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Blood Vessel Segmentation based on image Enhancement Technique

Dr. Sonali Dash[1], Dr. Ch. Vijay[2], P. Sowmya [3], T. Ajith Kumar[3], T. Bhargav Sai[3], S. Jayasri[3]

[1]Assoc Prof, Computer Science Department, Chandigarh University, Mohali, Chandigarh, Punjab Pin: 140413
[2]Asst Prof, Electronics and communications Department, Raghu Institute of Technology, Dakmarri, Vishakhapatnam, Andhra Pradesh Pin: 531163
[3]UG students, Electronics and communications Department, Raghu Institute of Technology, Dakmarri, Vishakhapatnam, Andhra Pradesh Pin: 531163

ABSTRACT

Among the many diseases that affect the retina, there are two serious diseases Diabetic Retinopathy and Glaucoma. Diabetic retinopathy is a diabetes complication that affects eyes. It's caused by damage to the blood vessels of the light-sensitive tissue at the back of the eye (retina). It occurs due to damage in the retina as a result of diabetes. So it can damage the optic nerve that transmits images to the brain. If damage to the blood vessels caused by high eye pressure continues, diabetic retinopathy causes permanent vision loss. The main objective is to propose new method in order to detect the blood vessel on the degraded retinal input image (DRIVE dataset).So, these diseases can be diagnosed by blood vessel extraction using morphological operation and calculate the accuracy of the images in the MATLAB simulation. So, the significance of the vessel analysis willhelp by the continuous overview in clinical studies of new medical technologies intended for improving the visualization of vessels.

Keywords: Blood Vessel, Detection, Extraction, Morphological operation

INTRODUCTION

Blood vessel detection are commonly used in many fields especially medical field. But recognition of blood vessels is a main troublesome in the automatic processing of retinal image in order to make work smoother and help patient in detecting their problems. The detection of blood vessel using retinal really helping to detect some disease such as diabetic and glaucoma. The recognition of blood vessels is a main troublesome in the automatic processing of retinal image. The diagnosis of cardiovascular and ophthalmological illnesses such as diabetic retinopathy and glaucoma is considered to be critical. Diabetic retinopathy is a complication of diabetes which affects the eyes. The figures for this condition improve the health of the population and are also the cause of sight loss. Manual analyses are conducted periodically by reviewing a patient's photographs, as not all images show signs of diabetic retinopathy. Accurate retinal blood vessel identification is therefore essential.

In 2015, Dal winder et al. present about the blindness among diabetic patients which is because of the diabetic retinopathy disease because of the small vessel to retina having a leakage of blood. They proposed a new vessel of blood detection which is morphologically based to eliminate the background and enhance the blood vessel with phase preserving noise removal algorithm. The processing techniques is the object classification, noise removal, thresholding and an enhancement by a standard template. They collect the set of retinal images from the DRIVE database and analyse it with an advance performance to find the accuracy.

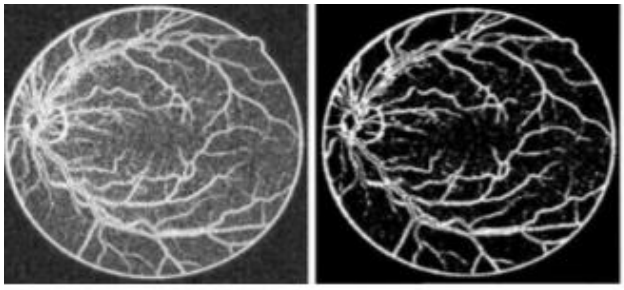


Figure 1: Example of blood vessel detection on retinal image

METHODOLOGY

The new approach began with the image acquired from the online DRIVE database. The original image was read by the 'uigetfile' option in MATLAB. As the true image read, to classify colour features, using complement to remove noise and can reverse black and white, complement intensity image and complement of a colour image.

Furthermore, the image processed visualized using 'label2rgb' segmentation, bwareaopen, contrast adjustment, brightness adjustment, imfilter and threshold level to produce the 'segmented image'. The result is to transform the images to a grayscale image and then apply the threshold to the binary colour frame. The 'bwareaopen' was then added to delete objects with less pixels. To fill the hole in the vessel, this function was added.

The system process flow started with the blood vessel images database collected from the DRIVE database in order to acquire the process of image processing. Then, the acquired images will be through the process of image pre-processing process. The adaptive of the filter was applicable to remove the remaining noise when enhancing edge sharpness. In addition, the Morphological operation consists of dilation and erosion also take place in order to add and remove pixels on the object boundaries.

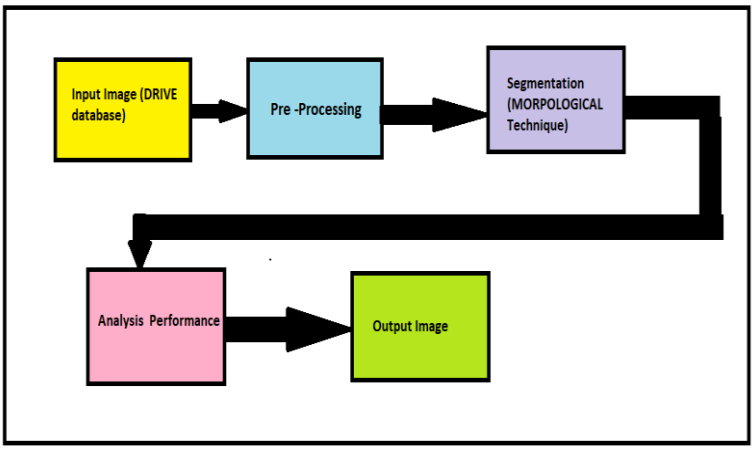


Figure 2: Blood vessel detection flow diagram

PERFORMANCE OF IMAGE ANALYSIS

The performance of the system was evaluated compared to the benchmark by observing the specificity, sensitivity and accuracy of the segmented image. This entire analysis investigates the correctness of the segmented images. As in code, the confusion matrix observed to assign the Specificity, Accuracy and Sensitivity by using TP (True Positive), TN (True Negative), FP (False Positive), and FN (False Negative). The terms referred as below:

a) True Positive (TP): Pixels correct segmented as foreground
b) True Negative (TN): Pixels false segmented as foreground.
c) False Positive (FP): Pixels correct segmented as background
d) False Negative (FN): Pixels false segmented as background

SPECIFITY:
The Specificity related to the classifier's ability to identify negative results which also known as 'True Negative' or negative predictive value. The higher the percentage of specificity, the higher the pixels correct segmented as background (black) of the image. The equation as below:

$$\text{Specificity} = \frac{(TN)}{(TN+FP)}$$

ACCURACY:
Accuracy is the simplest score metric, which calculates the total proportion of True Positive and True Negative cases which are counted correctly as truthful and complete. The higher the accuracy, the greater the "truth" of the process. The equation below:

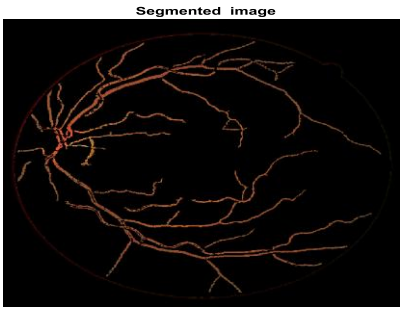
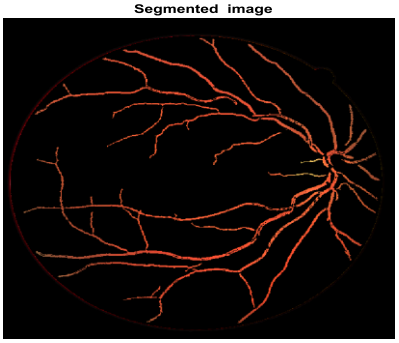
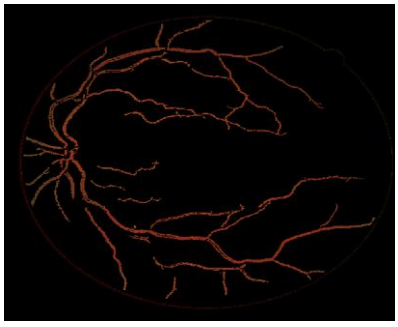
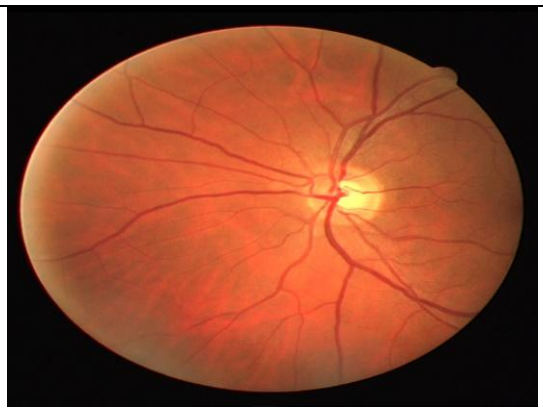
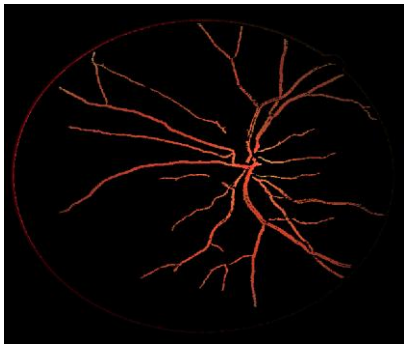
$$\text{Accuracy} = \frac{(TP+TN)}{(TP+TN+FP+FN)}$$

PRECISION
Precision is the ratio of the correctly positive labeled by our program to all positive labeled. Precision answers the following that how many of those who we labeled as diabetic are actually diabetic. The equation is as below:

$$\text{Precision} = \frac{(TP)}{(TP+FP)}$$

RESULTS

The proposed method for automatic segmentation of vessel tree structure from retinal images is evaluated on DRIVE datasets. For each image in test set hand labelling of vessel by specialists is also provided. In the dataset manual segmentation made by using morphological Technique and calculated the accuracy for performance evaluation. In this we are taking three input images they are retinal image, mask image , ground truth image and after the processing of the image we get the segmented image. And we also get the value of accuracy, specificity, sensitivity, precision where the values and image will help for the diagnoses and classification of the patient.

S.No	INPUT IMAGE	SEGMENTED IMAGE
1.		
2.		
3.		
4.		

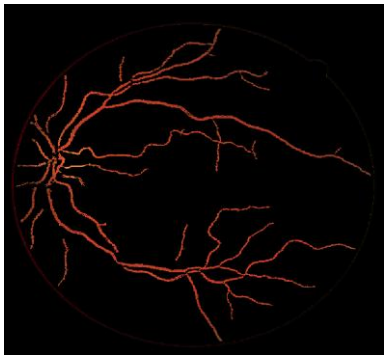
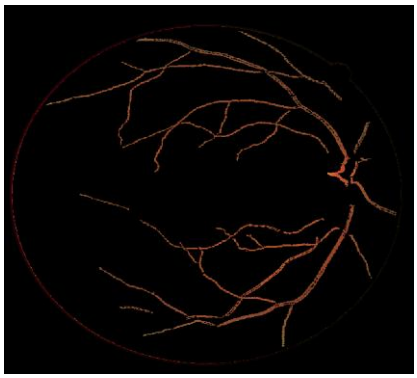
5.		
6.		

Figure 3: Output of respective images

IMAGE ANALYSIS OF THE ABOVE IMAGES:

S.NO	ACCURACY	SENSITIVITY	SPECIFICITY	PRECESION
1.	93.14	4.33	99.68	14.98
2.	91.48	5.37	97.19	11.89
3.	92.12	5.11	99.32	13.43
4.	91.10	5.81	97.11	12.43
5.	92.21	2.31	98.54	10.09
6. ,	93.02	0.98	99.54	12.56

Three Input images have been taken such as such as disease image, mask image and ground truth image. We took drive data set for the retinal vessel segmentation and delineation of morphological attributes of retinal blood vessels, such as length, width, branching patterns and angles are utilized for the diagnosis, screening, treatment, and evaluation of various ophthalmologic diseases .

The second input image is the mask image which we define a small 'image piece' and use it to modify a larger image. Masking is the process that is underneath many types of image processing, including edge detection, motion detection, and noise reduction.

The third input image is ground truth image is which contains information about the data source, label definitions, and marked label annotations for a set of ground truth labels. You can export or import a ground Truth object from the Image Labeller. From the table we can get to know the analysis of the image through the algorithm and by the sensitivity, specificity precision we can classify the stage of the disease of the person.

CONCLUSION

In this paper, a simple method for blood vessel detection of retinal image has by eliminating the OD region from the retinal image in order to increase the segmentation accuracy level for blood vessel segmentation The segmentation of blood vessels was essential for DR severity classifications and diagnosis. The performance of the

proposed segmentation methodology was analysed with respect to ground truth images. The proposed system achieved the average vessel segmentation accuracy of 98.08% in DRIVE dataset.

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