A Novel Based Algorithm for the Extraction of Blood Vessels Present In Retina

Dova.Veena Grace, B.M.S.Rani, Veeranki Naga Swapna Sri

Abstract: The purpose of tagging and describe about individuals, using the uniqueness and measurable characteristics of Biometric identifiers. These characteristics are classified as Behavioral versus Physiological. Information related to shape of body is presented in the characteristics of Physiological biometric identifiers with example of DNA, iris recognition, hand geometry, palm print, retina, face and fingerprint. Reliable and stable authentication is providing by the Human retina, so it is also consider as biometric system. In this paper we proposing a modified algorithm for the measurement and detecting of blood vessels in the retina with the uses of KNNRF classifier. Extracting the features of input retinal images are matching with the trained features are classified byusing the KNNRF classifier. For the purpose of classifying clustered blood vessels with high accuracy, KNNRF method is used.

Keywords: Blood Vessel Identification, Retinal Images, Biometric Authentication, Identification Methods.

I. INTRODUCTION

Biometric refers to automatic recognition and provides natural and reliable solution to the problem of person identity [1]. There are two types of biometric system are available depends upon physiological and behavioral characteristics of the person. For example fingerprint, face, iris, retina, hand, signature, voice, gait and DNA etc. Biometrics can be used in different applications such as security, banking, military and defense.

Retinal scanning is one of the most important biometric technology. Retinal blood vessels are unique patterned by using technique of retinal scan. It will be quite different to the iris technology. In retina the structure of blood vessel is unique. Every eye has its own unique patterns. Even identical twins also have the different blood vessel structure. Main focus was on the extraction of blood vessels with high accuracy. By using this extraction, diseases like diabetics and glaucoma are easily identified in retina.

This paper organized as literature survey presented in section II, Section III represents the proposed system for detecting and measuring the blood vessels in retina, Section IV represents the Results and Section V represents the Conclusion.

II. RELATED WORK

A new personal authentication technique for network security is proposed by K Jayaram, in this technique retinal vessel tree feature is used for authentication. Because of its unique configuration of individuals and doesn't vary forever. In this proposed approach build a security key by the registered user with include of retinal features. From the experimental observations, the proposed security method is work with more efficiency, simple, make it ready to applied alone by comparing with other existed security methods.

Different shaped Gaussian filters are used for the detection of blood vessels such as Derivative of Gaussian function and simple Gaussian model [2]. Different orientation of blood vessels are detected by the curve shaped Gaussian model cross section of vessel and rotate the matched filter based on the kernel or filtering methods [3-5] . This proposed method is also represented in mathematical sets with the features of known vessel and boundaries based on the mathematical morphology. These morphological operators are extracting the vessels from the background.

Vessel center lines are used to acquire the vasculature structure based on Vessel tracking methods are proposed. The local information and attempted to find the path are used to matching with the vessel profile is generates the vessels traces, when the establishment of start points sets. Blood vessels are clearly detected by the Vessel methods are stated in model based methods. These methods are used in snake or contour model, profile of vessel models and level set based geometric models (LSM) for the segmentation of blood vessel.

III. PROPOSED WORK

This section describes an algorithm to extract the blood vessel structure present in retina. The proposed methodology consists of following steps pre-processing, classification and blood vessel extraction. Below figure 1 describes the proposed technique

Revised Manuscript Received on March 12, 2019

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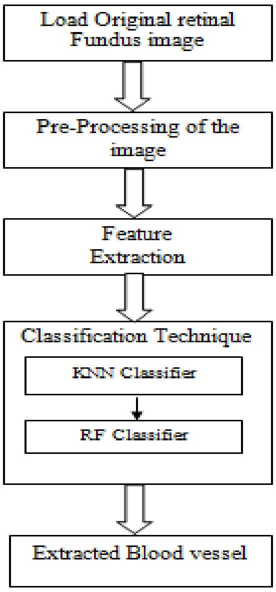

Fig. 1: Proposed Method Flow Chart

A. Acquiring the Fundus Image:

Image capture digital analysis is a first stage in fundal. It is acquired by back mounted digital camera of fundal. This mounted digital camera works as the conventional camera instead of film, it used as a image sensor.

B. Pre-Processing:

The acquired retinal fundus image from the camera is noisy, low contrast and contains some disturbances. Ancient singularities and contains 10% of disturbance is arrived in right of retinal pictures, when checking the retinal biometric. After the conversion of retinal fundus image to gray scale image, the "contrast" and to improve the quality of retinal image is enhanced by using the Adaptive histogram equalization. The output image of the histogram is matched with the specified histogram image by the process of transforming the image with their intensity values. After performing the equalization a Gaussian filter operation was applied to reduce the noise.

$$G(x,y) = \frac{\pi}{2\pi\sigma^2} \exp\left(\frac{x^2+y^2}{\sigma^2}\right) \quad (1)$$

C. Feature Extraction:

It defines as one or more function measurements have to specifies the quantifiable property and computing the significant characteristics of the object. The GLCM, local maxima of the largest Eigen value , local maxima of the gradient magnitude and green channel intensity features are included in this paper.

Gradient magnitude calculations are given as (max over scales):

$$|\Delta L| = \sqrt{L_x^2 + L_y^2} \quad (2)$$

$$L_x = I(x,y) \otimes sG_x$$

$$L_y = I(x,y) \otimes sG_y \quad (3)$$

Here L_x and L_y represents the image first derivatives in the directions of x and y. Gaussian derivatives are represented as G_x and G_y in the directions of x and y and s indicates the scale parameter. At different scales, gradient magnitude of the image intensity is calculated. The calculation of local maxima of the gradient magnitude γ as given:

$$\gamma = max\left[\frac{|\Delta L(s)|}{s}\right] \quad (4)$$

The Largest Eigen value (maximum over scales) the Hessian Eigen values (the small Eigen value, λ− and the large Eigen value, λ+), the calculations of intensity image I(x,y) and second order derivatives matrixes as given.

$$\lambda_+ = \frac{\alpha + L_{yy} + L_{xx}}{2} \quad (5)$$

$$\lambda_- = \frac{-\alpha + L_{yy} + L_{xx}}{2} \quad (6)$$

$$\text{Here}\ \alpha = \sqrt{4L_{xy}^2 + \left(L_{xx} - L_{yy}\right)^2}$$

Then, the calculation of the largest eigen values local maxima λmax given as:

$$\lambda_{max} = max\left[\frac{\lambda_+(s)}{s}\right] \quad (7)$$

From each one of the Co-occurrence Matrix can be extracting Co-occurrence features. Energy, Inertia, Correlation, Entropy and homogeneity are used as GLCM features.

Assuming the number of gray values in image as G, then N×N dimensions will be taken in co-occurrence matrix C(i,j).

Table. 1: Feature Representation

GLCM features	Feature Representations
Energy	$\sum_i \sum_j C(i,j)^2$
Inertia	$\sum_i \sum_j (i-j)^2 C(i,j)$
Correlation	$\dfrac{\sum_i \sum_j (ij) C(i,j) - \mu_i \mu_j}{\sigma_i \sigma_j}$
Entropy	$-\sum_i \sum_j C(i,j) \log C(i,j)$
Difference moment	$\sum_i \sum_j \dfrac{1}{1+(i-j)^2} C(i,j)$

Here $\mu_i = \sum_i i \sum_j C(i,j)$

$$\mu_j = \sum_j j \sum_i C(i,j)$$

Where σ_i is defined as $\sigma_i = \sum_i (i-\mu_i)^2 \sum_j C(i,j)$

where σ_j is defined as $\sigma_j = \sum_i \left(j-\mu_j\right)^2 \sum_j C(i,j)$

From the retinal images blood vessels are detected by classifier using 8 features algorithm works efficiently with abnormal images.

D. Classification:

Arranging and assigning of pixels to particular categories by using the Classification procedure. Characterizing the pixels with the uses of texture, gray band value, size, etc. feature vector is known as set of extracted features. Using a general procedure in Classification as given:

1. Definition of Classification classes: It determines the class is assigning pixels based on the objective and image data characteristics.
2. Selection of Feature: for the classification texture, gray band value, size, etc. features to be selected.
3. Characterize the classes in terms of the selected features: there are two types of data sets are available for the purpose of training and testing the classifier.
4. Defining the parameters (if any) required for the classifier: by using training data the classifier algorithm is to be determined with the proper decision rules or parameters.
5. Perform classification: with the help of class decision rules, the testing data classifying the classes in the trained classifier (e.g., minimum distance classifier or maximum likelihood classifier).
6. Evaluating the Result: depends on the results of test data classification accuracy and reliability of the classifier are evaluated.

Recognition of patterns are either supervised or unsupervised based on the classification method. Depends on the classification of pixels the patterns to be supervised in the extraction of blood vessels. These are useful to recognize and extract the features of the image [14]. These features are help to easily identifying the vessels.

As comparing to the background the blood vessels are dark. Defining the vessels and non vessels depends upon the gray level features. So in the local area other gray levels are bigger than the gray levels of pixels on vessels. The difference between the statistical values of local pixels and the gray level in the vessel pixels are gray level features in the retinal images.

The width of the pixel in the vessel is less than the one and it is shown in figure (2).

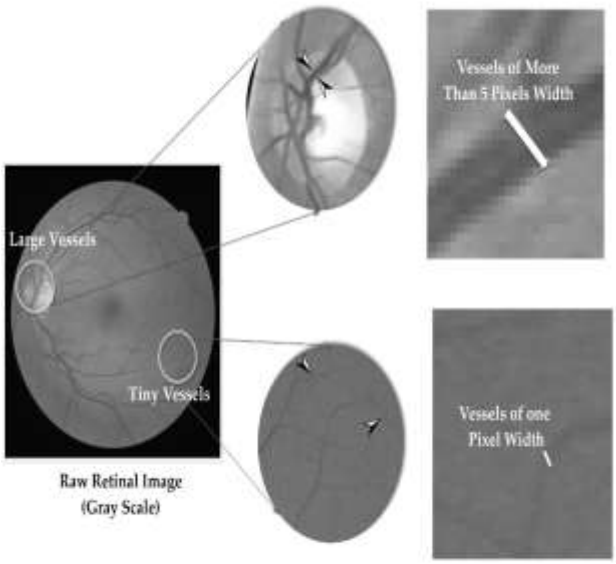

Fig. 2: Pixel Width Variations Of Retinal Vessels

In our proposed method two levels are carried out. Nearest input image pixels classified by the KKN classifier in the first level. Again RF classifier classifies the outputs because of to making the high precious and decision.

a. KNN classifier: in the feature space depends on the closet training examples object is classified by the KNN algorithm. These algorithm used for the process of training algorithm consisting with a storing feature vectors and label of training images. An object is classified by the distance from its neighbors. The K value will be considered as the number of nearest neighbors. In the retinal fundus image the value of K is based on the number of features, i.e square root of the number of features present in the blood vessel. Feature vector is composing the green channel intensity represents the each pixel.

Distance is the main keyword in this algorithm for finding the nearest neighbours. Between the training data and test instance distance is measured by using the Eucledian distance method.

$$Distance\ (x,y) = [\sum_{i=1}^{n}(x_i - y_i)^2]^{1/2} \qquad (8)$$

Here, we want to classify the retinal vessel feature data vector denotes with x. training data set of the retinal data feature vector denotes with y. The retinal data feature represent with xi and the training data set of the retinal vessel feature data is represented as yi. Further finding the all retinal vessel instances are denoted with k belong to maximum number of class.

b. Random Forest: for the classification of large data with accuracy using the Random Forests algorithm. Decision is the fundamental issue for deciding the class based on features. Decisions trees are modeled from the training data. To construct the tree the node will be considered based on the features. The vessel which has more features will be taken as major node. Based on the information gain it will be considered. The node which will have the maximum gain it will be selected as first node. The information gain will be calculated based on the entropy. The entropy means the total information is measured by using the formula

$$H(X) = E_X[I(x)] = -\sum_{x \in X} p(x) \log p(x) \qquad (9)$$

By using the above formula the information gain is the difference between the total information extracted and the left over information. For certain attributes we have different features but belong to the same class it is a leaf node, but belong to different class it is a internal node. The output of the classifier is determined by a majority vote of the trees that result in the greatest classification accuracy.

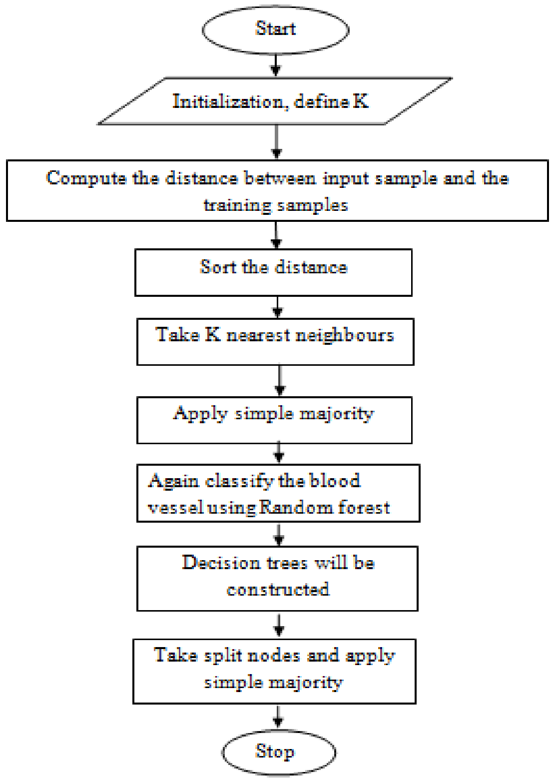

Fig. 3: Flowchart Of KNNRF Algorithm

The above figure (3) describes the flowchart of the KNNRF algorithm. First we initialize the value of K based on the number of features. And then compute the Euclidian distance between the test data and training data. The distance will be calculated for knowing the nearest neighbor's i.e which will having the maximum distance that vessel will be considered. By using the KNN some vessels are to be missed. For that purpose it will be again classified by using the random forest. In the random forest classifier decision tree plays a major role. Decision tree will be constructed based on the features and the nodes will be spitted based on the information gain and apply the majority. Then we get the extracted blood vessel.

IV. EXPERIMENTAL RESULTS

The purpose of this work is to extract the blood vessel present in retina which is the unique feature. Consider the DRIVE database consists of 20 images. The normal fundus images are 10 and abnormal images considered as 10.The results for the extraction of blood vessel in step by step manner is shown in below figures.

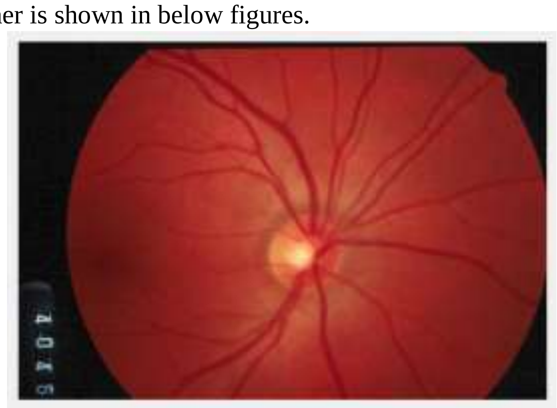

Fig. 4(a): Input Fundus Image

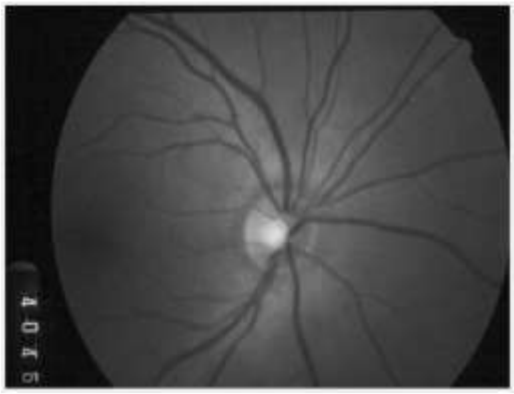

Fig. 4(b): Gray Scale Image

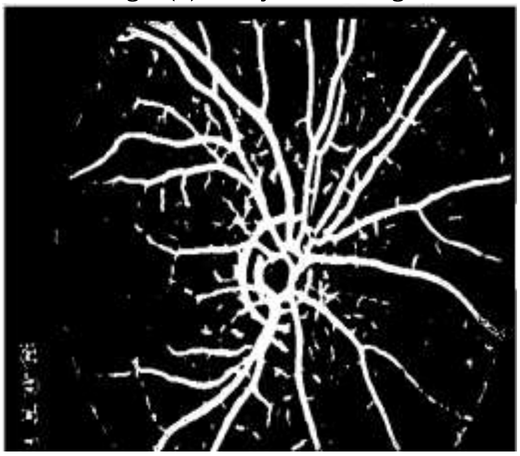

Fig. 4(c): Pre-Processed Image

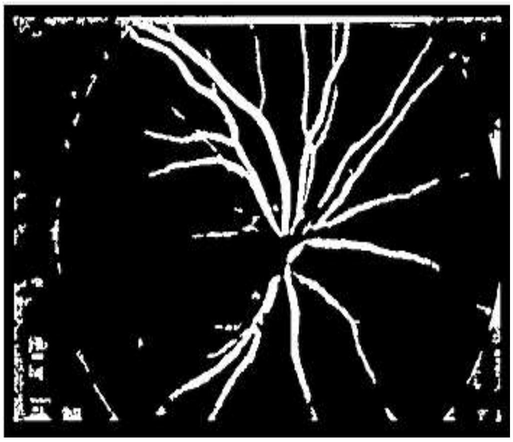

Fig. 4(d): Output Of KNN Classifier

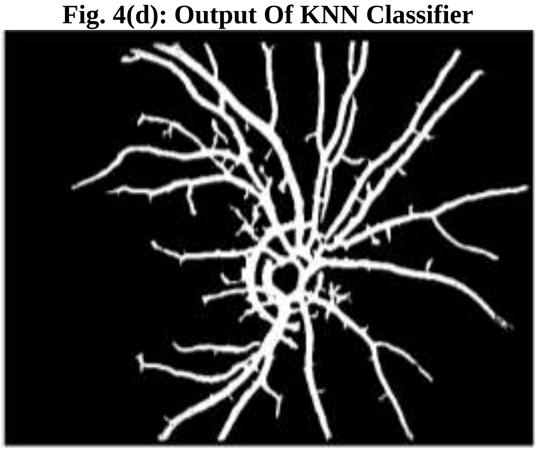

Fig. 4(e): Extracted Blood Vessel

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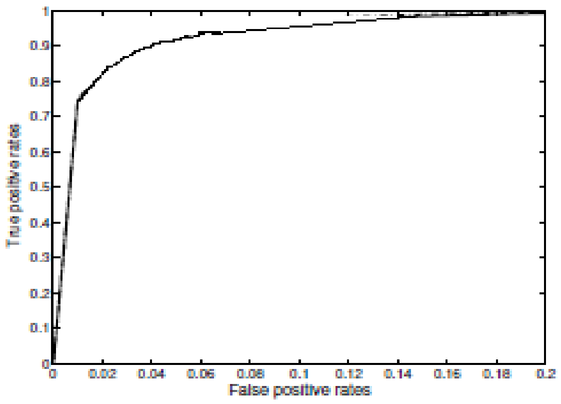

Fig. 4(f): ROC Curve For Fig 4(a)

The above figures will be the result for the extraction of the normal retinal fundus images. If it is the abnormal retinal fundus image the results will be as follows

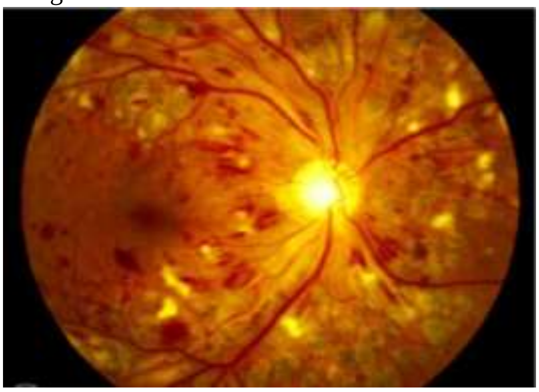

Fig. 5(a): Input Fundus Image

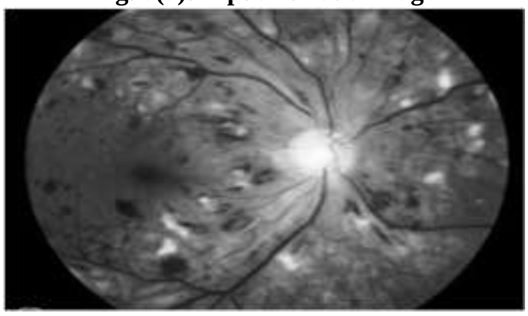

Fig. 5(b): Gray Scale Image

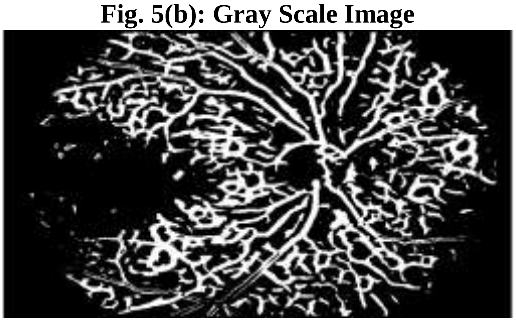

Fig. 5(c): Pre-Processed Image

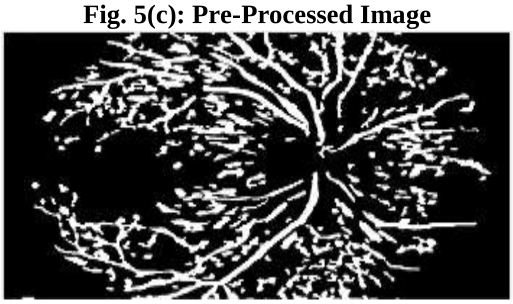

Fig. 5(d): Output Of KNN Classifier

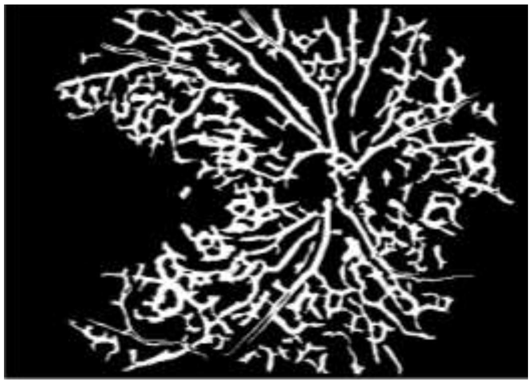

Fig. 5(e): Extracted Image

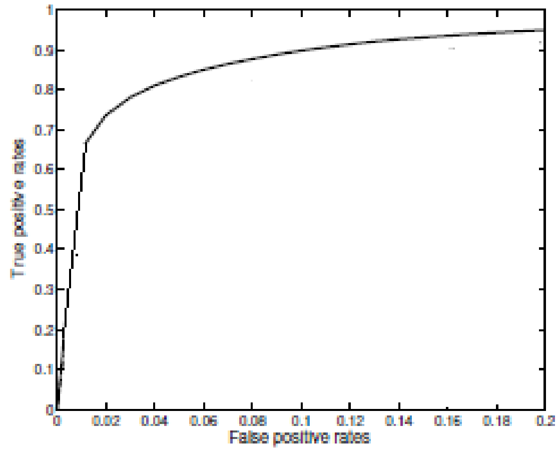

Fig. 5(f): ROC Curve For Fig 5(a)

Table. 2: Comparison Of KNNRF And Existing Methods Analysis

Method	Accuracy
KNNRF	0.9185
Existing method	0.8529

V. CONCLUSION

This project proposes an approach to extract one of the natural characteristic of retina. This proposed work helps in providing a unique identity for high security applications. The final result of this biometric system is a secured and unique template. Based on the feature vector with consists of structure of blood vessels provide the authentication in case of the pathological signs are occurred in the abnormal retinal images. By observing the experimental results 91.85% accuracy is given by the KNNRF algorithm

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