Detection of Blood Vessels and Diseases in Human Retinal Images

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Abstract— The detection of blood vessels is important task in diagnosis the diseases of eye. The present study is aimed at developing an automated system for the extraction of normal and abnormal features in retinal images. In this work, RGB image is used for obtaining the traces of blood vessels. The proposed algorithm has employed modules such as pre-processing, segmentation and feature extraction. This algorithm has been shown to be a highly effective method for classifying retinal blood vessels. The algorithm being simple and easy to implement.

Keywords— Blood vessel, retinal images, segmentation, feature extraction.

I. INTRODUCTION

The blood vessel network is an important anatomical structure in human retina. Several diseases such as Diabetic retinopathy, glaucoma, hemmorhages, the performance of automatic detection methods may be improved if regions containing vessels can be excluded from the analysis. Automated Retinal Image analysis system provides ophthalmologists with framework where retinal images can be managed, analysed and stored to assess the condition of the patients. For the diagnosis, ophthalmologists use color retinal images of the patient acquired from digital camera (ophthalmoscope). In this paper, we are using a new method to detect blood vessels and determine the diseases.

II. VARIOUS TECHNIQUES USED FOR SEGMENTATION

Depending on the image quality and the general image image artifacts such as noise, some segmentation methods may require image pre-processing prior to the segmentation algorithm. Some other methods apply post-processing to overcome the problems arising from over segmentation. Various algorithms and techniques in various categories: (1) pattern recognition techniques, (2) model-based approaches, (3) tracking based approaches, (4) artificial intelligence-based approaches, (5) neural network- based approaches, and (6) miscellaneous tube-like object detection approaches. A class of popular approaches for vessel segmentation is based filtering methods which work by maximizing response as ship-structures. Mathematical morphology is another approach by applying morphological operators. Trace-based methods to map out the global network of blood vessels after edge detection by tracing the centrelines of vessels. Such methods are highly dependent on the result of edge detection. Machine learning based methods have also been proposed and can be divided into two groups: supervised methods and unsupervised methods. Supervised methods exploit some labelling information before deciding whether a pixel belongs to a ship or not, while unsupervised methods do vessel segmentation without any prior knowledge of labelling[1, 2]. Some early methods of retinal vessel segmentation are based on hessian matrix and clustering algorithm which was proposed by Salem[3] and then detection of retina vascular intersection in retina image using modified cross number method and NN technique was given by Iqbal et al.[4] in which NN was better technique than SCN and MCN. Osareh and Shadgar[5] evaluated the method for automatic blood vessel segmentation in color retinal images using GMM and SVM classifier whereas Seyed, Morteza and Hamid[6] proposed a method for vessel segmentation using color images and local binary patterns with MLP classifier. Asha gowdey, karegowdey, Asfiya nasiha and M.A. Jayaram[7] used the method of Artificial Neural network for exudates detection in retinal images. Cong wu and Koichi Harada[8] used otsu's method for noise removal which was used for the study on digitization of TCM diagnosis in which branches of vessels detected. J. Benadict and Ravichandran[9] used ITK methods for blood vessel segmentation for high resolution images in ITK parallel method was better than serial and matlab. The algorithm based on morphological operations for vessel segmentation was given by Shilpa Joshi and dr. P. T. Karule[10]. Jaspreet kaur and Dr. H.P. Sinha[11] used local entropy thresholding which was an efficient method for blood vessel detection. Fuzzy Gaussian filter method was used for diagnosis of eye infection which was given by Jyoti Patil and A.L. Chaudhari[12]. Local Binary pattern method was used for vessel extraction of conjunctival images given by Zabihi, Pourezza and Banaee[13].

III. AN OVERVIEW

The proposed method for retinal image analysis system in this paper is composed of four main phases; pre-processing, segmentation, feature extraction and recognition.

A. Pre-processing

The main objective of pre-processing technique is to attenuate image variation by normalizing the original retinal image. Three main steps in pre-processing step are:

1) *Grayscale processing:* A grayscale image is a data matrix whose values represent intensities within some range. In

order to decrease the processing time we covert the true color image of blood vessel into gray scale.

2) *Edge detection:* In this process, the edges are defined in the gray image for further processing.

3) *Filtering:* To reduce the distortion or noise in the image.

B. Segmentation

Retinal vessel segmentation is an essential step of the diagnosis of various eye diseases. Automating the segmentation process provides several benefits including minimizing subjectivity and eliminating painstaking, tedious task. In this stage, blood vessels are segmented properly using ANFIS (Artificial Neural Fuzzy Inference System), it combines a NN and a fuzzy system together. Capability of ANFIS in classification made it popular in this area. ANFIS is used in classification and function approximation of many applications [14, 15].

C. Feature Extraction

Features are selected as input for the classification of pixels. HSI image is commonly used for image processing applications by extracting the hue, saturation and intensity image which is useful for the diagnosis of diseases in the eye. It is also used in previous technique [7]. Hue is a color attribute that describes a pure color, Saturation gives a measure of the degree which the amount of white light mixed with the hue .The "intensity", "lightness" or "value" is related to the color luminance.

Figures of the various steps used in the proposed algorithm:

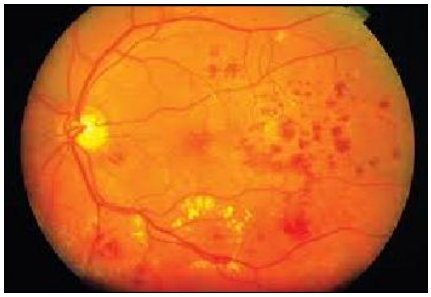

Fig. 1 RGB image

Fig. 2 Gray image

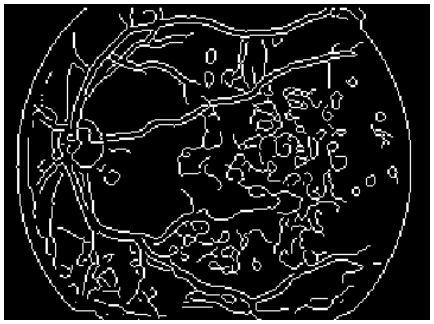

Fig. 3 Edge detection

Fig. 4 Filtered image

Fig. 5 Hue image

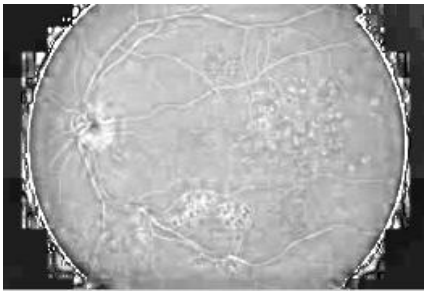

Fig. 6 Saturation image

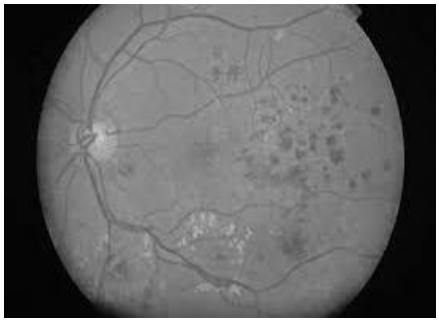

Fig. 7 Intensity image

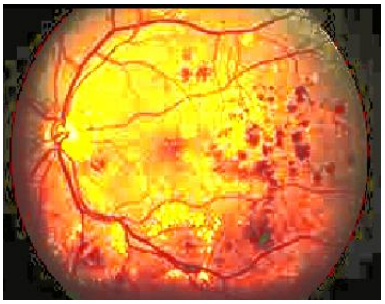

Fig. 8 HSI image

D. Recognition

By finding the HSI image we are able to find the infected area of the eye. In this step, we can detect the optic disc and infected area of the eye. This process is useful for the diagnosis of diseases such as diabetic retinopathy, glaucoma.

IV. Results and Discussion

The proposed system segments blood vessels in retinal images and recognizes the features. This can help in diagnosis the diseases. This algorithm has given the good efficiency and better results. Our proposed method does not use manually help for the segmentation and shows the value of sensitivity 87.4% and specificity 90.4%.

V. Conclusion

Retinal images are being used by ophthalmologists to aid in diagnoses, to make measurements, and to look for change in lesions or severity of diseases. Particularly, the appearance of blood vessel is an important indicator for many diagnoses, including diabetes, hypertension, and arteriosclerosis. An accurate detection of blood vessels provides us the basics for the measurement of a variety of features that can then be applied to tasks like diagnosis, treatment evaluation, and clinical study. The proposed algorithm gives the vessel information by removing noise, edge detection and optic disc detection.

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