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Palm Vein Recognition with Fuzzy-Neuro Technique

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Abstract: *Vein recognition is an emerging technology which frequently gains importance in the biometric field. In this paper palm vein recognition system is presented which is used for recognition or identification. The lots of work have been done on the Palm Vein technology but there is still a scope of further improvement. The accuracy and response time of the existing system is slow which can be improved. Error extractions due to bad quality of the palm vein pattern images may lead to the fatal errors of the process. The quality of images is low. In this paper feature is extracted using region growing approach and that Fuzzy-Neuro is used to enhance the response time and accuracy of system. This work s done with MATLAB and result is concluded on the bases of some parametric (Precision, Recall, Accuracy, Specificity, EER, FRR, FAR, NPV).*

Keywords: *Palm Vein, FUZZY-NEURO, EER, FRR, FAR, Precision, Recall, Specificity, Recognition.*

1. INTRODUCTION

Image processing methods stems from two principal application areas: improvement of pictorial information for human interpretation, and processing of scene data for autonomous machine perception. In advanced picture transforming framework, initial phase the whole time is Image Acquisition it oblige securing a picture, After a computerized picture has been gotten, the following step manages Pre-preparing its capacity is to enhance the picture in ways that expand the chance for accomplishment of alternate courses of action, the following step manages Segmentation it parcels a data picture into its constituent parts or items, Representation & Description manages make information in the structure that suitable for machine handling, and after that Recognition is that allots a name to an item, and last Interpretation includes intending to a collect of perceived articles.

1.1 Purpose of image processing

1.1.1 Visualization - Observe the objects that are not visible.

1.1.2 Image sharpening and restoration - To create a better image.

1.1.3 Image retrieval - Seek for the image of interest.

1.1.4 Measurement of pattern – Measures various objects in an image.

1.1.5 Image Recognition – Distinguish the objects in an image.

1.2 Palm Vein Technology

The individual ID utilizing hand and palm vein is getting more considerations these years [1]. In this biometric approach no of great properties can be captured:1) the vein data can speak to the exuberance of an item; 2) it is hard to be harmed, produce and changed as it is available inside in the body. Due to these reasons Vein Recognition System is better than unique finger impression and face distinguishment.

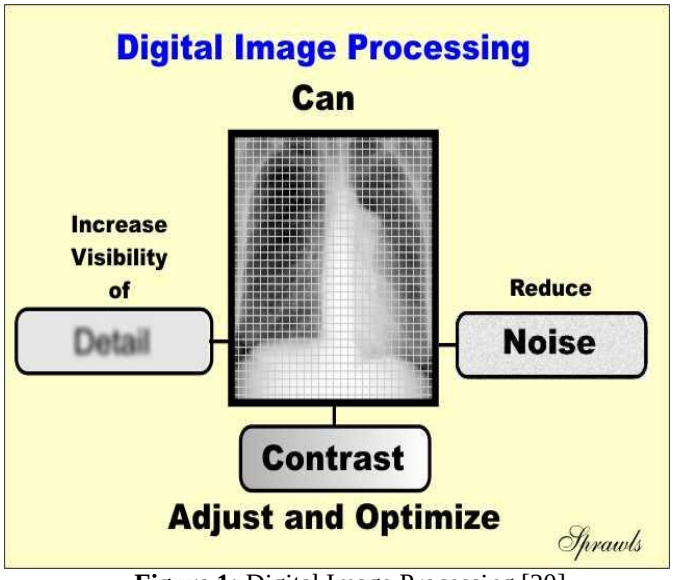

Figure 1: Digital Image Processing [20]

The Vein Recognition System is a sort of Biometric System which utilizes the vein example to perceive the individual as it is exceptional to every individual [3]. Separated from size, the example is consistent after some time. The Fingerprint and face distinguishment framework are not as much compelling as vein Recognition System on the grounds that it has a gimmick that makes it material for one to numerous matching. Palm

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distinguishment is a System which gets further examination among all the biometric procedures on the grounds that the framework's innovation beats a rendition to fingerprinting and related protection concerns, which its customary relationship to criminal movement is nonexistent. As palm veins lie under the skin surface so they are hard to reproduce, besides the framework meets expectations by distinguishing the subcutaneous vein examples of singular's vein. As veins are extraordinary even between twins that are the reason this System picked up more consideration and investment [7]. Moreover, it won't modified amid the ones lifetime and difficult to peruse or produce since it is available under the skin. The most imperative preference of palm vein is that it is exist just for live people.

1.3 Advantages of Palm Vein Technology:

Vein distinguishment engineering contains no of focal points as officially talked about that is secure in light of the fact that accreditation information is available inside the body thus it is truly difficult to manufacture. It is exceedingly substantial and dependable. Besides, it won't adjust amid the individual's lifetime and awkward to peruse or duplicate since it lies under the skin. In this manner it comprises of no of preferences portrayed as beneath [6]:

1.3.1 Vein design innovation is thought to be secure as it gives "enthusiasm" location.
1.3.2 The palm vein vascular structure is separately unique even between twins.
1.3.3 Vein examples are not effortlessly satirize, watched, harmed, clouded or changed.
1.3.4 Vein design distinguishment obliges straightforward low determination imaging gadgets.
1.3.5 the engineering is dependable in that is shows little execution corruption in cruel situations, for example, mines, assembling and development locales and in addition substantial movement territories, for example, schools, army installations and dorms.
1.3.6 capable of 1:1 and 1: numerous matching. Clients' palms are matched against customized ID cards/savvy cards or against a database of numerous checked palms.

The above area furnishes the presentation along with the different reasonable application and points of interest of Palm Vein Technology. Because of these application and focal points the Vein Recognition System accomplish prevalence for further research.

2. LITERATURE SURVEY

The paper published by Jing-Wein Wang, et.al on "Building Palm Vein Capturing System for Extraction" [3] Author creates a three phase vein controlling system. First phase is also called pre-processing in which author improves the image quality like a high boot filter for image enhancement. Second phase is called feature extraction phase. In which we extract the vein feature by "Pixel by pixel" scanning. After scanning equivalent level pair is sorted. In the last step a second scan is made through the image during that every level is replaced by the label assigned. Third phase is post processing phase in which we do thinning for removing the unnecessary information. This procedure erodes away the boundaries of foreground objects but does not affect pixels at the ends of lines.

A paper published by Huan Zhang, et.al, on "A Palm Vein Recognition System"[4] In this paper creator discussing the catching gadget which is utilization to catch the information or Photos. He utilized CCD cam for this reason. In the proposed palm vein revamping framework, a JAI AD-080 CL 1/3" CCD close infra cam is utilized to catch the palm vein picture. In pre-processing the engraved ring based division which separates the ROI from the first palm vein picture focused around a recorded round is utilized which meets the limit of a palm so it can remove as huge a territory as could be expected under the circumstances from the focal piece of the palm vein picture. Since diverse palms are distinctive measured, the radii and middle of the round may be diverse. On the off chance that the radii are not shut to one another, we can close instantly that the two palm vein pictures are from distinctive persons. When the round is dead set, the extraction just includes acquiring a predefined rectangular zone inside the ring. To diminish some high recurrence commotion, ROI picture is then smoothed by the Gaussian smooth channel, neighborhood contrast upgrade is utilized to improve the ROI picture. In the proposed palm vein distinguishment framework, we separated the vein designs which incorporate vein length and details for distinguishment and matching. Finally, the diminishing strategy which is an experienced innovation in finger impression distinguishment is utilized to thin and repair the vein line and the position data of the particulars can be got.

A paper published by Sahar Bayoumi, et.al, on "PCA-based Palm Vein Authentication System"[7] In which they proposed a framework for verification utilizing Palm Vein focused around utilizing standard part examination (PCA) for peculiarity extraction. Palm vein pictures of dorsa caught utilizing infrared cam. PCA is connected to create vector of peculiarities that speak to the most elevated nitty gritty variation data .They PCA on each one picture of the preparation set as opposed to building a network of all the preparation set. Different steps of PCA Algorithm are beginning from standardization which is utilized to change the scope of pixel power values. At that point covariance lattice will be computed from the standardized picture to recognize the most segregate peculiarities in the picture. The Eigen qualities and Eigen vectors are ascertained utilizing the covariance network which is utilized as the gimmicks of vein. A matching methodology is then connected to discover the best match from the information base to perceive and confirm the individual.

A paper published by Yi-Bo Zhang, et. Al on" Palm Vein Extraction and Matching for Personal Authentication" [1] in

which they propose a plan of individual validation utilizing palm vein. The proposed framework incorporates four stages. To start with stage is infrared palm pictures catch in which they utilize ease CCD cam to catch the infrared palm pictures. Second stage is discovery of Region of Interest in which a little region (128*128 pixels) of a palm picture is found as ROI to concentrate the peculiarities and to look at changed palms. return on initial capital investment is spotted by a standardized direction focused around the palm limits. The distinguishment blunder brought on by a client who somewhat turn or movement his/her hand is minimized. Third stage is palm vein extraction by multistage sifting to enhance the execution of vein discovery. Fourth stage is matching in which the palm vein picture is put away as palm vein layouts (just 0 and 1 in the formats), the closeness of two palm pictures i.e the format picture and the information picture can be ascertained by layout matching.. The trial results exhibit that the distinguishment rate utilizing palm vein is great.

A paper published by Qing Rae, et, al on "Personal Identification For Single Sample Using Finger Vein Location and Direction coding" [8] in which they propose an organized individual recognizable proof methodology utilizing finger vein Location and Direction Coding (LDC Author plan a finger vein imaging gadget with close infrared (NIR) light source, by which a database for finger vein pictures is built. At that point they do pre-processing of the picture in which they section the state of finger by utilizing slope administrator to locate the vertical lines as finger edge then they utilize size and splendor standardization for gimmick extraction and last matching. In LDC the vein valley attributes is dissected in which it is viewed as that the point has high likelihood of being in the vein range when it is in the valley. After division the average channel is utilized to smoothen the picture by uprooting the clamor. In the wake of smoothening the vein area and heading coding is carried out in which the covering of the bearing guide onto the double vein area guide yield the vein gimmick map with course data. The organized gimmick picture is used to lead the individual recognizable proof on our picture database for finger vein by ascertaining the aggregate no. of matched focuses.

A paper published by Debnath Bhattacharyya, et al; "Vascular Pattern Analysis towards Pervasive Palm Vein Authentication"[2] in which they propose an Image Analysis strategy for Vascular Pattern of Hand Palm, which thusly heads towards Palm Vein Authentication of a single person. These three separate methodologies are: a. Vascular Pattern Marker Algorithm (VPMA); in which the two pass covering is utilized, for example, level and vertical portions to smoothen the picture b. Vascular Pattern Extractor Algorithm (VPEA). In the event that a pixel in the picture has a force esteem short of what the edge esteem, the relating pixel in the resultant picture is situated to dark. Something else, if the pixel power quality is more noteworthy than or equivalent to the limit force, the ensuing pixel is situated to white. Accordingly making a pairs picture, or a picture with just 2 colors, dark (0) and white (255). Vascular Pattern Thinning Algorithm (VPTA) in which diminishing is finished catching the Vascular Pattern of hand Palm of a single person.

A paper published by Du Ge-guo, et.al on "The Anti-spoofing Study of Vein Identification System"[9] in which they shows a sort of vivacity identification strategy focused around an optical estimation for grouping infrared pictures. The vein pictures are connected with essential signs, for example, oxygen immersion in human blood and heart rate. Two sorts of distinctive calculation are utilized for gimmick extraction, one for fundamental signs discovery, the other for distinguishing proof. In the calculation the peculiarity closeness degree limit are characterized as p1 and p2. In the event that the gimmick comparability degree p of two pictures from nonstop testing is extraordinary than p1, the two pictures are checked similarity. In the event that p is short of what p2, the two pictures are stamped freedom. This technique can keep the ID mocking and enhance the security capacity of vein recognizable proof framework. Applying the above expressed calculation, an enhanced framework can be effectively developed that fake vein enrolment, quick finger vibration, false blood ease can't pass the examination.

A paper published by Mona A. Ahmed, et.al on "Analysis of Palm Vein Pattern Recognition Algorithms and Systems"[10] in which they presents an analysis of palm vein pattern recognition algorithms, techniques, methodologies and systems. It discusses the technical aspects of recent approaches for the following processes; detection of region of interest (ROI), segment of palm vein pattern, feature extraction and matching. In this paper they analyze the various techniques that is used by the various researchers to develop their system i.e the various method by which the acquisition, region of interest, feature extraction and matching is done. The results show that, there is no benchmark database exists for palm vein recognition. For all processes, there are many machine learning techniques with very high.

A paper published by Masaki Watanabe, et.al on "Palm vein authentication technology and its applications"[10] in which the various application of the palm vein are described. This paper discusses the contactless palm vein authentication device that uses blood vessel patterns as a personal identifying factor. The vein information is hard to duplicate since veins are internal to the human body. The palm vein authentication technology offers a high level of accuracy, and delivers the following results: a false rejection rate (FRR) of 0.01%, and a false acceptance rate (FAR) of 0.00008% or lower, based on Fujitsu research using the data of 140,000 palms.

Table below show the data in points from where description is given about the paper. It has paper title, authors name, year of publication and Pros & Cons...

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PAPER	AUTHOR NAME	YEAR	PROS	CONS
Building Palm Vein Capturing System for Extraction	Jing-Wein Wang, Tzu-Hsiung Chen	2011	The performance of The accurate extraction ratio is 93.35%	Error extractions due to bad quality of the palm vein pattern Images may lead to the fatal errors of the process.
A Palm Vein Recognition System	Huan Zhang, Dewen Hu	2010	Equal Error Rate (EER) of our approach is only 1.82%,	the proposed system got a fine Recognition performance but not good.
PCA-based Palm Vein Authentication System	Sahar Bayoumi, Sara Al-Zahrani Afnan Sheikh, Ghada Al-Sebayel, Sulaf Al-Magooshi, Sara Al-Sayigh	2013	Their system was able to identify 85% of the unknown patterns in real-time which considered good results regarding to the local PCA features	The accuracy and response time is slow.
Palm Vein Extraction and Matching for Personal Authentication	Yi-Bo Zhang, Qin Li, Jane You, and Prabir Bhattacharya	2007	They achieved 98.8% recognition rate	1. The images are of poor quality. 2. Recognition rate of our system is fine but not good enough to be a real system.
Personal Identification For Single Sample Using Finger Vein Location and Direction coding	Wenming Yang, Qing Rao, Qingmin Liao	2011	High robustness and recognition rate in the Experiment.	Database is small.
Vascular Pattern Analysis towards Pervasive Palm Vein Authentication	Debnath Bhattacharyya, Poulami Das, Tai-hoon Kim, Samir Kumar Bandyopadhyay	2009	The algorithms are proved To improve the recognition performance with different training samples.	Threshold value is assumed.
The Anti-spoofing Study of Vein Identification System	Qin Bin Pan, Jian-fei Cao, Guang-zhong , Du Ge-guo	2009	This method can prevent the identification spoofing and improve the security Capability of vein identification system.	the cost of hardware implementation is also high, which may hinder its popularization and Development.
Analysis of Palm Vein Pattern Recognition Algorithms and Systems	Mona A. Ahmed, Hala M. Ebied, El-Sayed M. El-Horbaty, Abdel-Badeeh M. Salem	2013	–	–
Spectral Minutiae for Vein Pattern Recognition	Daniel Hartung, Martin Aastrup Olsen, Haiyun Xu, Christoph Busch	2011	1. Features are extracted with the reasonable quality. 2. provide good performance	1. Limitation of dataset is that they are captured during only one session, which limits the variability in the signals. 2. threshold value is assumed
Design and Implementation of a Contactless Palm Print and Palm Vein Sensor	Goh Kah Ong Michael, Tee Connie, Andrew Teoh Beng Jin	2010	The system is of low cost, accuracy , flexibility	1. Threshold value is assumed. 2. coefficient that determine the level of intensity is also assumed

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3. PROPOSED METHODOLOGY

A Vein Recognition System is used to recognize the veins of human palm for any authorized access. In the purposed system no of steps have been taken to reach recognition point. First step is pre-processing in which median filter is used to remove the noise present in an image. Secondly ROI is extracted to reduce computational complexity. In third step Features are extracted from the palm image using region growing technique in which shortest distance is used as criteria. Then minutiae are calculated for later purposes and finally, Fuzzy-Neuro Technique is applied for recognition.

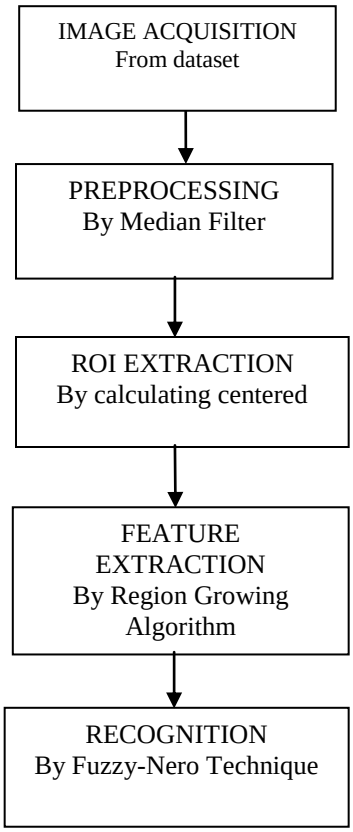

Figure 2: Flow of Work

3.1 Work Flow

Begin

Step 1: Image Acquisition
- a) Acquire test image
- b) Acquire training images one-by-one and apply following tasks in iterative fashion

Step2: Test and Training image pre-processing
- a) Compute grey-threshold
- b) Binary Conversion
- c) Obtain the boundaries of the hand

Step3: ROI Extraction
- a) Rotate the picture
- b) Obtain the center of the palm
- c) Set (x1, y1) and (x2, y2) values
- d) Extract Region of Interest (ROI)

Step 4: Apply Region growing technique for feature specification
- a) get seed pixel i.e. starting pixel
- b) For every pixel in image
- c) Find shortest distance between neighboring pixel using distance formula
- d) Select pixel with shortest distance in the region

Step 5: Extract Minutiae Points
- a) Re-binarization of the ROI image
- b) Apply thinning technique to extract the palm-vein skeleton
- c) Compute the minutiae points

Step 6: Apply fuzzy-logic to short-list the matching training samples according to the minutiae point extraction and matching
- a) Match training set minutiae with testing set minutiae
- b) Extract the most matching image according to fuzzy-sets
- c) Pass-on extracted training image set to neural network

Step 7: Apply pattern based neural network
- a) Create the neural network based on pattern recognition feed forward neural network
- b) Train the training set using neural network
- c) Return the matching sample according to decision logic

4. SIMULATION RESULTS AND DISCUSSION

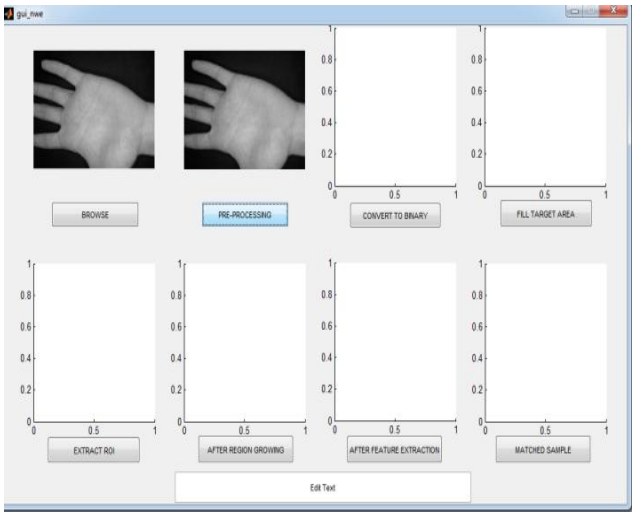

Figure 3: This represents image acquisition from the database and preprocessing done by median filter

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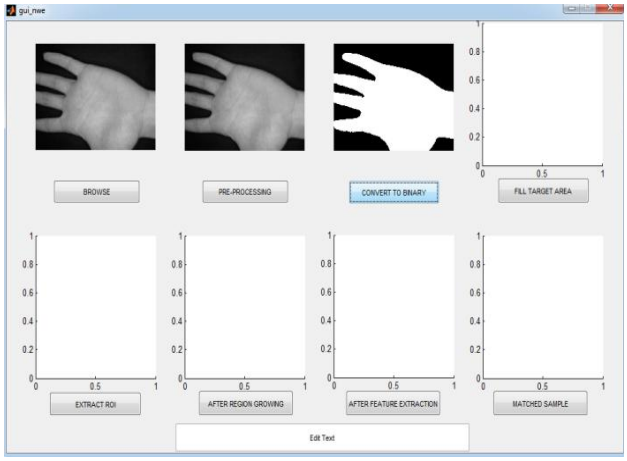

Figure 4: In this ROI extraction starts in which first step is to convert the image into binary form

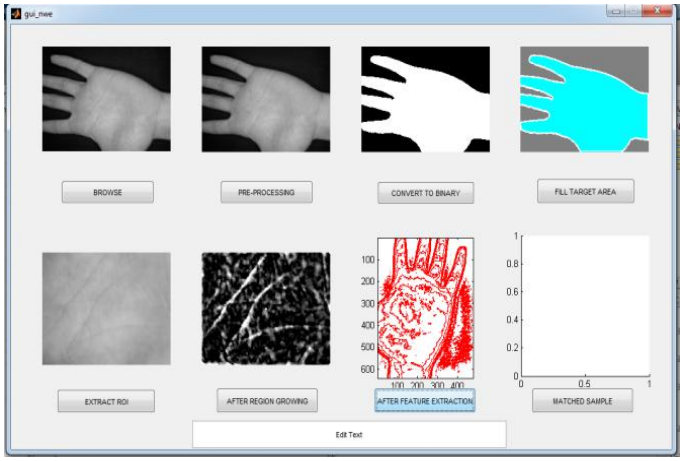

Figure 7: This graph represents image segmentation done by region growing technique

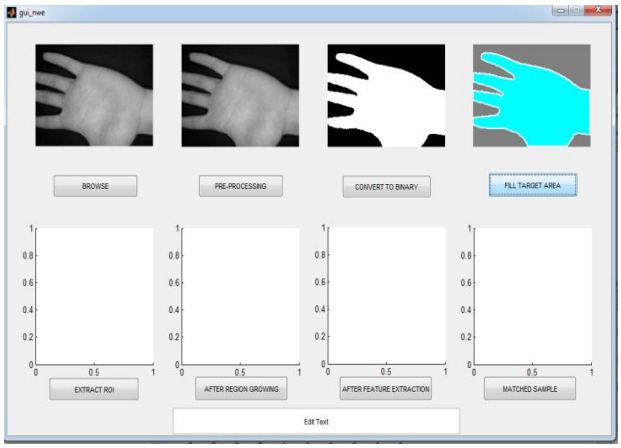

Figure 5: This graph represents the second step of ROI extraction in which image is filled with the color before extracting sub-image

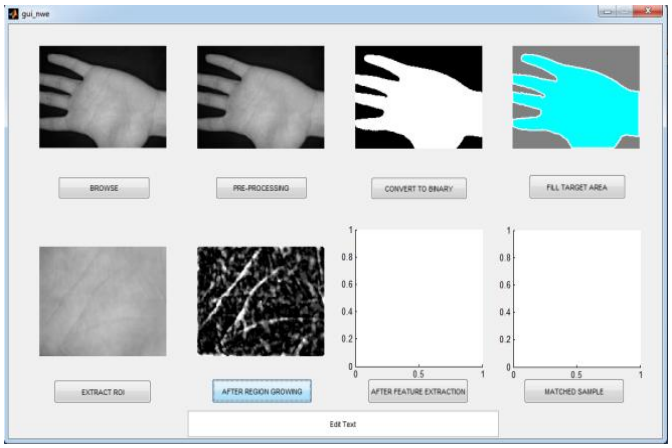

Figure 8: This graph represents the feature extraction by calculating minutiae

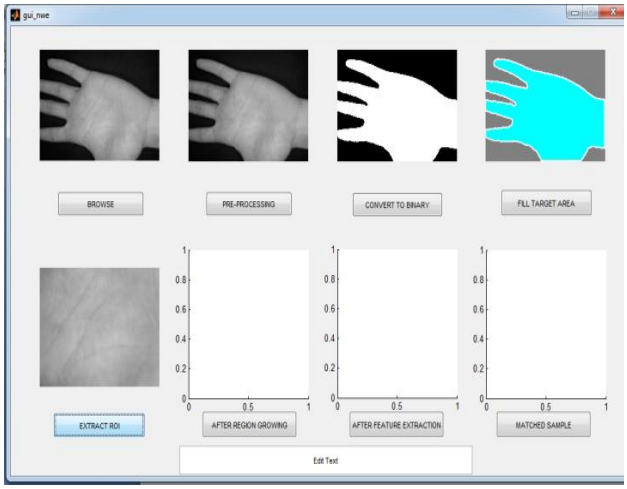

Figure 6: This graph is use to represent the third step of ROI extraction in which the sub image is extracted

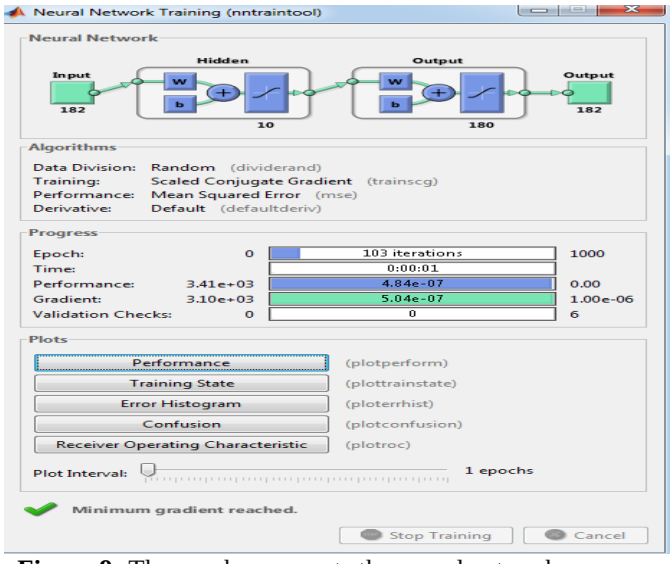

Figure 9: The graph represents the neural network for matching or recognition

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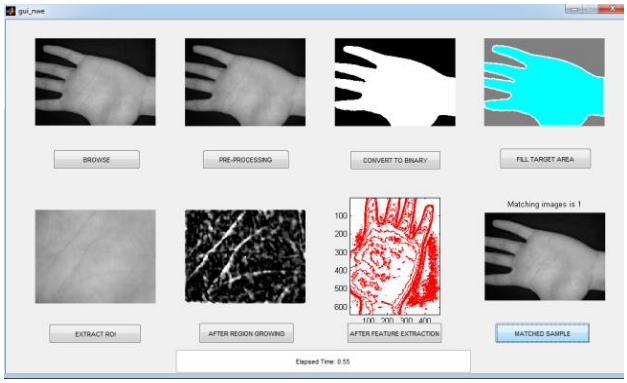

Figure 10: This graph represents the matched sample with the elapsed time

Comparative Conclusion

Parameters	Results with PCA	Results with FUZZY_NEURO
Recall	85.71%	93.33%
Precision	92.31%	100%
Accuracy	81.25%	93.75%
Specificity	50%	100%
False Acceptance Rate(FAR)	2%	0%
False Rejection Rate (FRR)	1%	1%
Equal Error Rate (EER)	0.015%	0.005%
Negative Predictive Value (NPV)	33.33%	50%

Table 2: Parameter Evaluation

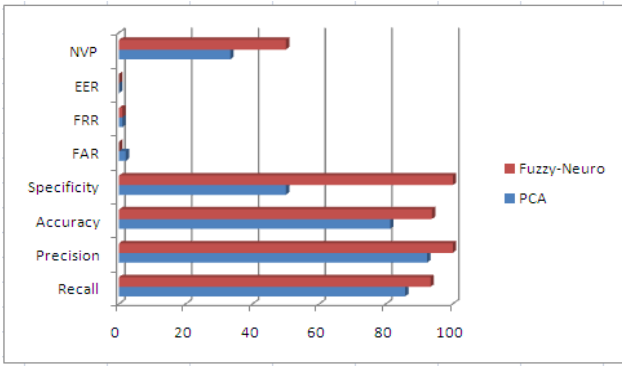

Figure 11: Represents Parameter Evaluation in Graph Form

5. CONCLUSION AND FUTURE WORK

In our research work, the new palm-vein based authentication algorithm has been proposed using the fuzzy-neuro technique. The fuzzy-neuro technique is based on the combination of the fuzzy-logic (fuzzy sets) and pattern recognition based feed forward neural network. An effective and accurate palm-vein recognition technique is purposed by combining the fuzzy logic and neural network with effective preprocessing techniques used to extract the region of interest and denoise the palm-vein image samples. The proposed palm-vein recognition algorithm is proposed for the new age biometric systems hence, it must be efficient, accurate and fast. The image de-noising and image filters for palm-vein recognition method to tackle the brightness in the palm-vein images, which have helped to improve the accuracy of the proposed algorithm. Our algorithm has been made able to tackle the light variations, noise and other specific image characteristics in the palm-vein recognition systems. The performance of the proposed algorithm has been recorded on the basis of various performance parameters. The accuracy of the proposed system is approx. 94%, whereas specificity and precision has been recorded at 100% which shows the effectiveness of the proposed algorithm. The specificity or recall value is computed near 93% which is higher than the existing systems.

In the future, the algorithm design would be evaluated to find the probability of improvements in the proposed algorithm. The proposed algorithm would be tested on the larger databases. The proposed algorithm can also be applied to the finger-vein recognition and the performance evaluation can be performed afterwards. Also, in the future, the performance of the proposed algorithm can be evaluated and compared with the other latest candidate algorithms in the future.

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