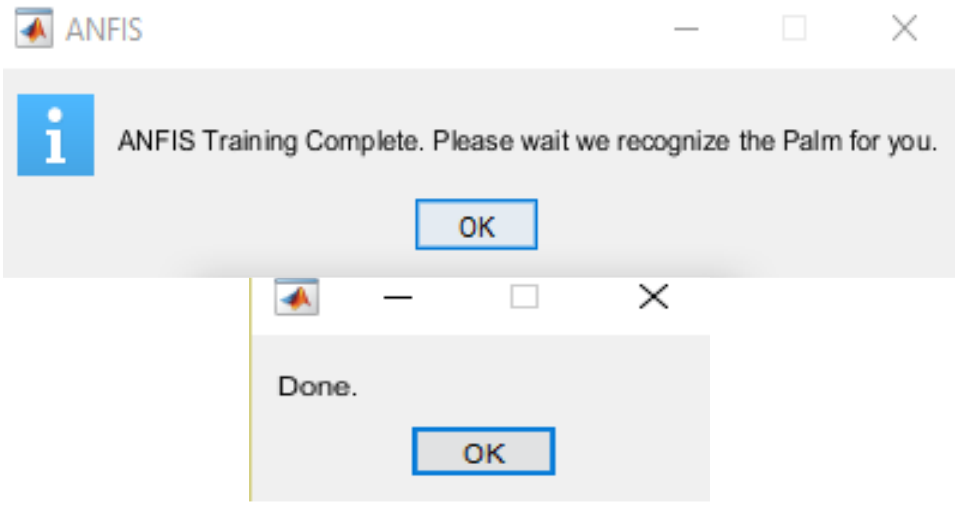


**Figure-5(e):** Recognized Result.

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