Proc. of Int. Conf. on Current Trends in Eng., Science and Technology, ICCTEST

An Approach for Validation of Improved Feature Point Detection in Human Retinal Recognition

Prashantha G R[1] and Dr.Chandrashekar M Patil[2]
[1] SKSVMACET, Laxmeshwar, Karnataka,India
Email: prashanthagr.sjce@gmail.com
[2] VVCE, Mysore, Karnataka, India
Email: patilcm@vvce.ac.in

***Abstract*— The retinal recognition is yet another step in biometric, as a very rare but the most accurate authentication technique. In this paper a windowing technique for feature extraction and feature point detection in order to improve the accuracy of retinal recognition. The proposed paper contains distinct property exceptionally low FAR & FRR. This paper presents a four stages feature extraction and feature point detection using retinal vascular pattern of Human retina. In first and second stage, Image acquisition, is the process of obtaining an image from the source. Image preprocessing is the image resizing that is before resizing the image was shown at 67% instead of the normal 100%. It involves four process, RGB to gray scale and green channel image selection, Histogram equalization, Noise removal, filtering, sharpening and smoothing in third step. In forth stage, it performs feature extraction and feature detection using Morphological structuring and FAST (Features from Accelerated Segment Test) algorithm. The proposed method is tested on available databases DRIVE. Experimental analysis of given approach shows a significant decrease of false feature point.**

***Index Terms*— Feature Extraction, Feature point Detection, FAST, Retinal recognition.**

I. INTRODUCTION

Biometric Recognition refers to the automated recognition/ identification of individuals based on their physiological characteristics and to some extent also behavioral characteristics. By use of biometrics it is possible to achieve this high level of security requirements in the facilities mentioned above. This mainly concentrated on the use of retinal scans as means of identification and the retina as the biometric. The retina contains numerous blood vessels which form distinct patterns in the eye. This unique blood vessels patterns form the foundation of the retinal recognition system. In [1] proposed an efficient means that is Artificial neural network which is of prediction, optimization and recognition. Retina is a unique biometric pattern that can be used as a part of a verification system. An ANN can be configured and trained to handle such variations observed in the texture of the retina. In [2] the novel biometric identification system with high performance based on the features obtained from human retinal images. This system is composed of three principal modules including blood vessel segmentation, feature generation, and feature matching. In [3] presents biometric identification system base on combination of Fourier transform and that special partitioning and wavelet transform.In [4] proposed a personal identification (PI) system using color retinal fundus images which are unique to each individual. The proposed procedure for identification is based on

Grenze ID: 02.ICCTEST.2017.1.179

comparison of an input fundus image with reference fundus images in the database. In the first step, registration between the input image and the reference image is performed. The step includes translational and rotational movement. The PI is based on the measure of similarity between blood vessel images generated from the input and reference images. In [5] used kernel is map to test the distance between different retinal images as projected onto their respective feature spaces. We tested the following feature set: angle among branches, the number of fiber based on distance, distance between branches, and inner product among branches. Proposed Retinal Biometrics based Authentication and Key Exchange System [6] in which Extraction of retinal features, Retina Normalization and building secret key using encoding and decoding method and generating the secret key.Review paper on retina authentication and its security issues In this they analyzed different methods required to extract, filter, and store the blood vessels, and features of retina the methods are bifurcation method, bifurcation and crossover method, optic method and retina feature points extraction algorithm [7]. In [8] proposed An Introduction to Biometric Recognition paper in which system performance at all the operating points (thresholds, t) can be depicted in the form of a Receiver Operating Characteristic (ROC) curve. A ROC curve is a plot of FMR against (1-FNMR) or FNMR for various threshold values. Biometric authentication using digital retinal images proposed, the one based on level set extrinsic curvature (LSEC), has useful invariance properties [9]. Our algorithm is composed of four stages:1. Image acquisition, is the process of obtaining an image from the source. 2. Image preprocessing is the image resizing that is before resizing the image was shown at 67% instead of the normal 100%. 3. It involves four process, (i) RGB to gray scale (ii) green channel image selection (iii) Histogram equalization, (iv) Noise removal (v) Filtering, sharpening and smoothing in third step. 4. Feature extraction and feature detection using FAST (Features from Accelerated Segment Test) algorithm.

II. System Methodology

In this algorithm four stages feature extraction and feature point detection using retinal vascular pattern of Human retina

A. Image Acquisition

Image Acquisition is the process of obtaining an image from a source. This source is usually a hardware source like a digital camera or mobile phone. In this project, it is the process of obtaining the color image photograph of the retina to be used for feature extraction. The color image is obtained with the help of a specialized hardware source known as retinal image scanner.

B. Image Pre-processing

This is the process of preparing the acquired images for image enhancement. Image resizing was the major process carried out. This reduced the size of the image to enable digital image processing to be carried out. It enabled the MATLAB application to display the full image instead of a reduced size of the image as witnessed before resizing. That is before resizing the image was shown at 67% instead of the normal 100%.

C. Image Enhancement

This is a process that commonly involves removing low frequency background noise that may arise during image acquisition process, normalizing the intensity of the various parts of the image, sharpening, filtering and smoothing the image. This process highlights the areas of interest. With respect to this project, it is the process of making the image characteristics more visible and highlighting the blood vessels of the retina in preparation of the feature extraction process. It involves four process

- RGB to grayscale conversion and Green Channel Image selection
- Histogram Equalization
- Noise removal and Filtering
- Image sharpening and smoothening

RGB to grayscale conversion:

This is the process of converting the true color image RGB to the grayscale intensity image. This is done by eliminating the hue and saturation information of the image and retaining the 17 luminance of the image. Luminance is described as the amount of light that is emitted from a specific area of the image. The conversion basically gives a scale of the various intensities of the image from the lowest to the highest based on their light each part of the image emits. Matlab application uses this same technique to perform the conversion. It ranks the various intensities using a scale of 0-255 which means that zero refers to the darkest shade of gray while 255 refers the lightest shade of gray . Green channel selection using the green channel to perform the image enhancement procedures. This channel is chosen because of the three (RGB), it has the highest intensity as compared to Red and Blue.

Histogram Equalization:
This is the process of enhancing an image using the image histogram. It enhances the image by transforming the values in an intensity image such that the histogram of the image obtained after the process matches a specified histogram. The specified histogram parameters are defined to allow one to get the output desired.

Noise Removal and Filtering:
Digital images are susceptible to a wide range of noise. Noise in images could arise from theprocess of image acquisition such that the image does not reflect the true intensities of the all the pixels. This may be as a result of how the image was transmitted from the acquisition hardware, process of acquisition or even during transmission of the image through electronic media. There are various methods of noise removal. Linear filtering: Includes Averaging filters and Gaussian filters. Averaging filter is useful in removing grain noise from images since it gives each pixel the average of all the surrounding and thus variations caused by grains are greatly reduced. Gaussian filters are a class of low-pass filters based on Gaussian probability distribution. Median filtering: It is similar to in that it also sets each output pixel to an average value. The difference is that the output pixel is determined by the median of the surrounding pixels instead of the average value. This is because the median is not very sensitive to18the extreme pixel values (i.e. high pixel value and low pixel values). Median filter is therefore better and efficient at noise removal and it doesn't affect the sharpness of the image. Adaptive filtering: This method of filtering uses the wiener filter. Wiener filter is a type of linear filtering that utilizes the image variance. It is a low-pass filter that filters constant power additive noise by use of pixel adaptive wiener method based on statistics estimated from the surroundings of the pixel in the matrix. This method produces better results as compared to linear filtering since it is more selective unlike linear which is inclined mostly towards comparing. It preserves high frequencies and edges of the image.
For this work, both Adaptive and Median filters have been used to remove the noise in the
images during the image enhancement process. This is due to their advantages and superiority in terms of quality of the images produced and appearance.

Image Sharpening and Smoothing:
This is a process of enhancing that deals with de-blurring an out of a focus image, highlighting edges, improving image contrast and brightening the image.

D. Feature Extraction

In this technique of morphological structuring knows as skeletonization was used to make the extracted vessel paths more distinct. Key Feature points of the extracted blood vessels and Feature point were detected using FAST Features detecting tool.

III. PROPOSED ALGORITHM

Accurate retinal blood vessel feature point extraction is required as a pre-processing method. The proposed algorithm is designed for retinal blood vessels segmentation. Input to the system is a color fundus image of human retina acquired by a fundus camera and the output is a binary image which contains only the blood vessels.The contrast of the fundus image tends to be bright in the center and diminish at the side, hence preprocessing is essential to minimize this effect and have a moreuniform image. After which, the green channel of the image is applied and also histogram equalization, Image sharpening and filtering with morphological structuring. Image segmentation is then performed to adjust the contrast intensity and small pixels considered to be noise are removed. The obtained image would represent the Feature point detection of the original image. Fig.1 has shown the architecture of the proposed algorithm for the Feature point detection of Human retina

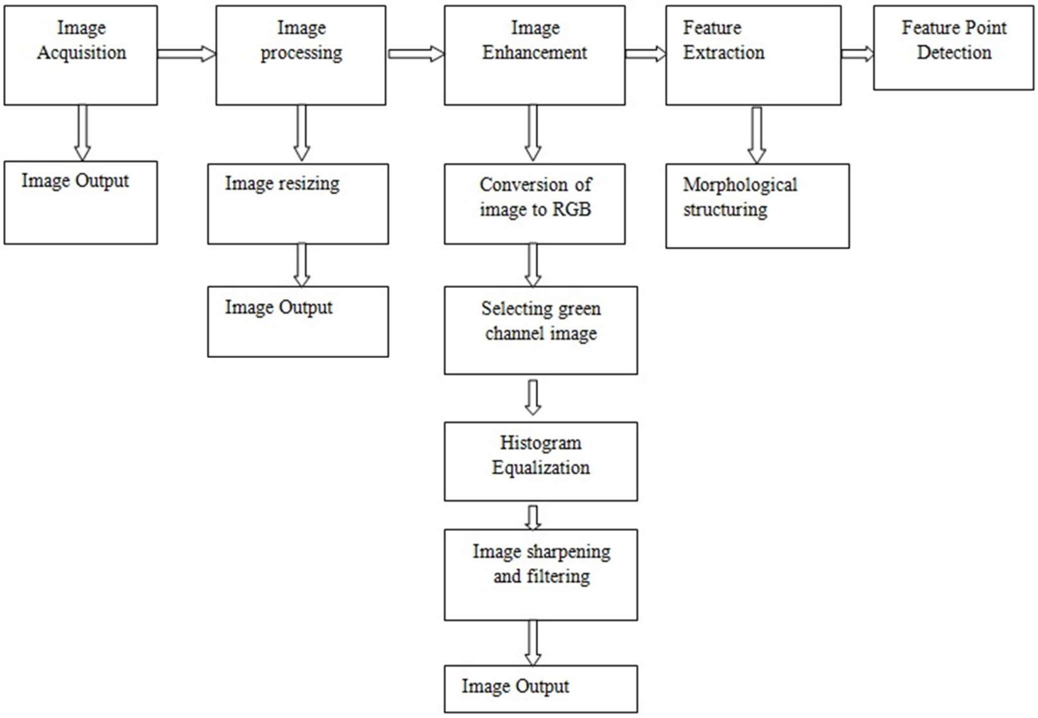

Fig.1: Block Diagram for the Feature Point Detection

F. Extraction of Feature Point Detection:

The results are shown below are arranged in order of the blocks outputs of each step of the block diagram. Each stage shows two different images for comparison purposes.

Image Acquisition Stage:
This is the result of running the section of the code as highlighted in the Block diagram

Fig. 2. Image Acquired from Retina

Fig. 2. shows the image acquired from retina which is the first step of the workflow.

Image Pre-processing Stage:
The image is resized to enable efficient conditions for image enhancement as shown in the Fig.3(a)

Image Enhancement Stage:
The 1st step of this process is conversion of the RGB to Grayscale image and selection of the Green channel enhancement as shown in the Fig. 3(b).This phase involves histogram equalization and the output is as shown in the Fig. 3 (c).At this Stage the histogram equalized image was sharpened to make edges of the vessels clearer as shown in Fig. 4.5.
Adaptive Histogram equalization was carried out on the image to increase the intensity of theImage as shown in Fig. 3(d). Noise as a result of image enhancement was removed using filtering methods and wiener method as shown in Fig. 3(f).Contrast of the Image was adjusted to enhance the detail as shown in Fig. 3(g).Filtering and smoothing is done again to enhance the edges of the imageas shown in Fig 3(h)

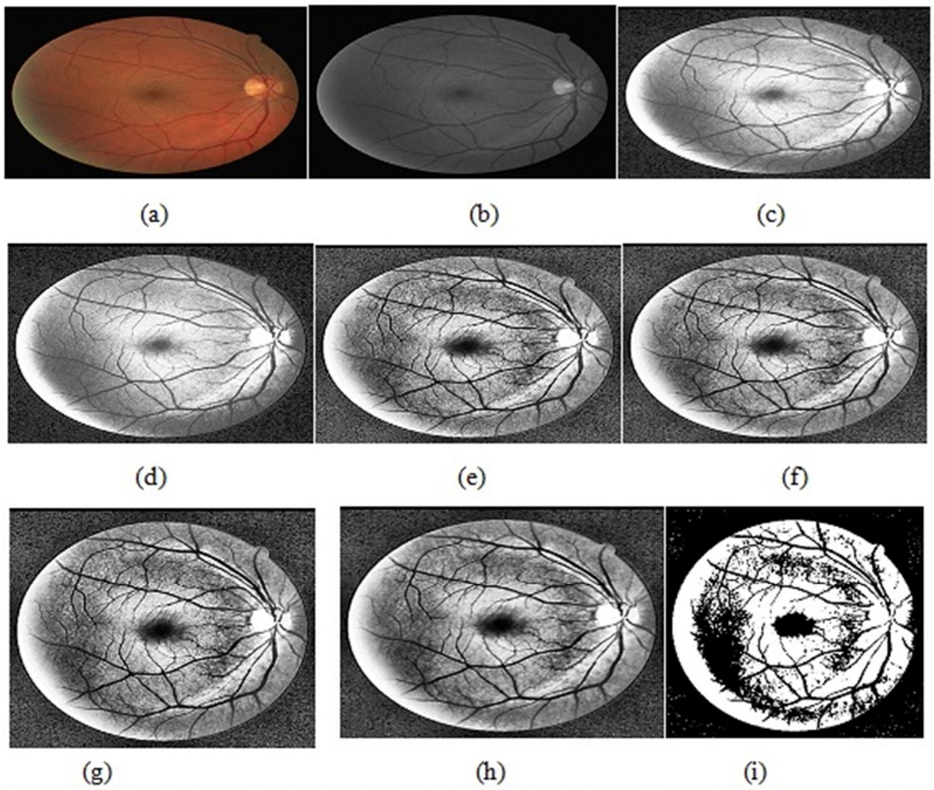

Fig.3: (a) Image Resize of retina (b) Green Channel Image (c) Histogram Equalized Image (d) Sharpened Image (e) Adaptive Histogram Equalized Image (f) Adaptive Histogram Equalized Image (g) Contrast Adjustment in Image (h) Filtering and Smoothing in Image (i) Thresholding and Conversion to Binary for Image

Feature Extraction Stage:

Thresholding was carried out and the images converted to Binary as shown in Fig.3(i).
Morphological structuring elements were incorporated. Specifically the ‘disk’ operator as shown in Fig.4(a).

(a) (b) (c)

Fig.4 (a) Morphological Structuring Elements in Image (b) Morphological Skeletonization on image (c)Feature point detection on image

A different technique of morphological structuring knows as skeletonization was used to make the extracted vessel paths more distinct as shown in Fig. 4(b).Key Feature points of the extracted blood vessels were detected using FAST Features detecting tool and the strongest most dominant 500 points shown on Fig.4(c).

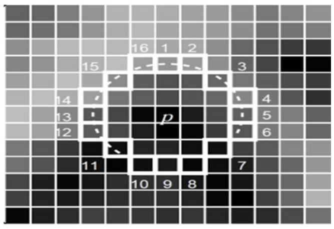

Fig.5: Image showing the interest point under test and the 16 pixels on the circle

FAST Feature detector algorithm is explained below:

- Select a pixel p in the image. Assume the intensity of this pixel to be IP. This is the pixel which is to be identified as an interest point or not.
- Set a threshold intensity value T, (say 20% of the pixel under test).
- Consider a circle of 16 pixels surrounding the pixel p image as shown in the Fig.5
- "N" contiguous pixels out of the 16 need to be either above or below I_P by the value T, if the pixel needs to be detected as an interest point. (The authors have used N = 12 in the first version of the algorithm)
- To make the algorithm fast, first compare the intensity of pixels 1, 5, 9 and 13 of the circle with I_P. As evident from the figure above, at least three of these four pixels should satisfy the threshold criterion so that the interest point will exist.
- If at least three of the four pixel values - I_1 ,I_5 ,I_9 I_{13} are not above or below I_P + T, then p is not an interest point (corner). In this case reject the pixel p as a possible interest point. Else if at least three of the pixels are above or below I_p + T, then check for all 16 pixels and check if 12 contiguous pixels fall in the criterion.
- Repeat the procedure for all the pixels in the image.

The Features detected by the FAST Feature detector where isolated and plotted on a graph as shows in Fig.6:(b).

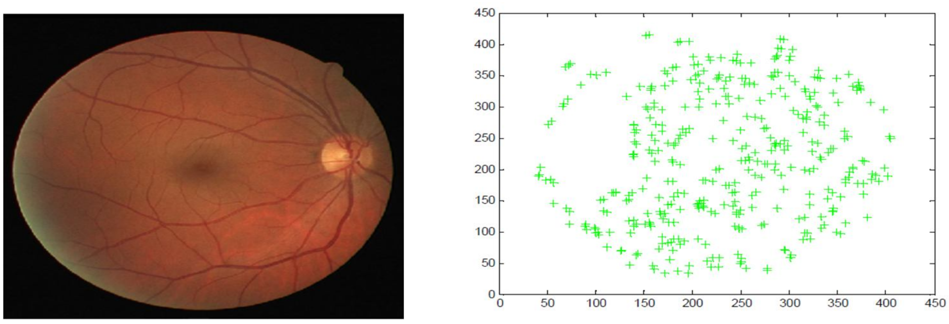

Fig. 6 (a) Original Fundus Image (b) Features Points Extracted from Image

IV. RESULTS ANALYSIS

To verify the performance of the feature detection we experiment with color images from different databases. We show results of some of these experimental. In Fig.4.1 shows typical results of our color images. The Graphical User interface shows the extracted features point detection using Fundus images. First Image Resize of retina, Green Channel Image ,Histogram Equalized Image, Sharpened Image Adaptive Histogram Equalized Image ,Adaptive Histogram Equalized Image, Contrast Adjustment in Image Filtering and Smoothing in Image, thresholding and Conversion to Binary for Image

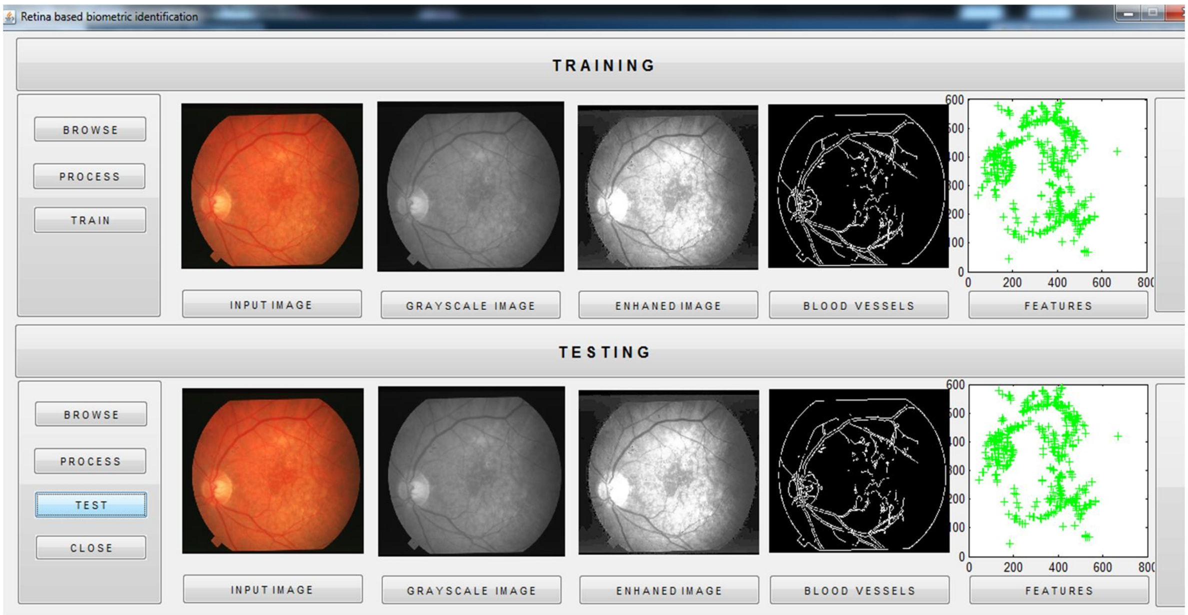

Fig 4.1: The GUI shows the Feature point Detection

The above feature points are used for template creation which is used for matching of images stored in a database and the image acquired.

V. CONCLUSION

We presented an algorithm for efficient extraction of Feature point detection from retina images. The post processing on the skeleton vascular pattern is proposed to help and improve the matching phase. In this algorithm first phase image acquisition, second phase image preprocessing, third phase image enchantment and finally forth phase feature extraction, feature point detection. The limitation of image acquisition was countered by there being standard image databases of retinal images. For this work a database known as DRIVE was used to get images that would replace the image acquisition process and therefore enabling the main objective of this work to be met and the retinal scans used to show the extraction of the blood vessels and feature point detection. The feature extraction of retinal scan has been shown to be unique and therefore gives a high level of safeguarding information. Further improvements can be done to improve the accuracy of the extraction of feature point detection.

REFERENCES

[1] Tripti Rani Borah, Kandarpa Kumar Sarma & Pran Hari Talukdar[1] "*Artificial Neural Network Aided Retina Based Biometric Identification System*" International Journal of Electronics Signals and Systems (IJESS), ISSN: 2231-5969, Vol-3, Iss-1, 2013.

[2] Hadi Farzin, Hamid Abrishami-Moghaddam, andMohammad-ShahramMoin[2]"*A Novel Retinal Identification System*," *EURASIPJournal on Advances in Signal Processing*, vol. 2008, . Article ID:280635, 2008.

[3] Masoud Sabaghi, S. Reza Hadianamrei, Mehdi Fattahi, Mohammad Reza Kouchaki, Ali Zahedi[3] "*Retinal Identification System Based on the Combination of Fourier and Wavelet Transform*"Journal of Signal and Information Processing,vol. 2012, 3, 35-38.

[4] Keisuke Fukuta, Toshiaki Nakagawa , Yoshinori Hayashi , Yuji Hatanaka , Takeshi Hara , Hiroshi Fujita [4] "*Personal Identification Based on Blood Vessels of Retinal Fundus Images*"Medical Imaging 2008: Image Processing, edited by Joseph M. Reinhardt, Josien P. W. Pluim,Proc. of SPIE Vol. 6914, 69141V, (2008)1605-7422/08/$18 · doi: 10.1117/12.769330.

[5] Donghyeop Han, Heeyoul Choi, Choonseog Park, and Yoonsuck Choe[5] "*Fast and Accurate Retinal Vasculature Tracing and Kernel-Isomap-based Feature Selection*"Proceedings of International Joint Conference on Neural Networks, Atlanta, Georgia, USA, June 14-19, 2009.

[6] K. Saraswathi, B. Jayaram,Dr. R. Balasubramania "*Retinal Biometrics based Authentication and Key Exchange System*"International Journal of Computer Applications (0975 – 8887) Volume 19– No.1, April 2011.

[7] Ms. Shivani Shikarwar1 , Ms. Devanshi Rathod2 , Mrs. Hiteshi Diwanji *“review paper on retina authentication and its securityissues”* International Journal For Technological Research In Engineering Volume 1, Issue 8, April-2014.
[8] Herbert Bay, Andreas Ess,Luc Van Gool, "*SURF Speed Up robust features*," *Computer vision andImage Understanding (CVIU),* vol. 100, no. 1, pp. 346- 359, 2008.
[9] S. Chaudhuri, S. Chatterjee, N. Katz, M. Nelson, and M. Goldbaum, "*Detection of blood vesselsin retinal images using two-dimensional matched filters,*," *IEEE Transactions on MedicalImaging,* vol. 8, no. 3, pp. 260-268, 1989.
[10] M. Ortega, C.Marino, M.G.Penedo, M.Blanco, F.Gonzalez “*Biometric authentication using digital retinal images*” Proceedings of the 5th WSEAS International Conference on Applied Computer Science, Hangzhou, China, April 16-18, 2006 (pp422-427)
[11] Herbert Bay, Andreas Ess,Luc Van Gool, "*SURF Speed Up robust features*," Computer vision and Image Understanding (CVIU), vol. 100, no. 1, pp. 346- 359, 2008
[12] X. Jiang and D.Mojon, "*Adaptive Local thresholding probing with application to vessel detectionin retinal images*," *IEEE Transaction on Pattern analysis and machine intelligence,* vol. 25, pp.131-139, 2003
[13] J.Klein and F.Zana, "*Segmentation of vessel-like patterns using mathematical morphology and curvature evaluation,*" *IEEE Transaction on Image Processing,* vol. 10, no. 1, pp. 1010-1019,2001.
[14] Ms. Shivani Shikarwar1 , Ms. Devanshi Rathod2 , Mrs. Hiteshi Diwanji *“review paper on retina authentication and its securityissues”* International Journal For Technological Research In Engineering Volume 1, Issue 8, April-2014.