A Survey Paper on an Artery Vein Classification of Retinal Images to Identify Diabetes Using Graph Based Approach

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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 be 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 leads 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.

Keywords- Retinal images, Vessel segmentation, Artery/vein classification, Graph

Introduction

The retinal images are widely used by the ophthalmologists who play 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. So it will be very helpful to ophthalmologist to diagnosis 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 main arteries, veins, and their branches (Guan et al., 2006; Neubauer et al., 2006), are also frequently associated with several diseases. The manual detection of blood vessels is very difficult since the blood vessels in a retinal image are complicated in structure and with low contrast.

In this paper we present a method for the automatic ex-traction of blood vessels from low quality retinal images, while enhancing the quality of image in frequency domain by adjusting the histogram of image also capturing points of intersection/overlap and **endpoints of the vascular tree.** The algorithm is performed on the green channel of the RGB triad. The green channel can be used to represent the illumination component. The matched filter is used to enhance vessels with respect to the background. Several works on vessel classification have been proposed (Hughes et al., 2009; Rothaus et al.., 2009; Grisan et al., 2003; Vazquez et al., 2010; Hsu et al., 2003; Kondermann et al., 2007; Niemeijer et al., 2009) but automated classification of retinal vessels into arteries and veins has received limited attention, and is still an open task in the retinal image analysis field. 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 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 arties/veins ratio the diabetes can be detected.

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

Literature Review

Ramchandran *et al.,* (2015) proposed a system for de-tecting A/V classification and diseases like glaucoma and hy-pertension. First it recognizes the detection of vascular changes in retinal vessels. From the retinal vasculature, artery/vein classification is done. It classifies the types of graph nodes and assigns graph links for one of two labels. 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 these diseases like glaucoma, hypertension is detected by using feed forward neural network (FFN). A gray level co-occurrence matrix (GLCM) is used for feature extraction.

Devisaranya *et al.,* (2015) proposed a system which is used for identifying Micro aneurysms, which can be detected by automatically 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 trace 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.

Balasubramanian *et al.,* (2014) proposed a severity analysis method for the identification of the severity level of Diabetic Retinopathy in retina. The proposed method contains the 5 stages –

(1) Pre-processing phase

(2) Segmentation Phase

(3) Feature Extraction Phase

(4) Classification Phase I and

(5) Classification Phase II.

First the severity in retinal images are analyzed, it is necessary to classify the images into normal and abnormal images using 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 and also the features mean, variance, entropy, area, diameter and number of regions are extracted from the segmented blood vessels of retinal images. From the abnormal images, the severity of Diabetic Retinopathy can be evaluated by using SVM classifier based on area and intensity level of Hard Exudates and Hemorrhages. The performance of 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.

Maheswari *et al.,* (2013) discusses about various existing methodologies for classification of retinal image into 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 low ratio of AVR. Thus 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 method classification is done on the major vessels. But for AVR measurement this

method maintains high classification rate for vessels in region of interest.

Malek *et al.*, (2013) 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.

Patwari *et al.*, (2013) Proposed algorithm for the detection and measurement of blood vessels of the retina and finding the bifurcation points of blood vessels is general enough that it can be applied to high resolution fundus photographs. Edel *et al.*, (2013) 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 because it normally presents a higher contrast between vessels and retinal background. 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. The quantitative performance results of both segmentation and enhancement steps show that this method effectively detects the blood vessels in less than 1 min.

Zamperini, (2012) performed several tests aimed to understand which groups of features are useful to discriminate veins and arteries in digital fundus images. Results are quite interesting and could be useful to improve the performances of existent systems for the estimation of related biomarkers such as the AVR. First of all, color contrast between vessels and background appear the most important cue for discrimination, but there are vessels that are not well recognized so simply and require adding more information. This information can be related to vessel position and to the color variations inside the vessel, while the vessel width does not seem to add useful information. Finally, image resolution should be taken into account: it seems that high resolution sensors introduce noise and can reduce the color based information: the same features computed on subsample images gave, in fact, better results even if an excessive sub sampling could remove the information about the central reflex in vessels. The dependency of performance on color confirms the importance of normalizing image resolution in studies involving different-resolution fundus cameras to guarantee consistency (Grisan *et al.*, 2010) developed a tracking A/V classification technique that classifies the vessels only in a well-defined concentric zone around the optic disc. Then, by using the vessel structure reconstructed by tracking, the classification is propagated outside this zone, where little or no information is available to discriminate arteries from veins. This algorithm is not designed to consider the vessels in the zone all together, but rather partitions the zone is divided into four quadrants, and works separately and locally on each of them.

Proposed Work

In this section author proposes a graph based approach, where mostly focus is on a characteristic of the retinal vessels. The Figure shows the workflow of the proposed system. Input image is enhanced by frequency domain image enhancements. Then histogram adjustment of image will be used to improve quality of image after that image will be segmented for finding vessel. Then graph extraction module will be work. After getting the lines from images it will find the node in images, then use feature extraction algorithm to detect and extract the feature points from image. And then it will be result in expected outcome.

The main phases are graph generation, graph analysis, vessel classification and disease detection. Firstly, the image enhancement will be used to enhance the contrast between arteries and veins in the retinal images. After getting the improve image, the canny edge detector will be applied to find the edges in image for classification.

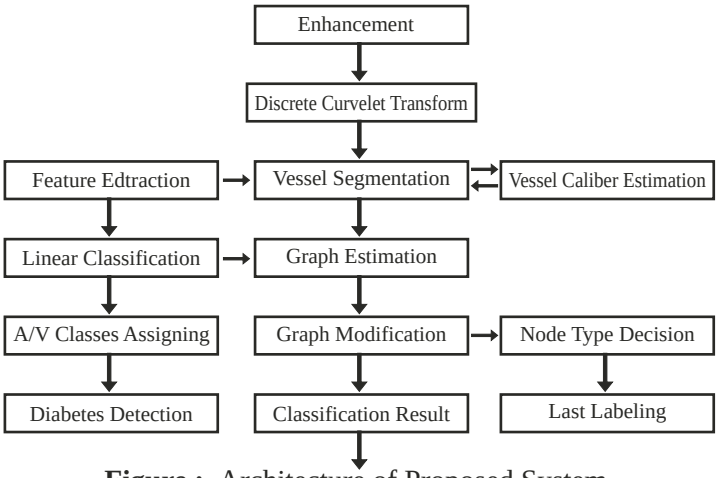

Figure : Architecture of Proposed System

The graph generation phase has three steps. First the segmented image is used to obtain vessel centerlines, in which an iterative thinning algorithm is used, then the graph is generated from centerline image and finally some modifications are applied to graph. Feature extraction module contain SVM (state vector machine) module which is used to train the project for detection the feature points in image. The main phase that is graph analysis, which has Node and branches descriptor used to finding the cross section points of edges in image to classify the vein and artery by using graph method with the help of bfs(breath first search) to traverse a graph. This module classifies the input image by basic of training of feature detection and node descriptor module and shows calculate the result. Finally, by calculating artioveinular ratio the disease like diabetes detection can be possible.

Conclusion

As we know that number of patients suffering from diabetes is increasing day-by- day so the early detection is essential which will be helpful to Ophthalmologist. The structure of retinal image is very complex so various image processing methods like image enhancement, discrete curve-let 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 we present a new methodology ie. Graph based approach which efficiently classifies artery and vein in retinal images. Finally the diabetes can be detected on the basis of the artery-to-vein ratio.

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