International Journal of Future Generation Communication and Networking
Vol. 13, No. 2s, (2020), pp. 149–158

Vein Pattern Recognition and Authentication Based on Gradient Feature Algorithm

Munwar Pathan[1], Gagandeep Singh[2], Ajay Yelane[3]
[1,2,3,]*Dept. of E & TC Engg., Smt. Kashibai Navale College of Engineering, Savitribai Phule Pune University, Pune*
pathanmunwar8@gmail.com
gagan948@outlook.com
ajay.yelane2@gmail.com

Abstract

In today's world, Biometrics plays a really crucial role in authentication and verification of a person's identity. Existing technologies like fingerprint sensing, voice/face recognition are quiet accurate. Vein pattern detection is another such authentication technique for personal information which can be incorporated in our systems and databases. Finger vein detection may be a secure and convenient method of authentication. Researchers in research fraternities everywhere the planet are now trying to find such cost effective methods to extend the accuracy of authentication. We propose a procedure involving fetching infra-red image of vein pattern of an individual. Infra-red imaging of a finger would give us subsidiary shading patterns of bones and muscles alongside the vein pattern. Using gradient feature extraction algorithm vein pattern from the unclear infra-red image are going to be obtained. the higher vein pattern algorithm has got to be introduced to realize the higher Equal Error Rate comparing to the prevailing vein pattern recognition algorithms.

Keywords-*Gradient feature extraction, equal error rate, Vein pattern detection, authentication.*

I. INTRODUCTION

In the era of information technology, security of information plays a vital role. Conventional security systems are constructed so as to allow authorized persons access to certain information sources, while preventing access by unauthorized persons. Biometrics, which uses human physiological or behavioral features for personal identification, has attracted more and more attention and is becoming one of the most popular and promising alternatives to the traditional password or PIN based authentication techniques. Existing technologies such as fingerprint sensing, voice/face recognition are quiet accurate. Like unique fingerprint patterns, every person has a unique finger vein pattern under the dermis of their skins. These patterns are unique from finger to finger as well as from person to person. Unlike face recognition, fingerprint recognition or any other biometric authentication techniques which are vulnerable to forgery, finger vein patterns cannot be modeled easily and hence prove to be highly reliable and effective way for authentication of an individual. Biometric verification based on finger vein patterns is fairly new and is currently under a lot of research. With the help of infrared imaging technique we can obtain a vein pattern of a particular part. The use of infrared imaging technique is a relatively less explored area but promises to deliver high- end results at low development costs. We

ISSN: 2233-7857 IJFGCN

designed a special device for acquiring high quality finger-vein images and propose a DSP based embedded platform to implement the finger-vein recognition system in the present study to achieve better recognition performance and reduce computational cost.

II. LITERATURE SURVEY

Vein detection is one among the newest biomedical techniques researched today. While the concept behind the tactic is straightforward , there are various challenges to be found throughout the planning and implementation of a tool concerning the lighting system and therefore the image processing algorithms at a really low price. While a really few devices supported the infrared technique are implemented, there still exists a robust got to develop such medical devices.

[1] "*Finger vein extraction and authentication supported Gradient Feature Selection Algorithm"*, Parthiban K, Amitabh Wahi, IEEE International Conference 978-1-4799-2259, 2014

In this paper, they introduced a Gradient Feature detector to extract vein patterns. It can obtain all the points on the Gradient of vein within the image and increase the knowledge of the feature. We also proposed a replacement pattern normalization method, which may reduce the irregular distortions caused by variance of finger pose. By using this method, we not only use the mutual information among different vein branches, but also treat every vein branch with independence. The proposed algorithm to extract finger-vein images by considering various parameters like vein width, position, length, pixels and intersection of veins. Our system is suitable for mobile devices and ATM's due to its low computational complexity and low power consumption. The advantage of this proposed system is more secured and confidential. The EER of 0.05% is achieved which shows the higher performance than the prevailing vein recognition algorithms.

[2] "*Human finger vein images are diverse and its patterns are useful for personal identification*" Takashi Yanagawa∗ ,Satoshi Aoki†, and Tetsuji Ohyama,MHF 2007- 12, 2007, pp. 1–7.

In this they investigated the range of human finger vein patterns by comparing the right and left index finger and middle finger of about 500 persons and considered its usefulness for personal identification.The validity of our personal identification is evaluated by two probabilities inherent to the device, the false rejection rate (FRR) and therefore the false acceptance rate (FAR). From FRR and much , we will estimate the reliability of the private identification by the human finger vein. The above paper proposed that there's difference in vein pattern of human fingers. There are unique vein patterns in every finger of human and that they vary person to person. This paper helped us to understand that the vein pattern are often used for authentication. Like other biometric identification system, vein pattern are often one among the important and secured way of authentication and identification.

[3] "*An Embedded Real-Time Finger-Vein Recognition System for Mobile Devices*",Zhi Liu and Shangling Song, IEEE Transactions on Consumer Electronics, Vol. 58, No. 2, May 2012.

This paper proposed an end-to-end finger-vein recognition system supported the blanket dimension and lacunarity implemented on a DSP platform. The proposed system includes a tool for capturing finger-vein images, a way for ROI segmentation, and a completely unique method combining blanket dimension features and lacunarity features for recognition. the pictures from 600 fingers within the dataset were appropriated while interval (i.e., from

summer to winter) by a prototype device we built. The experimental results showed that the EER of our method was 0.07%, significantly less than those of other existing methods. Our system is suitable for application in mobile devices due to its relatively low computational complexity and low power consumption. The system is implemented on a DSP platform and equipped with a completely unique finger-vein recognition algorithm. The proposed system takes only about 0.8 seconds to verify one input finger vein sample and achieves an equal error rate (EER) of 0.07% on a database of 100 subjects. The experimental results demonstrate that the proposed finger- vein recognition system is qualified for authentication on mobile devices.

[4] *"Vein detection using infrared imaging system"*,Vishal Gaikwad, Sanjay A. Pardeshi, International Journal of Electrical, Electronics and Computer Systems (IJEECS) 2347-2820, Volume -2, Issue-3, 2014.

This paper proposed a Simultaneous observation system for a body surface image and a transillumination image of blood vessels. The system Basically consists of a light-weight source, a camera, a private Computer. As a light-weight source, many LED's were arranged on a computer circuit board. It made the high-intensity and small-leak illumination possible. Using the developed system, the blood veins in palm hands were visualized. We could obtain the transillumination images of the palm hand and using image processing algorithm we extract veins from palm.

[5] "*Finger Vein Authentication Using Local Ternary Co- Occurrence Pattern Feature Descriptor*.",Manmohan, C.Varun ,IEEE International Work Conference on Inventive computational technologies(ICICT2016).

The concept demonstrated during this research are often incorporated during a hardware model for authenticating people in sites like banks, where security is of prime importance and to spot or maintain a record of the people that tried to or got access of the bank or a locker inside. The hardware application thus eliminates the utilization of keys or maintaining one. Accordingly the Finger Vein Authentication using LTCoP concept has widespread application and isn't limited to security systems, creating lot of future scope. This paper proposes a replacement approach to finger vein authentication using the Local Ternary Co-occurrence Patterns (LTCoP) concept. The illustrated method takes advantage of the unique finger vein patterns in one's finger to accurately authenticate one. the tactic used is a smaller amount complex and proves to be highly reliable, offering constructive results for world applications. the entire research is completed keeping in mind the longer term application of the algorithm on low cost processing devices for practical implementation. The experimental results show that the equal error rate (EER) was 11.8134% and therefore the EER reduces because the number of samples increases proving to be one the foremost reliable approach for finger vein authentication. thanks to the high equal error rate we aren't considering this sort of method.

[6] "*FINGER VEIN RECOGNITION*", Dr..S.Brindha, International Research Journal of Engineering and Technology (IRJET),p-ISSN: 2395-0072,e-ISSN: 2395 -0056,Volume: 04 Issue: 04, Apr -2017.

The neighborhood elimination technique is employed to get rid of redundant minutiae points for enhancing the performance of the system. There are a spread of things taken into consideration during this biometric system, like the amount of intersections within the vein pattern, and therefore the pattern round the intersection . This intersection spot are going to be taken by the system itself, taking the intersecting point as the mid-point. Thus finger vein

authentication by means of this new method will ensure high level of security. The reduced feature set method proposed has high accuracy and improved performance.

III. METHODOLOGY

A. Infrared finger image:

Vein detection using infrared imaging, to obtain the pattern for the database record, a private inserts a finger into an attester terminal containing a near-infrared LED light or a monochrome CCD camera [3]. The hemoglobin within the blood absorbs near- infrared LED light, which makes the vein system appear as a dark pattern of lines. The camera records the image and therefore the data is digitized, certified and sent to a database of registered images[6].

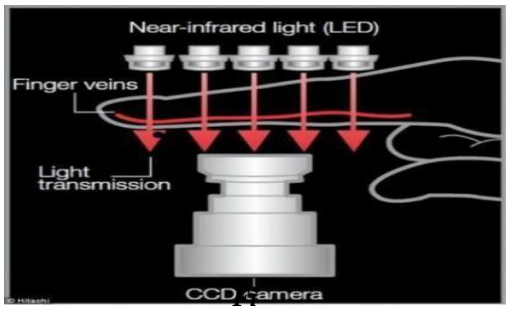

Fig. 3.1. Infrared finger image module.

The IR light irradiates the backside of the finger. A light- emitting diode (LED) is employed because the illumination source for IR light. With the LED illumination source, however, the shadow of the finger-vein obviously appears within the captured images[3]. Raw finger-vein image captured by using this device.

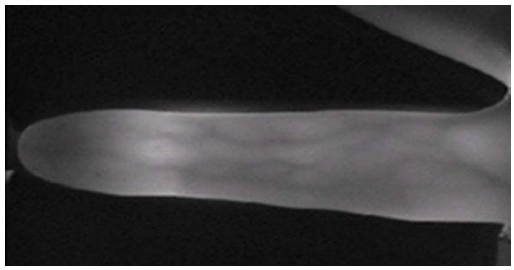

Fig.3.2. Finger vien image.

B. Image pre-processing:

The Captured finger vein image can contain various noise and distortion there on[1] . To extract the feature vein patterns, the image captured need to be normalized by means of image pre-processing techniques[1]. The resultant image is that the high contrast image which is to be further processed for the extraction of vein patterns by the algorithm proposed. during this the initial image is read and therefore the RGB image is converted into the grey scale image[2]. Increase the contrast of the grey scale image by multiplying the image pixel value with the constant. then remove the noise contrasted image by adding the “Salt and Pepper” noise onto the image. and therefore the image is processed for further operation.

C. Gradient feature extraction:

The feature veins are extracted from the improved image by means of theproposed Gradient Feature Selection Algorithm [1]. a picture of a finger captured under infrared contains not only the vein pattern but also irregular shading produced by the varied thicknesses of the finger bones and muscles [3]. The gradient direction representation provides better discrimination ability than the image intensity, and it shows that the mixture of gradient directionality and intensity outperforms the gradient feature alone.In the proposed algorithm, the gradient magnitude has been identified by the given equation. The Gx and Gy give the worth of the n-dimensional filtering of the gray-scale image

with the sobel operator matrices in “Replicate” as border options[3]. The Sobel operator creates the own filter and performs a 2- D spatial gradient measurement of the image that corresponds to the sides . absolutely the gradient magnitude at each point of the Input gray scale image is calculated by the equation. The gradient is high at borders of the image and low. the grey scale image is converted to the double precision image for locating the gradient magnitude.The double precision image along side the filter created by the sobel operator has been wont to perform the magnitude calculation.
For Gx, The Sobel matrix is given as

$$Sx = \begin{bmatrix} -1 & 0 & 1 \\ -2 & 0 & 2 \\ -1 & 0 & 1 \end{bmatrix}$$

For Gy, the sobek matrix is transpose of Sx,

$$Sy = Sx^T$$

$$Sy = \begin{bmatrix} -1 & -2 & -1 \\ 0 & 0 & 0 \\ 1 & 2 & 1 \end{bmatrix}$$

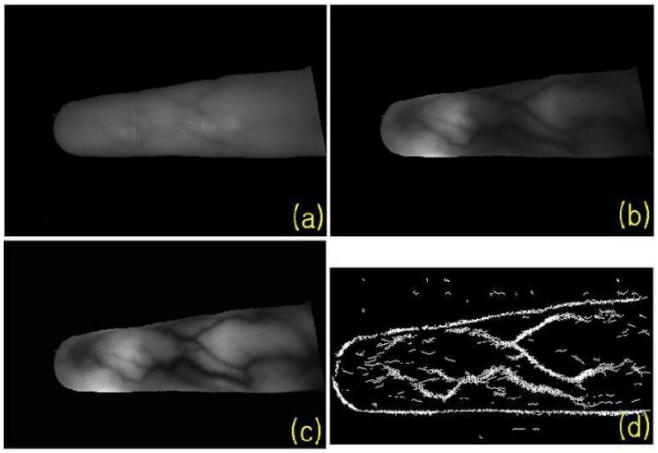

Fig.3.3 Image after pre-processing and feature extraction.

D. Database:

The feature vectors created for every image are stored during a separate file for simple managing data [6]. This prevents extracting the features whenever the program runs. The feature vectors are stored during a well-defined manner. It reduces time consumption and allows efficient operation [1]. A database provides user and programmers with a scientific thanks to create, retrieve, update and management of knowledge.

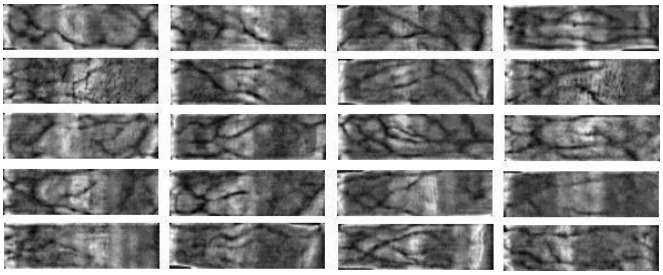

Fig.3.4 pre-processing

E. Template Matching:

The feature extracted image and template stored earlier within the data base is compared[4]. Here predefined threshold were used because the classifying criterion for matching and recognition. Recognized pattern is further given for authentication[1].

IV. RESULT

Accurate extraction of finger vein pattern may be a fundamental step in developing finger vein based biometric identification systems. Finger veins have textured patterns, and therefore the directional map of a finger vein image represents an intrinsic nature of the image. The finger vein pattern extraction method using gradient feature extraction method. The algorithm was implemented on matlab, finger vein image capture was performed taking under consideration the convenience of users, while collecting index image. The image is converted into gray scale image using matlab function rgb2gray. The image also can be converted to negative image for having clear difference between vein and background.

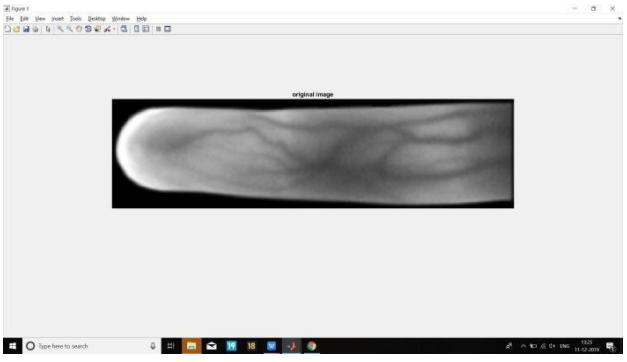

Fig. 4.1. Original Image.

The finger image is further given for pre- processing where the image is gone through various steps. The image is first enhanced using techniques such as histogram equalization, image adjustment, image sharpening.

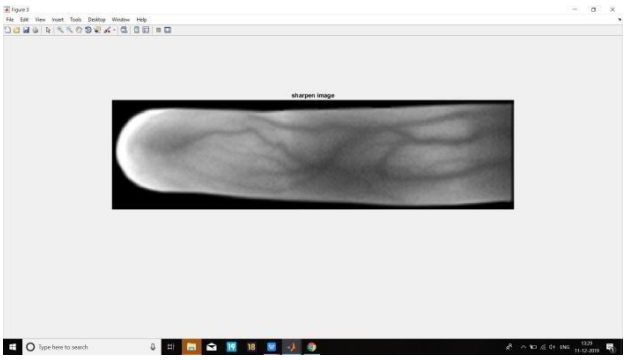

Fig.4.2. Sharpen Image.

The gray image is also enhanced by histogram equalization technique. The process of adjusting intensity values can be done automatically using histogram equalization. Histogram equalization involves transforming the intensity values so that the histogram of the output image approximately matches a specified histogram.

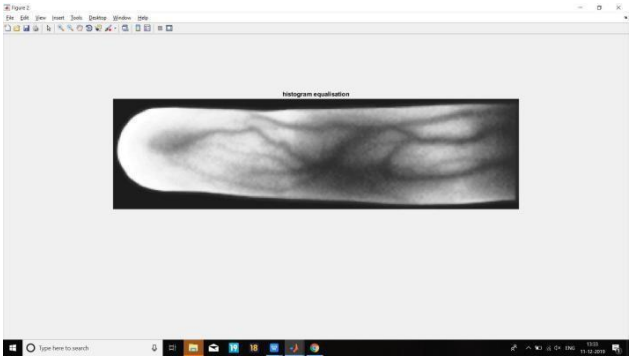

Fig.4.3.Histogram Equalized.

The above figure shows histogram equalized image, in this the contrast of image is increased. The another preprocessing technique is contrast adjustment of image technique which also increases or decreases the contrast of the image as per the need.

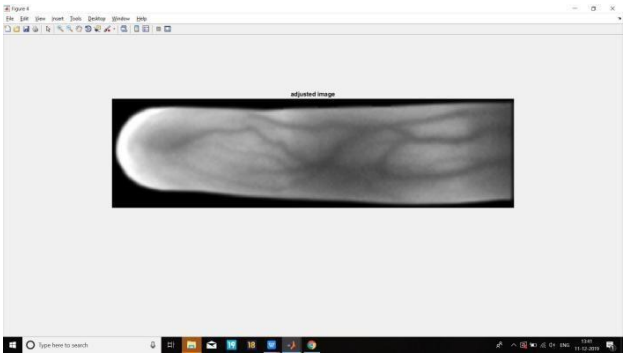

Fig.4.4. Adjusted Image.

From the techniques used above the histogram equalization techniques gives a better pre processed image. The image shows clear vein pattern and hence used for feature extraction.

The preprocessed image is next given to for filtering process, where salt pepper noise is added to the image.By randomizing the noise values, the pixels can change to a white, black, or gray value, thus adding the salt and pepper colors. By randomizing which pixels are changed, the noise is scattered throughout the image. The combination of these randomizations creates the "salt and pepper" effect throughout the image. The image with salt pepper noise is given below,

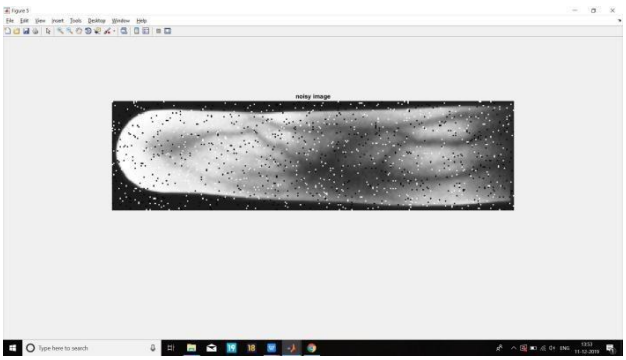

Fig.4.5. Noisy Image.

The median filter is used to remove salt and pepper noise. The filtered image is given below,

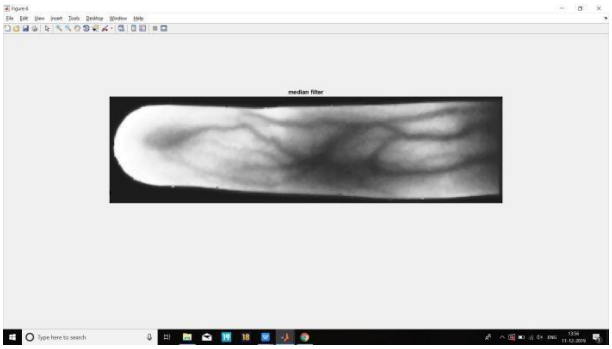

Fig.4.6. Filtered Image.

The filtered image is used for edge detection. There are various methods available for edge detection. Sobel operator is one of the edge detection method used.The double precision image along with the filter created by the sobel operator has been used to perform the magnitude. The sobel filter gives a x gradient, y gradient image and a final combined image.

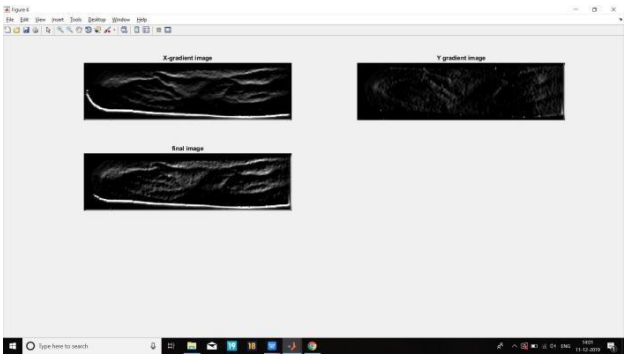

Fig.4.7.Sobel Operator.

The sobel operator dose not give detailed edges of the veins. Hence another edge detection method called as canny detector is used. This canny edge detection provides detailed boundaries of the veins and thus we are able distinguish vein pattern and background.

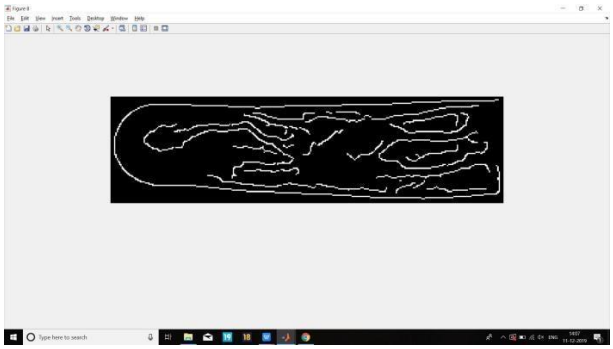

Fig.4.8 Canny Edge Detection.

This feature extracted data is further stored in database. This is enrollment of the authentication process. While verifying this stored templet is compared with the real time feature extracted image and thus authentication is processed depending on the verification.

V. CONCLUSION

In this project proposed the biometric identification technique supported the gradient feature algorithm. The proposed system includes a tool for capturing finger-vein images, a way for extracting features. The proposed algorithm to extract finger-vein images by considering various parameters like vein width, position, length, pixels and intersection of veins. This shows better EER than other existing algorithm. thanks to the higher performance than other systems, this technique are often used for various applications. The reduced feature set method proposed has high accuracy and improved performance.

ACKNOWLEDGMENT

This is our honest and sincere feeling towards all those that directly or indirectly encouraged us, helped us, criticized us in accomplishment of this project work. the quantity of labor wouldn't are possible without contribution in one form or the opposite by few names to say . We welcome this chance to precise our heartfelt gratitude and regards to our project guide Mr. S.V. Moholkar, Department of Electronics and Telecommunication Engineering, Smt. Kashibai Navale College of Engineering, for his unconditional guidance. He always bestowed parental care upon us and evinced keen interest in solving our problems.

REFERENCES

[1] Parthiban K,Amitabh Wahi,Sundaramurthy S,Palanisamy C,“Finger Vein Extraction and Authentication Based on Gradient Feature Selection Algorithm”,IEEE International Conference on (ICADIWT).978-1-4799-2259,2014.

[2] Yanagawa, T. et al.: “*Human Finger Vein Images Are Diverse and Its Patterns Are Useful for Personal Identification.*” MHF 2007-12, 2007, pp. 1–7.

[3] Zhi Liu and Shangling Song,”An Embedded Real-Time Finger-Vein Recognition System for Mobile Devices”,IEEE Transaction on Consumer Electronics, vol.58, no.2, pages522-527,May,2012.

[4] Vishal V. Gaikwad, Sanjay A. Pardeshi "Vein detection using infrared imaging system." International Journal of Electrical, Electronics and Computer Systems (IJEECS) 2347-2820, Volume -2, Issue-3, 2014.

[5] Dr.S.Brindha, "Finger Vein Recognition", International Research Journal of Engineering and Technology (IRJET),p-ISSN: 2395-0072,e-ISSN: 2395 -0056,Volume: 04 Issue: 04, Apr - 2017.

[6] Manmohan, C.Varun, Kuchimanchi Bhaskar Sri Lalith, Surbhit Bhatnagar,"Finger Vein Authentication Using Local Ternary Co-Occurrence Pattern Feature Descriptor",IEEE International Work Conference on Inventive computational technologies(ICICT) Aug2016.

[7] M. Sapkale and S. M. Rajbhoj, 2016 "A biometric authentication system based on finger vein recognition," 2016 International Conference on Inventive Computation Technologies (ICICT), Coimbatore, pp. 1-4.

[8] Mona A. Ahmed, Hala M. Ebied and Sayed M. El-Horbaty, 2013"Analysis of Palm Vein Pattern Recognition Algorithms and Systems" International Journal of Bio-Medical Informatics and e-Health (ISSN). ISSN 2321-9017, Volume 1, No.1, June – July 2013.

[9] Mohit Soni ,Sandesh Gupta, M.s. Rao and Phalguni Gupta "A New Vein Pattern based Verification System" 2010 International Journal of Computer Science and Information Security(IJCSIS) 2010

[10] Vandana S. Bujare and Dr. Jayamala K. Patil " Palm Vein Recognition Based on Local Binary Pattern and Uniform Local Binary Pattern" IJEDR 2019, Volume 7, Issue 3, ISSN 2321-9939

[11] Di Huang, Yinhang Tang, Yiding Wang and Yunhong Wang "Hand-Dorsa Vein Recognition by Matching Local Features of Multisource Keypoints" IEEE Transactions on Cybernetics, IEEE 2168-2267, 2014