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Palm Vein Recognition: An Advanced Biometric Technique for Authentication

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ABSTRACT: There are different biometric traits that are used for security purposes in different areas. Palm vein human identification is one of the prevailing biometric techniques, which employs the vein pattern inside the palmer skin in the human palm to verify the person. This technique is becoming very popular with time as it is highly secure as vascular pattern is unique to an individual and difficult to forge as veins are inside skin. This paper presents the improvement in accuracy, Peak Signal to Noise Ratio (PSNR) and Mean Square Error (MSE).

KEYWORDS: Biometrics, hand biometrics, palm print, palm-vein identification.

I. INTRODUCTION

Automated human recognition is one of the most challenging and critical tasks to meet the increasing demand for stringent security. The use of different physiological and behavioural features of humans, i.e. biometrics, has been massively increased in the identification of criminals and the matured as an essential tool for law enforcement sectors. These biometric based human identification methods have become highly accepted in a broad range of civilian applications and has become a very powerful substitute to the traditional (password or token) identification systems. Human palms are easier to present and can also reveal a variety of information. Because of this, palm print research has provoked a lot of attention for civilian and forensic usage.

Palm vein recognition technique is a non invasive biometric technique. The blood veins pattern is unique to every individual, even among identical twins. Our palm has a broad and complex vascular archetype, and thus it contains a range of distinguishing features for personal identification. Secondly, it does not vary with the lifetime. Furthermore, it is a very safe method for identification because the vein pattern lies under the human skin. The feature makes it an almost impossible task for others to read or copy anyone's pattern. One more benefit of this technique is, that palms usually do not have hairs on them which can be a hurdle in capturing photographs for the blood vessel pattern. Moreover, it is less susceptible to a change in skin colour, in contrast to, the back of a hand or fingers.

Because the blood veins lies inside the body, and have a wide range of person wise unique features, so any attempt to forge an identity are extremely difficult, thereby enabling a high level of security. Moreover, the sensor of the palm vein identification apparatus can recognize the pattern only in case when the deoxidized haemoglobin is lively flowing inside the person's veins. Although, in some civilian applications it is also sometimes crucial for the biometrics feature to make sure the extreme collectability, when the user interacts with the device. In this context, palm print identification technique has emerged as a good substitute for manual personal identification. It has the benefit of the towering agility along with the guarantee that the crucial identity information will be unrevealed, and hence, providing a high security and privacy for the user.

An individual first rest his wrist on an image sensor, which then flashes near –infrared ray on the palm. Deoxygenated haemoglobin in blood flowing through veins absorb near infrared ray, illuminating the haemoglobin, causes it to be visible to scanner. Still image is captured, appear as black network, reflecting the palm's vein pattern against lighter background of palm skin as illustrates by fig. 1

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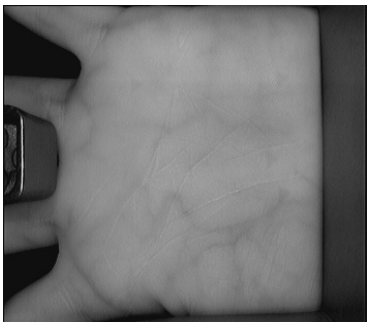

Fig. 1 Palm Vein image by palm scanning.

An individual's palm vein image is converted into data points by algorithms, which is then compressed, encrypted, and stored by the software, and also registered along with other details in his profile as reference for future comparison. Each time a person logs in attempting to gain access by palm scanner to a particular bank account or secure entryway etc., newly captured image is processed and is then compared to registered image for verification, all in a period of seconds.

Different skin layers have different responses to wavelength of the incident rays [8]. The optical depth of penetration at 850 nm for near-infrared imaging is estimated to be 3.57 mm, and this illumination has revealed to offer higher contrast for the subcutaneous veins when imaging [11].Absorption Spectrum of Haemoglobin is illustrated as shown in Fig. 2.

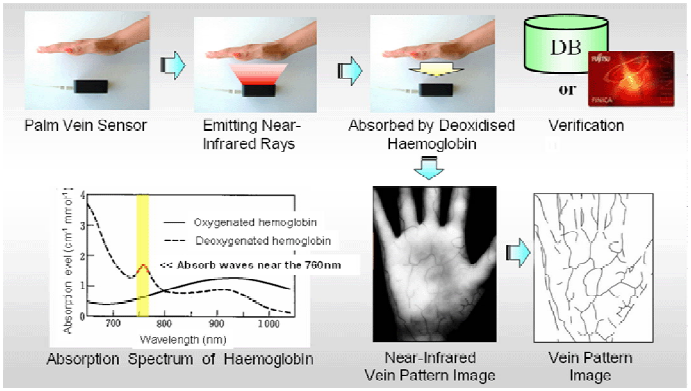

Fig. 2 Absorption spectrum of Haemoglobin [11]

As palm veins are interior to the body, so these are well guarded, and this system is not vulnerable to minor trauma, cuts, etc in contrast to some fingerprint systems. Furthermore, palm vein system does not have the similar potential civil freedom issues like face recognition techniques: Your face can be scanned without you being aware of it, but this cannot be done with your palm vein, as it remain hidden. [14]

II. RELATED WORK

Palm vein imaging requires infrared illumination in order to produce multispectral palm print images that acquire all vein details inside palm. But these multispectral palm print images require more computation [1]. Two approaches had been introduced to improve performance. First is Hessian–phase based method preserve vessel formation by utilizing eigen value of second order derivate of normalized palm vein that result small template size and computation efficient. Second is neighbourhood matching random transform. Recognition rate should be highest for minimum no of samples [1]. Further to improve accuracy fusion of palm print and palm vein images is done at feature level [2].Further homo morphological filtering method for pre-processing of image in done in order to extract region of interest (ROI) [8].

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III. PROPOSED ALGORITHM

From the review of work done on palm vein recognition it is found that if the number of samples per class is small, recognition rate also decreased. The aim of proposed work is to utilise image pre-processing in a different way that it is independent of image translational, rotational and scale changes and for feature extraction we use LBP and then at last matching of current palm vein is done with using Neural Networking with the templates stored in database. The complete proposed work has been divided into two parts, first is training of the input images from NIR sensor and stores the templates of each user in database and the second is matching of current palm vein pattern with trained database.

Firstly input image is browsed in MATLAB. Acquired images have noise with rotational and translational variations. Therefore firstly input image is required to
pre-processed that consist of

1) Segmentation of ROI
2) Translation and orientation independent
3) Enhancement to extract vein pattern.

The key objective while segmentation of ROI is done is that it gets automatically normalized its region and independent of individual way of placing his/her palm on sensor. So it is necessary to construct such a coordinate system that makes identification process effective and efficient.

Firstly image is converted to binarized image so that palm can be extracted from the background. After that edges of image are detected so that image can be segmented and Region of Interest (ROI) is detected. Further ROI region is enhanced so that vein pattern become clearer for the authentication person. Then finally output is taken by using repeated line tracking method and output that is obtained is given to Gabor filter in order to remove noise.

Feature extraction is done by using LBP and for dimension reduction Principle Component Analysis (PCA) is employed that reduces the size of template so that the size of individual image in database is small and maximum images can be stored in database. For matching Neural Network method has been used. Artificial neural network is composed of interconnected artificial neurons. Artificial neural network may be used to gain understanding of biological neural networks or for solving artificial intelligence problem without forming model of real biological system. The complexity of real biological system is very high so artificial neural network algorithms effort to reduce complexity and works only from information processing view. Three types of layers are present in neural network: input layer, hidden layer, output layer.

IV. SIMULATION RESULTS

To verify our proposed technique, we simulate our algorithm in MATLAB and following are the steps mentioned below:

- A Graphical User Interface (GUI) is implemented.
- Code is designed to load database in MATLAB.
- Code is developed for pre processing of input images.
- After that feature extraction is done LBP and code is developed for the same.
- Code is designed for matching of palm print with images in database for authentication.

Results:

When we simulate our results in MATLAB, firstly we have created GUI for our work. On simulation a window that open is shown with the help of fig 3.

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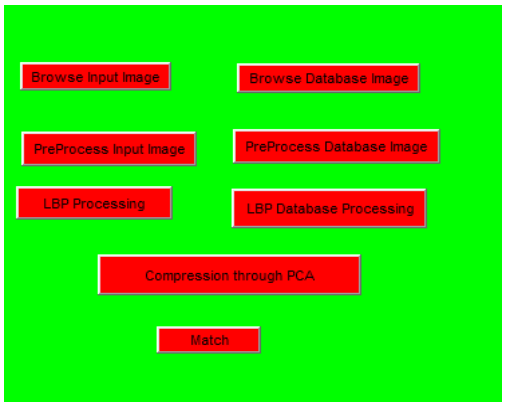

Fig 3: Main window of model

After that we browse the input image, input image is pre-processed. Pre-processing steps are shown in fig 4.

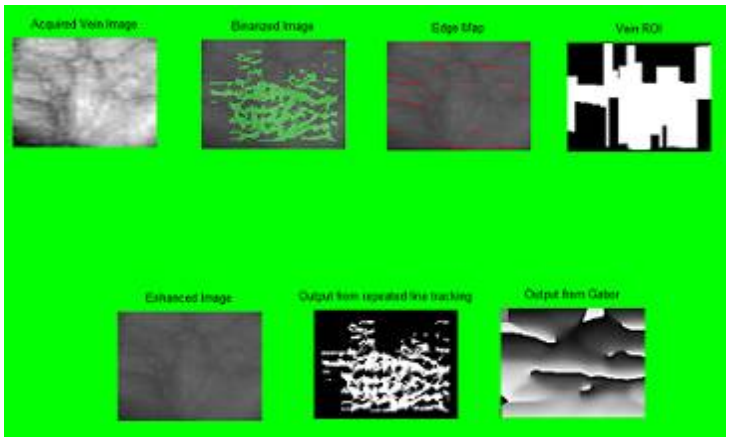

Fig 4: Pre-processing steps

After pre-processing features are extracted by using LBP and matching of current palm vein is done by using neural networks. After simulation we have compared our proposed method with previous existing techniques in term of accuracy, MSE, PSNR. Table 1 shows comparison of accuracy with existing method and fig 5 represents graphical representation of table 1.

ACCURACY in Percentage	
Proposed Method	99.5000
Repeated Line Tracking	93.5030
Even Gabor	64.9939
Even Gabor with Morphological	74.5930
Automatic Trimap Generation	75.6930

Table 1: Average Accuracy Comparison

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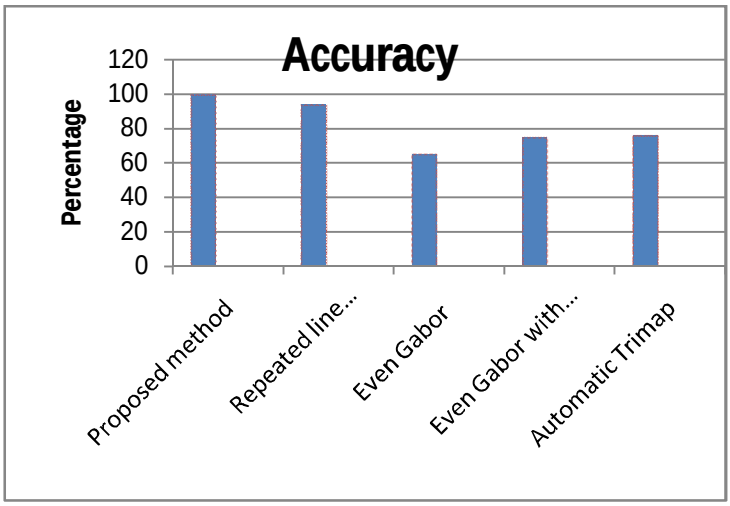

Fig 5: Graphical representation of table 1

Table 2 shows comparison of MSE with existing method and fig 6 represents graphical representation of table 2.

MSE	
Proposed Method	141.3394
Repeated Line Tracking	175.4594
Even Gabor	151.9594
Even Gabor with Morphological	151.2294
Automatic Trimap Generation	146.8994

Table 2: MSE comparison

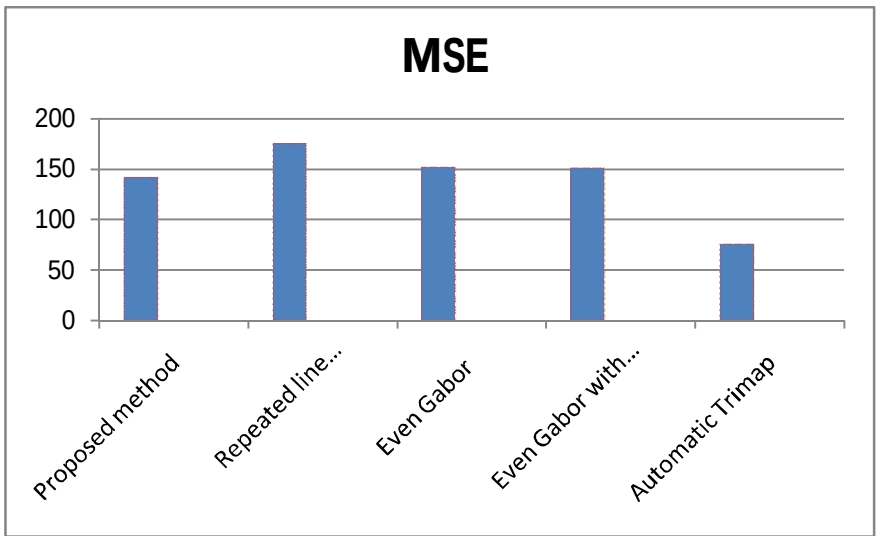

Fig 6: Graphical representation of table 2

Table 3 shows comparison of PSNR with existing method and fig 7 represents graphical representation of table 3.

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PSNR in db	
Proposed Method	51.3781
Repeated Line Tracking	42.2581
Even Gabor	16.7710
Even Gabor with Morphological	26.3881
Automatic Trimap Generation	27.5611

TABLE 3: PSNR COMPARISON

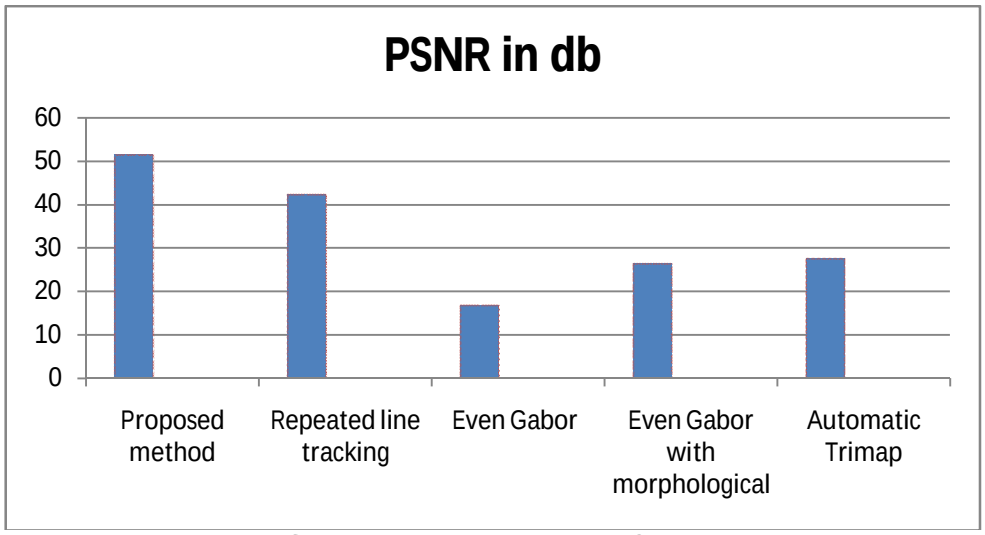

FIG 7: GRAPHICAL REPRESENTATION OF TABLE 3

FRR plot against threshold value is shown in fig 8

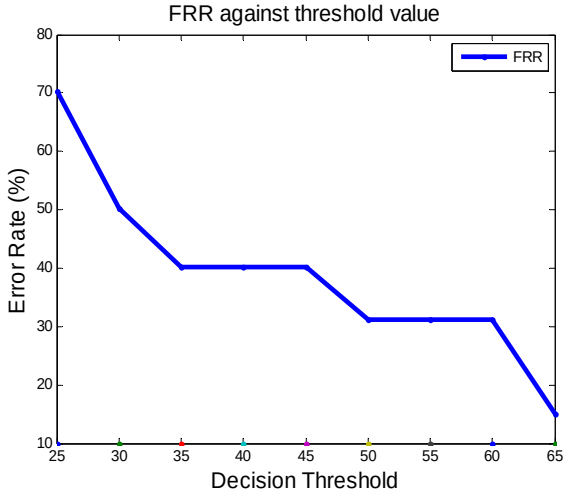

FIG 8: FRR AGAINST THRESHOLD VALUE

V. CONCLUSION

In this paper, we proposed a novel approach for person's authentication, which can be more reliable and achieve higher identification rate i.e. accuracy as compared to previously proposed palm vein authentication systems. Our proposed system has worked more effectively in real time application system and leads to more accurate performance

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and higher user's acceptance level. Dimensional reduction is done by using PCA gives compact size of template so maximum images can be stored in database. Our algorithm gives more accuracy even when number of training samples per user is minimum i.e. one sample per user.

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BIOGRAPHY

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