Biometric Security: Palm Vein Recognition Using Lbp and Sift

Pooja ,Vinay Bhatia

Abstract: ***Palm vein recognition is an unique vascular recognition technique used for identification of individual. Palm vein recognition offer high degrees of security as vein are inside the skin so therefore difficult to forge. Palm vein pattern are unique for any individual so this can also be used to grant access to the user instead of using passwords, identification cards etc. In this paper we have used the combination of pixel wise Local Binary Pattern (LBP) and Scale Invariant Feature Transform (SIFT) technique to extract the palm vein features to improve the accuracy. In this paper the authors have presented a systematic comparison of some of previous palm vein recognition techniques with a novel technique proposed based on PolyU database. Evaluation of improvement in performance for recognition and verification process has been carried out and thereafter an elaborate analysis has been done on the effect of the size of enrolment. Simulation results depict an improvement of recognition rate and false acceptance rate. Implementation of the proposed method has been carried out using Image Processing Toolbox under MATLAB software***

Key Words: Biometric, hand biometric, multispectral palm print, palm vein recognition, personal identification.

I. INTRODUCTION

…………………………………. ……...	Layer 1 Epidermis layer (Topmost layer)
…………………………………. ……...	
/// /////////	Layer 2 Dermis layer (Middle layer)
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Fig. 1. : Cross section of palmer anatomy

All three layers contain fat and blood with different proportions. However the subcutaneous layer contains subcutaneous veins and arteries. Different skin layers have different responses to wavelength of the incident light, for example depth of penetration for (Near Infra Red) NIR imaging at 850 nm is estimated to be 3.57 mm and these illumination offer higher contrast for the subcutaneous veins while imaging [1].

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Biometric is the study of methods for measuring physical and behavioural traits of an individual that can be used for the authentication or verification of individual's identity. The term "biometrics" is derived from the Greek words "bio" meaning life and "metric" meaning to measure. Biometrics can be broadly classified into two categories: physical and behavioural. Physical biometrics include iris, retina, fingerprint, palm print, palm vein, DNA(deoxyribonucleic acid), face, ear, retina, odour recognition that are very common in use and much easier to understand and measure as compared to behavioural biometrics that include gestures, handwriting, gait and writing patterns, voice recognition. Palm vein recognition is a biometric method that is used for the identification of individual identity by recognising the individual vascular vein pattern inside the skin. As illustrated in Fig. 1, palmer skin consists of three layers viz. epidermis, dermis, and subcutaneous layer. The epidermis is the outermost of all layers following by dermis and lowermost subcutaneous layer. The cross section of palmer skin with three layers is illustrated in Fig 1.

The process to capture the palm vein image consists of relaxing one's palm on palm vein sensor that may be touched based or contact free. It is based on the fact that oxidized haemoglobin flows from heart to finger tips and when it flows from finger tips back to heart it is

deoxidized. In palm vein capturing NIR camera is used so its produces dark print for deoxidised haemoglobin as it absorbed the light [7]. These palm vein pattern is recorded, prepossessed and features are extracted for matching purpose. Palm vein method offer a unique

Advantage over other biometric methods that it is difficult to forge as it is inside the skin.

A. 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].

B. Proposed Work

From the review of prior work on palm vein recognition by author Yingbo Zhou et. al it is studied that if the number of gallery samples per class is less, recognition rate is also decreases. This paper investigates a novel approach for human identification using palm vein recognition. The aim of proposed work is to use image pre-processing in such a unique way that it is independent of image translational, rotational and scale changes and for feature extraction we have combined pixel wise LBP with SIFT so that combination also act as compression of image that results in maximum number of templates can be stored in database and then at last matching of current palm vein is done with using Euclidean distance and Hamming distance 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. The rest of this paper is organized as follow: Section II emphasises on pre-processing steps detailed description. Feature extraction and matching algorithm of our proposed method for palm-vein recognition is discussed in Section III. Section IV shows experimental results. At the end conclusion is summarised in section V.

II. PRE-PROCESSING

A. Image Segmentation and Normalization

Contactless palm vein images require many translational and rotational variations. Region of interest (ROI) should be selected in such a way that it is independent of individual way of placing palm on image sensor equipment. So segmentation should be in such a way that it automatically adjust with variation in sample images. Therefore good and noble pre-processing steps are required to obtain stable and oriented ROI. After that it is followed by nonlinear enhancement so that pattern of vein extracted from ROI images and more clear. Main objective of segmenting ROI is that input image automatically gets normalized. Firstly RGB (Red Green Blue) image is converted to its corresponding binary value and this process is known as thersholding that is done by checking the index value present in the image and then by selecting a threshold value of index. With the help of input image and binarized image, noise free image in background is obtained by making index value of background to zero as shown in Fig. 2.

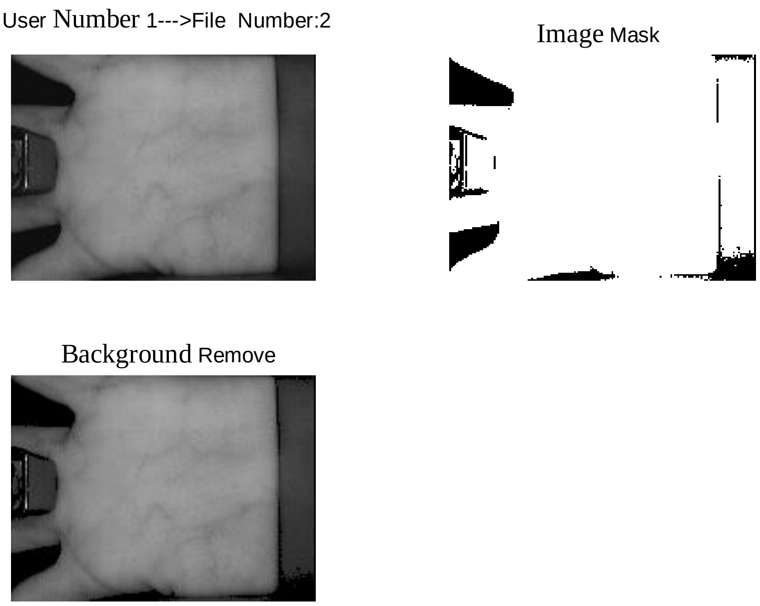

Fig. 2: Image With background clear

Now on application of low pass Gaussian filter in spatial domain that reduce sharpness and blends of disc size (mask) of 5 so that there is only minor effect on sharpness and blends. After that junction points of palm vein image is obtained i.e. point between index finger and middle finger, and point between middle finger and ring finger by using approach to find out number of connected object during the scanning of palm image, till we have no of connected objects that indicate presence of fingers. As no of connected object become single it indicates presence of palm and we get junction points. Now we get three junction points, arranging these points in ascending or descending order we get our extremer point. After that we find out the slope between these two points by using equation (1), and then we find out the angle of inclination by using equation (2).Now we plot a square or rectangle at this extremer point. After that ROI extracted from the palm image. Then this square is again rotated by angle theta and this is known as skewed operation.

$$slope(m) = (Y2 - Y1)/(X2 - X1) \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

$$theta\,(\emptyset) = \tan^{-1}(m) \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (2)$$

B. Image Enhancement

Palm vein that is used in our work is NIR; these images generally have low contrast. So enhanced images shows more clear vein and texture pattern that is required. Subsequently, estimated background intensity profile is resized to same size as original image using bicubic interpolation and then resulting image is subtracted from original ROI image.Histogram of skewed corrected image is shown and contrast of image is enhanced as images acquired by NIR appear darker with low contrast level. Finally histogram equalisation is employed to get enhanced and normalized palm vein ROI image as shown in Fig. 3. All pre-processing steps can be summarised with the help of Fig. 4

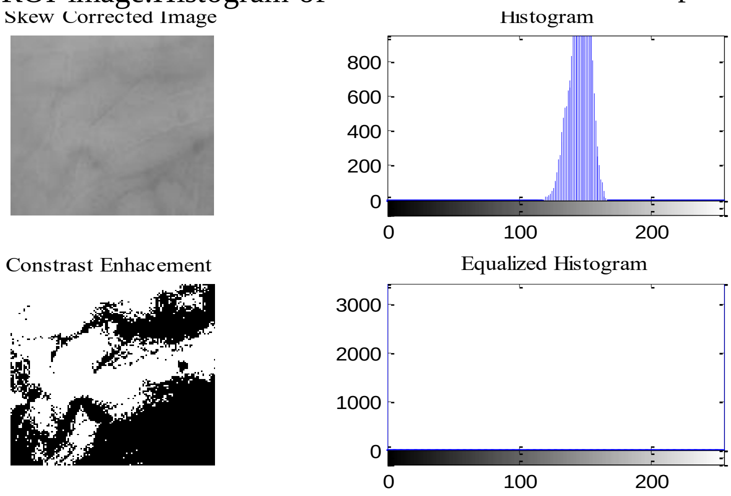

Fig. 3: Skewed image and equalised histogram

Palm Vein Image → Image Background Index Estimation → ROI Estimation → Skewed Operation → Contrast Stretchin → Histogram Equalization

Fig. 4: Steps in pre-processing of palm vein image

III FEATURE EXTRACTION AND MATCHING

After the enhancement and normalization of image that depict curved vascular vein pattern and these vessels can be approximated by small line segments which are otherwise curved. We have proposed to use pixel wise LBP that gives the position of vein as shown in Fig. 5. On the application of SIFT over pixel wise LBP image thatspecify which locations and descriptors that are to be used out of pixel wise LBP image are shown in Fig. 6. In this way a template of palm vein image is created that is stored in database for matching purpose.

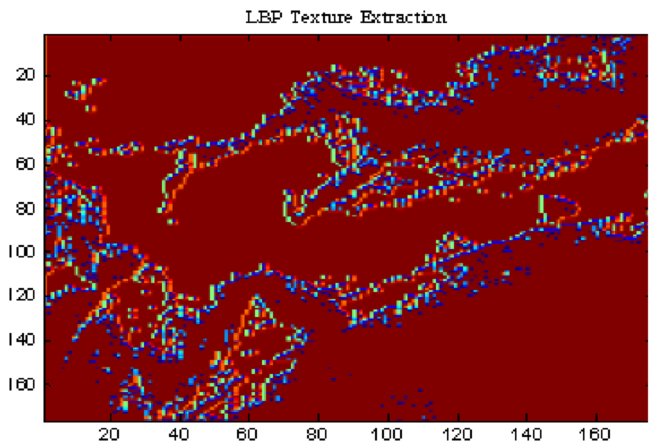

Fig. 5: Pixel wiseLBP textured image

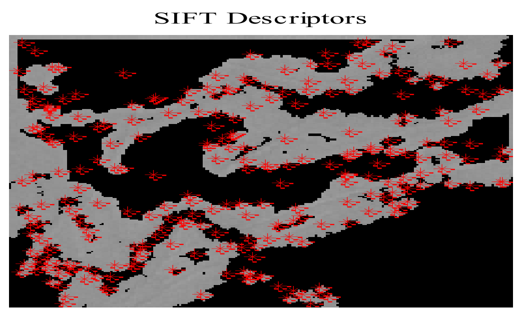

Fig. 6: Pixel wise LBP textured image with SIFT descriptors

For matching, current palm vein sample image is matched with each template of palm vein images in database with the help of Euclidean distance or Hamming distance and user can authorised as authentic or non-authentic user as shown in Fig 7.

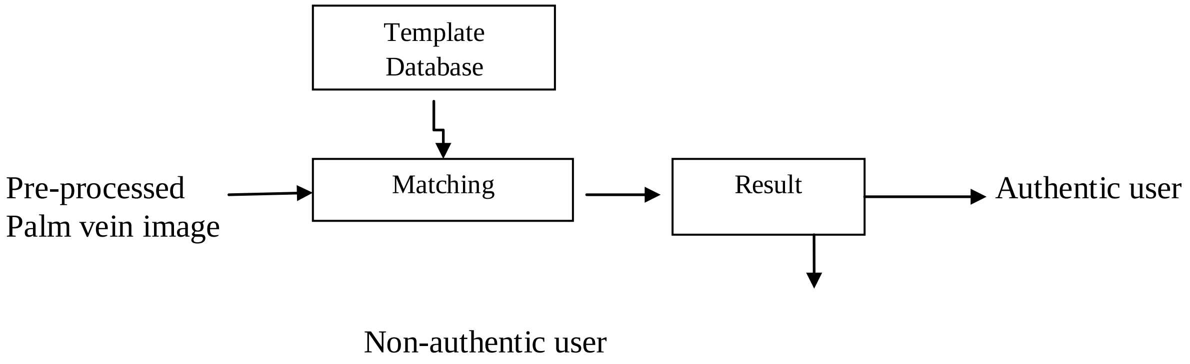

Fig. 7: Matching process

IV EXPERIMENTAL SETUP AND RESULTS

A. Database

In this work PolyU Multispectral Palm print Database (PolyU database) [11] has been used in which all the images were captured with constrained device with finger-pegs and it consist of images from 500 users with 12 images per user. Only 250 users considered for our experiment. The images were captured in two sessions with an interval of nine days in two sessions. Only NIR images from PolyU database were used as our aim to identify individual using palm vein authentication.

B.Experimental Results

The aim of the work is to achieve higher performance with minimum number of training samples. An analysis is presented of present approach with various other approaches by varying number of samples. Three experiments has been performed on PolyU database: First the recognition rate for all left palm, second on right palm images and third on both left and right palm images and their performance rate is illustrated in Table 1-3 and tabular results are expressed graphically with the help of figure 8-10. So from the result it is find that recognition rate of our proposed method is more even when number of gallery samples per user is minimum i.e. one training sample per user. The accuracy of our proposed system is 100% therefore False Acceptance Rate (FAR) is 0% and False Rejection Rate (FRR) is 0%.

Table 1: Rank One Identification Rate in Percentage from All Left Palms of PolyU Database using Different Approaches with Variations in Number of Gallery Images Per Class

Number of Gallery samples per Class	LBP with SIFT	NMRT	Hessian Phase	Ordinal Code	Laplacian Palm	Comp Code	Sift
1	100.00	99.40	97.07	98.67	65.87	92.40	81.60
2	100.00	99.60	99.00	99.20	76.60	95.47	89.73
3	100.00	100.00	99.53	99.93	83.80	97.87	92.73
4	100.00	100.00	99.53	99.93	87.07	98.00	94.00
5	100.00	100.00	99.67	99.93	89.33	98.53	94.53
6	100.00	100.00	99.73	99.93	90.53	99.07	95.53

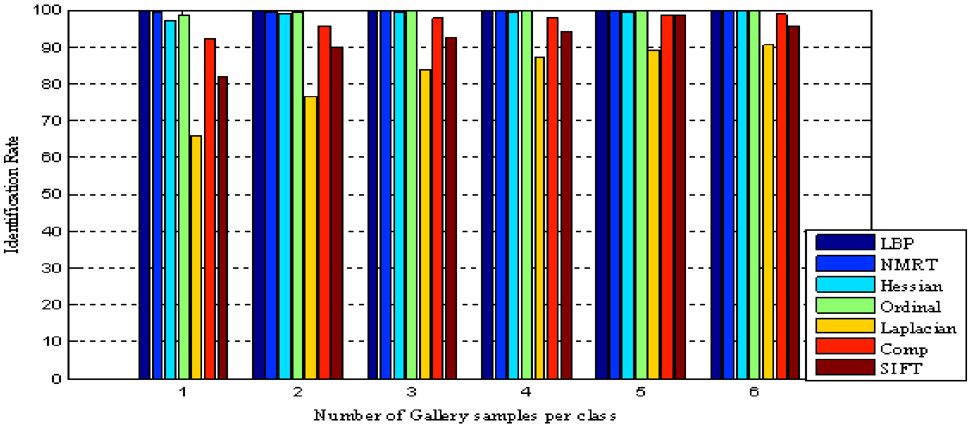

Fig. 8 : Graphically representation of table Identification in Number of Gallery Images Per Class

Table 2: Rank One Identification Rate in Percentage from All Right Palms of PolyU Database using Different Approaches with Varia

Number of Gallery samples per Class	LBP with SIFT	NMRT	Hessian Phase	Ordinal Code	Laplacian Palm	Comp Code	Sift
1	100.00	99.93	98.87	100.00	77.67	92.80	85.33
2	100.00	100.00	99.40	100.00	85.13	96.67	91.60
3	100.00	100.00	99.40	100.00	87.40	97.93	93.33
4	100.00	100.00	99.60	100.00	88.80	98.80	94.60
5	100.00	100.00	99.60	100.00	89.33	98.80	95.67
6	100.00	100.00	99.60	100.00	89.20	98.87	96.20

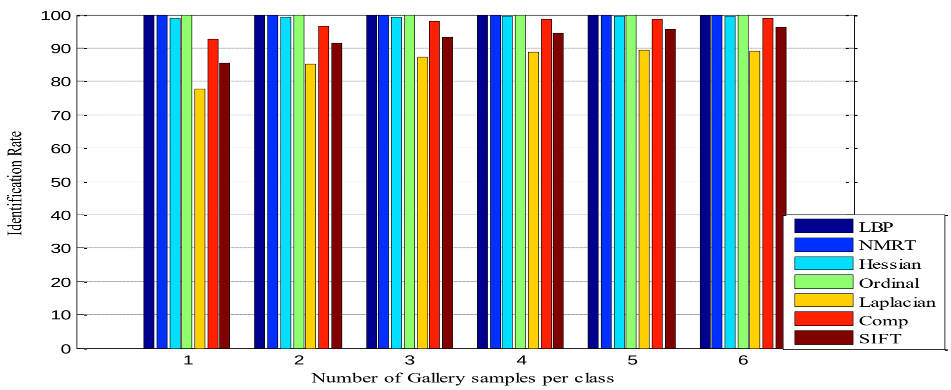

Fig. 9 : Graphically representation of table 2

Table 3: Rank One Identification Rate in Percentage from All Left and Right Palms of PolyU Database using Different Approaches with Variations in Number of Gallery Images Per Class

Number of Gallery samples per Class	LBP with SIFT	NMRT	Hessian Phase	Ordinal Code	Laplacian Palm	Comp Code	Sift
1	100	99.67	97.9	99.33	63.13	92.57	83.13
2	100	99.8	99.23	99.6	72.17	76.07	90.17
3	100	100	99.47	99.93	76.67	97.9	92.57
4	100	100	99.57	99.97	79.6	98.4	94.13
5	100	100	99.63	99.97	81.13	98.67	94.93
6	100	100	99.63	99.93	82.73	98.97	95.5

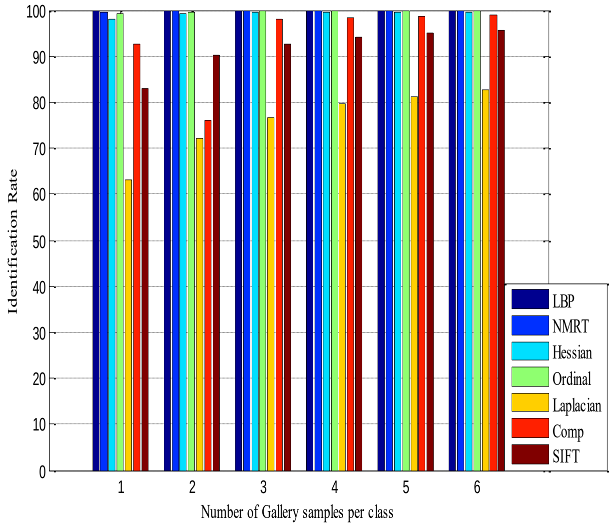

Fig. 10 : Graphically representation of table 3

V. CONCLUSION

This paper investigated a novel approach for human identification using palm vein images. A novel feature for extraction and matching approach has been proposed. In this paper, 'Biometric Security: Palm Vein Recognition Using LBP and SIFT' has been proposed and discussed in detail. Pre-processing and enhancement of palm vein image has been done. After feature extraction dimensionally reduced image are stored in database. It offers computationally simpler and compact storage (templates). After that finally matching of current palm vein image with the template database has been completed by using hamming or Euclidean distance. Proposed method shows its robustness and superiority. This approach performs well to a great extent and gives maximum accuracy and recognition rate even for minimum number of training image. We have achieved rank-1 identification rate of 100% from left, right palm images employed on PolyU database and 0.00% FAR and FRR.

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