Artery/Vein Classification of Retinal Images to Identify Diabetes Using Graph Based Approach

Vishakha Fursule1 M.Tech. Computer Science & Engineering email:vishakhaf11@gmail.com
, R.S. Mangrulkar 2 Head, Department of Computer Engineering, BDCE Sevagram2 email:rsmangrulkar@gmail.com

Abstract—The prevalence of diabetes is expected to increase; already today it accounts for a large number in many countries. In this paper, we can able to detect diabetes by automating the vascular changes in retinal images. The extraction of retinal vessel is an important phase for automating the detection of vascular changes. The retinal vessels are of two types viz. Arteries and veins. Any changes may lead to several diseases. This paper proposed a graph based approach for artery-vein classification which classifies the entire vascular tree deciding on the type of intersection point and assigning one of two labels to each vessel segment. Finally by comparing the diagnostic indicator like arteriolar-to-venular ratio: the disease like diabetes can be detected.

Index Terms: retinal images, vessel segmentation,Artery/vein classification, graph.

1. INTRODUCTION

The retinal images are widely used by the ophthalmologists, which plays an important role in the detection and diagnosis of many eye diseases. Automated detection of retinopathy in eye fundus images using digital image analysis methods has more benefits which allow the examination of a large number of images in less time, with lower cost. Therefore, it will be very helpful to ophthalmologist to diagnose the patient suffering from eyes.

The structure of retinal vessels is very messy. Changes in retinal blood vessels, such as significant dilatation and elongation of the main arteries, veins, and their branches are also frequently associated with several diseases [1] [2]. The manual detection of blood vessels is very difficult for the blood vessels in a retinal image are complicated in structure and with low contrast.

In this paper author presents a method for the automatic extraction of blood vessels from low quality retinal images, while enhancing the quality of image in the frequency domain by adjusting the histogram of an image also capturing points of intersection/overlap and endpoints of the vascular tree. The algorithm is performed on the gray scale image. The matched filter is used to enhance vessels with respect to the background. Several works on vessel classification have been proposed [3]- [9], but automated classification of retinal vessels into arteries and veins has received limited attention. In this paper, a graph-based method for automatic A/V classification is proposed in which the graph is extracted from the segmented retinal vasculature, which is analyzed to decide on the type of intersection points (graph nodes), and afterwards one of the two labels is assigned to each vessel segment (graph links). Finally, intensity features of the vessel segments are measured for assigning the final artery/vein class. On the basis of parameter, i.e. standard artist/veins ratio the diabetes can be detected.

Rest of the paper is organised as follows: The section I deals with the introduction, Section II comprises of the Literature review, Section III explores the proposed system, Section IV deals with the methodolgy and Section V draws the conclusion to this paper.

2. Literature review

Mr. Rahul Ramchandran et.al [10] proposed a system for detecting A/V classification and diseases like glaucoma and hypertension. First, it recognizes the detection of vascular changes in retinal vessels. Then it classifies the types of graph nodes and assigns graph links to one of two levels. Finally, for the classification of artery/vein (A/V), graph based labeling results with a set of intensity features are performed. To measure the distance between nodes, a biometric graph matching algorithm (BGM) is used. In this disease like glaucoma, hypertension is detected by using a feed forward neural network (FFN).

S.Devisaranya, J.Suganya [11] proposed a system which is used for identifying Microaneurysms, which can be automatically detected by analyzing the retinal image. Initially the blood vessels are extracted from the fundus image and classification of blood vessels such as arteries and veins should be made for determining the vessel parameters. The Graph traces algorithm is used for the classification of retinal blood vessels. It also calculates parameters of the vessels such as length, caliber measurement and diameters of the vessel. Diseases can be detected by comparing these parameters with the normal value. If there is any deviation it will indicate the presence of certain diseases. This automatic retinal image analysis reduces the difficulty and burden of ophthalmologist by providing ophthalmologists.

D. Selvathi[12] proposed a severity analysis method for the identification of the severity level of Diabetic Retinopathy in the retina. The proposed method contains the 5 stages - (1) Pre-processing (2) Segmentation (3) Feature Extraction (4) Classification Phase I and (5) Classification Phase II. First the severity in retinal images are analyze, it is necessary to classify the images into normal and abnormal images using the Neural Network classifier. For this classification of images, the features mean, variance, entropy and area are extracted From the segmented optic disk of retinal images. From the abnormal images, the severity of Diabetic Retinopathy can be evaluated by using SVM classifier based on the area and the intensity level of Hard Exudates and Hemorrhages. The performance of

the proposed method is analyzed by Sensitivity, Specificity and Accuracy. From the results, it is proved that proposed work outperforms other existing methods and provides effective segmentation and classification results for the retinal images.

S. V. Anandhi [13] discuss about various existing methodologies for classification of retinal image into an artery and vein, which are helpful for the detection of various diseases in retinal fundus image. This process is analyzed for the AVR calculation, i.e. for the calculation of average diameter of arteries to veins. Most of the diseases cause abnormally wide veins and this leads to a low ratio of AVR. Thus the classification of blood vessels into arteries and veins is more important. A novel automated and structural method for classification of retinal blood vessels into arteries and veins has been presented in the paper [11]. In this classification method is done on the major vessels. But for AVR measurement this method maintains high classification rate for vessels in the region of interest.

Jihene Malek et.al[14] present an approach to separate arteries and veins based on a segmentation and neural classification method. Blood vessels are segmented using two-dimensional matched filters, which derived from Gaussian functions. The obtained features will be introduced as the input vector of a Multi-Layer Perceptron (MLP); to classify the vessel into arteries and veins ones. Good rate of classification of the blood vessel into arterial and vein vessel in the database has been obtained at the end of this process. Manjiri B.Patwari et.al[15] Proposed algorithm for the detection and measurement of blood vessels of the retina and finding the bifurcation points of blood vessels which can be applied to high resolution fundus photographs. E. Annie Edel Quinn et.al[16] novel method for the retinal vessel segmentation is presented. Specific characteristics of retinal images make the vessel detection more difficult. The green channel is considered in this work, as the natural basis for vessel segmentation. The green channel is inverted so that the vessels appear brighter than the background. To reduce the effect of non-uniform illumination contrast adjustment process is applied to the inverted green channel.

3. PROPOSED WORK

The method proposed in this paper follows a graph based approach, where mostly the focus is on a characteristic of the retinal vessels. The Figure 1 below shows the workflow of the proposed system. The input image is enhanced by frequency domain image enhancements. Then the histogram adjustment of the image will be used to improve quality of image after that image will be segmented for finding vessel. Then graph extraction module will be working. After getting the segments from image it will find the node and links in images,then feature extraction algorithm will be used to extract features from image which will be help to classsify artires and veins from the entire graph. Finally by calculting the arteio-veinular ratio(AVR), it will give the expected outcome.

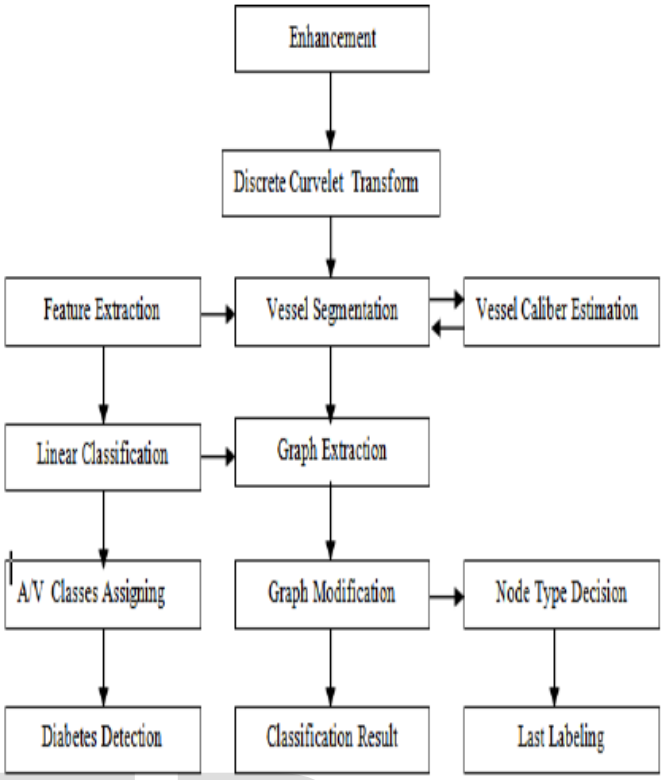

Fig. 1. Architecture of Proposed System

4. METHODOLOGY

The diagnosis of various diseases is very common now a days and medical imaging are playing a vital role in such diagnosis. The proposed work goes through a number of stages between them preprocessing, edge detection and segmentation is implemented. Here the methods are tested on the images of three databases, DRIVE [17], INSPIRE-AVR [18], and VICAVR [19]. The images in the DRIVE dataset was captured with 768584 pixels, with 8 bits per color plane. The 40 high resolution images of the INSPIRE-AVR database have resolution of 2392 2048 pixels and are optic disc-centered. Finally, the 58 images of the VICAVR database were acquired using a TopCon nonmydriatic camera NW-100 model with a spatial resolution of 768 584, and are also optic disc-centered.

1. Preprocessing :In this algorithm for enhancement of retinal blood vessels some Image Processing techniques are used. The preprocessing is used to remove the noise from the background and to enhance the image. In the first stage of preprocessing the retinal image is converted into green image. Mathematical formula for finding green channel is given asg= G/(R+G+B) Here, g is Green channel and R,G,B are Red,Green and Blue respectively.The result is shown in figure

2. Edge Detection: Detecting edges is an important task in boundary detection, motion detection/estimation, texture analysis, segmentation, and object identification.The edge de-

tection techniques are also implemented on retinal images for extraction of blood vessels.

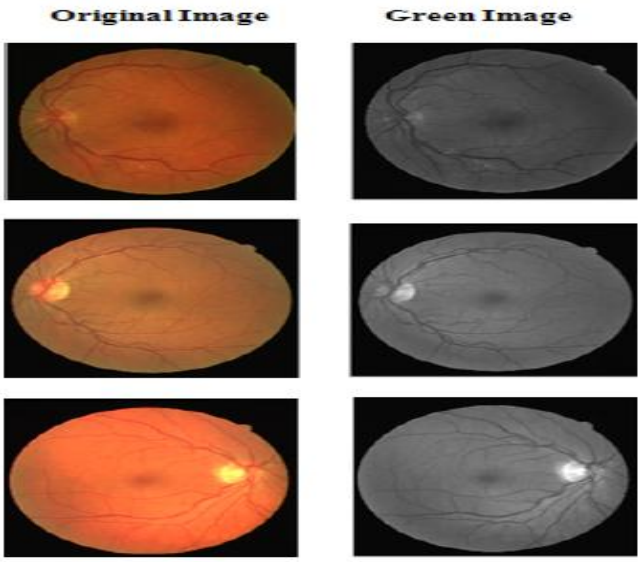

Fig. 2. Original image and green image

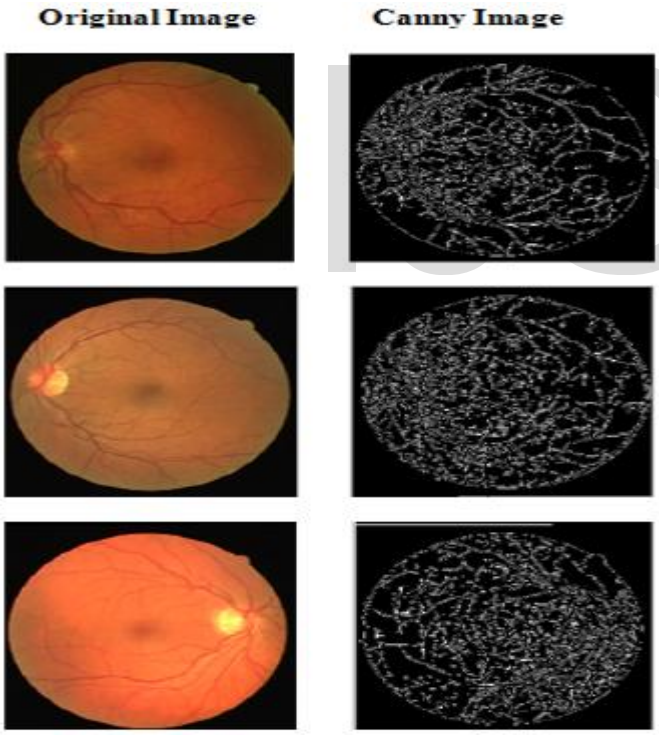

Fig. 3. Original image and canny imag

. Different edge detection methods are Prewitt, Sobel, Canny. Here the canny is best method as compare to other.The result is shown in figure 3. 3. Segmentation Kirsch's Template is used for blood vessel extraction from retinal image.The operator takes a single kernel mask and rotates it in 45 degree increments through all 8 compass directions: N, NW, W, SW, S, SE, E, and NE.The edge magnitude of the Kirsch operator is calculated as the maximum magnitude across all directions. The result is given in figure 4

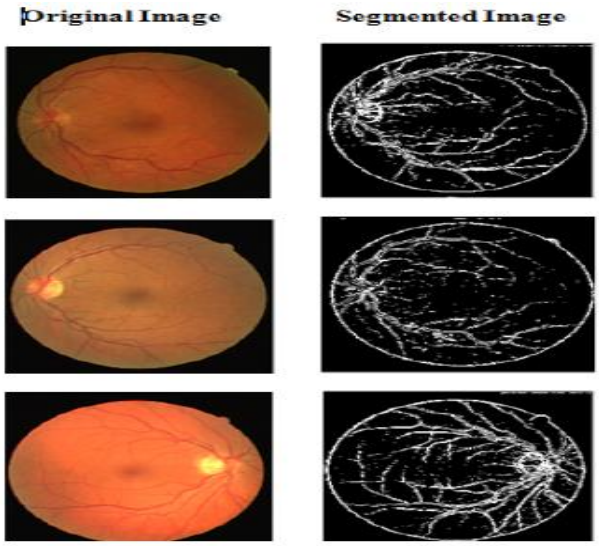

Fig. 4. Original Image nd segmented image

5. CONCLUSION

As we know that number of patients are suffering from diabetes is increasing day-by-day so the earlier detection is essential which will be helpful to Opthalmologist. The structure of the retinal image is very complex, so various image processing methods like image enhancement, discrete curvelet transform, vessel segmentation, feature extraction is applied on the retinal images to obtain a good result. The classification of arteries and veins in retinal images is essential for the detection of vascular changes. Here the author presents a new methodology i.e. A graph based approach which efficiently classifies arteries and veins in retinal images. Finally the diabetes can be detected on the basis of the artery-to-vein ratio.

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