A SUPERVISED METHOD FOR BLOOD VESSEL EXTRACTION USING NEAREST NEIGHBOR CLASSIFIER

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Abstract— This paper presents supervised method for blood vessel extraction in digital retinal images. In this method nearest neighbor classifier for pixel wise classification. The method is evaluated on publically available DRIVE & STARE Database. Nearest neighbor classifier classifies the retinal image into two categories as vessels and background. The result of overall process is vessel extracted image. As neural network classifier is tedious to implement and to avoid the complexity we have implemented this methodology using nearest neighbor classifier. Our approach is the simplest and implementation is also easy. This approach will give the best result for different retinal structures as well.

***Index Terms*— Diabetic retinopathy, retinal image, blood vessels extraction, nearest neighbor classifier.**

I. INTRODUCTION

Diabetic retinopathy is a disease that affects individuals suffering from diabetes, and causes changes to the blood vessels found within the retina, resulting in decreased vision and blindness. The retina is light- sensitive layer at the back of the eye that senses light and transmits images to the brain. High blood sugar level cause damage to retinal blood vessels which in turn causes bleeding and leakage of exudates in retina and in advance to disease this leads to formation of abnormal new blood vessels. This is the most common cause of blindness in working population in the world. For solution to this problem, we have found a new approach for detection of blood vessels in retinal images by using a simple nearest neighbor classifier. Simplicity, implementation efficiency makes this approach suitable for blood vessel segmentation of retinal images for computer analysis and for diabetic retinopathy detection at early stage. The retinopathy may cause due to diabetics and blood pressure as well. As the research fetches us the brief idea about the percentage of people suffering from retinopathy due to diabetic is more than the blood pressure. So we have selected specifically diabetic retinopathy as the issue of implementation.

II. PROCEDURE FOR IMPLIMENTATION

While implementations of our vessel extraction approach we have followed the steps which are as shown in fig.1.

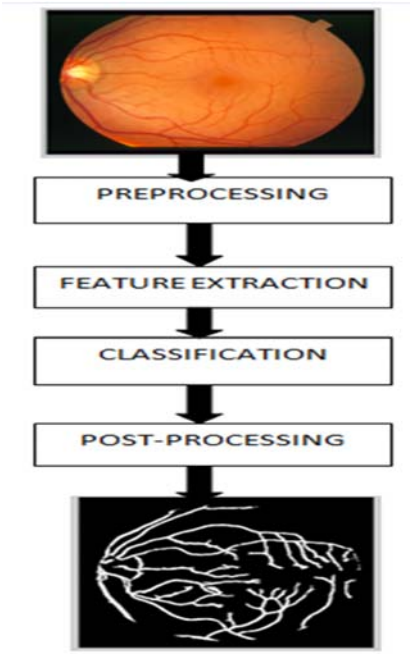

Fig.1

A. Preprocessing: It performs subsequent operations without losing the relevant information.

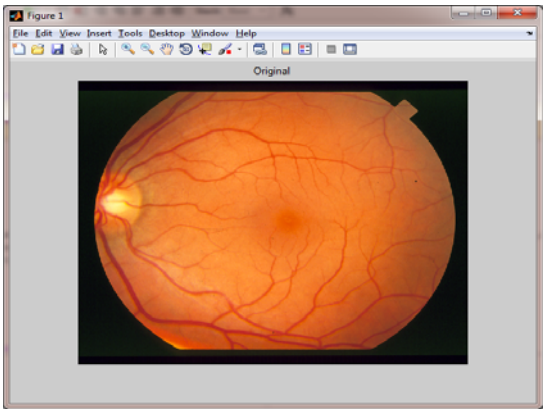

Fig.2

i. Green channel extraction: The blood vessels usually have lower reflectance compared with the background of retina. A colored retinal image is made up of red, green and blue components. Among these, green color plane shows the best vessel/background contrast, the blue color plane tends to be empty and the red color plane tends to be saturated. Furthermore, green component is less noisy compared to other two, it contains significant information that can be extracted from the fundus image. Thus the green color plane is used for the analysis and feature detection of diabetic retinopathy.

ii. Noise removal: By using various techniques we can remove the noise by means of filtering.

iii. Vessel enhancement: The final preprocessing step consists on generating a new vessel-enhanced image (I_{VE}), which proves more suitable for further extraction of moment invariants- based features. Vessel enhancement is performed by estimating the complementary image of the homogenized image I_H , I_H^C, and subsequently applying the morphological *Top-Hat transformation.*

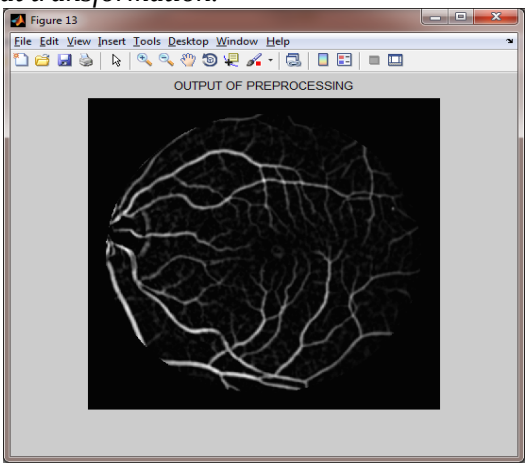

Fig.3

B. Feature Extraction

Information from an image is sent to a feature extractor whose purpose is to reduce the data by measuring certain features or properties. Features depend on the problem. It measures relevant quantities. Some techniques are available to extract more relevant quantities from the initial measurements. After feature extraction each pattern is a vector.

In this stage we have considered three features as entropy, eccentricity and energy values of image.

• Eccentricity is the ratio of the distance between foci of ellipse and its major axis length and it is equal to 0 for a circular region.

• Entropy value of all pixels in the square region including candidate region pixels and its neighboring pixels.

$$\frac{sum(s1(:).^2)}{sum(s2(:).^2)}$$

• Energy value of all pixels in the square region including candidate region pixels and its neighboring pixels.

$$\sum_{i,j} p(i,j)^2$$

C. Classification: The features from feature extraction stage are passed to a classifier.

Classifier is a function to map such vectors into class labels. Many general techniques of classifier design are available. From which we had used the nearest neighbor classifier technique for classification. We have categorized whole image pixels into two categories as background, vessel.

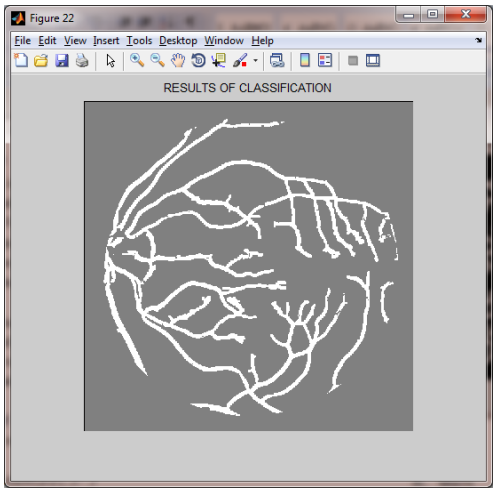

Fig.4

D. Post-processing: The first step is aimed at filling pixel gaps in detected blood vessels, while the second step is aimed at removing falsely detected isolated vessel pixels. It is quick simple stage in this whole process. In this stage we have converted the classified matrix into the intensity image. Then the final step is converting image to binary image.

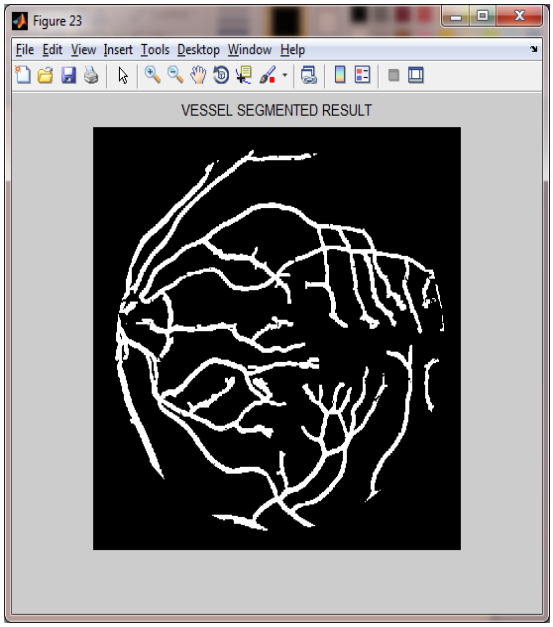

Fig.5

III. MATH

1. Nearest neighbor classifier:

By using following formulae we can classify each sample by nearest neighbor classification technique.

$$\sum_{i=\frac{(k+1)}{2}}^{k} \binom{k}{i} p(\frac{w_m}{x})^i [1 - p(w_m|x)]^{k-i}$$

IV. RESULTS

After implementation our approach we got these results. We have used nearest neighbor classifier technique for classification.

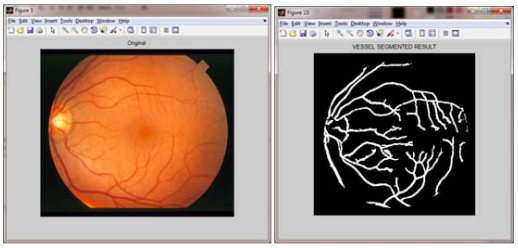

Fig.6

V. CONCLUSION

A supervised method for blood vessel extraction using nearest neighbor classifier is the simplest approach to implement for extraction of vessel structure for retinal image. This approach is compatible with any simulation software. This will fetch us the comparatively perfect vessel extraction results.

By implementing this methodology we have extracted the vessel structure from retinal image. Which helps further detection of diabetic retinopathy at early stage, in turn automatically helps to cure or to reduce its growth. By this methodology we are trying to reduce work load of eye specialists.

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