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Overview of Artery and Vein Classification in Retinal Images using Graph based Approach

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Abstract: To investigate whether retinal vessel caliber measurements on optical retinal Photography are affected by light and dark exposure prior to photography. Whether the vessel caliber changes during an imaging sequence ,Digital optical retinal photographs which is obtained from 32 healthy Adults in two separate image sequences of six images during 1 min; one sequence with of dark exposure and one with of light exposure for 10 min each of prior to imaging. Retinal arteriolar and venular calibers were measured computer-assisted and summarized as central retinal artery and vein equivalents (CRAE and CRVE).from that Outcome measures were difference in calibers after prior light versus prior dark exposure also difference in calibre during each of the two imaging sequences. We also present a 3D reconstruction of retinal blood vessel trees using two views of fundus images.

Keywords: Vessel segmentation, artery/vein classification, retinal images, graph, vascular caliber, etc.

I. INTRODUCTION

In today's world most important internal components in eye is called retina, covering all posterior compartment, on which all optic receptors are distributed. Some basic concept is given in the paper such as disorders in retina associated from special diseases are diagnosed by special images from retina, which are obtained by using optic imaging called fundus. In this paper also include some important features blood vessel is one of the most important features in retina consisting of arterioles & arteries for detecting retinal vein occlusion, grading the tortuosity for hypertension and early diagnosis of glaucoma [1]-[2]. It is also checked by the obtained changes in retinal images in an especial period can help the physician to diagnose the disease. In Paper some applications also include such as retinal images are diagnose the progress of some cardiovascular diseases, diagnosing the region with no blood vessels (Macula), using such images in images in biometric applications and using such helping automatic laser surgery on eye, etc. The quantitative assessment of retinal vasculature provides useful clinical information to assist in the diagnosis of various diseases. The detection and measurement of retinal vasculature can be used to quantify the severity of disease and the progression of topology. Retinal blood vessel tree geometry, therapy and vessel tracking have been studied by means of digital image processing task mainly using retinal images also known as fundus images [1,2].Also 2D fundus images helps to do the majority of work. A first effort to obtain a 3D view of fundus images was developed in last some year [3,4]. This work focuses on the reconstruction and display of 3D fundus patterns using branching vessel point correspondences between two images and multiple views. Another approach to reconstruct the retinal fundus is presented, where a popular geometry with a plane-and-parallax method is used.

II. LITERATURE SURVEY

With respect to said work an extensive literature survey is conducted accordingly which is presented as below,

1. Various features like geometrical and visual have explored the methods for artery or vein classification. Vessel diameter is not a reliable feature for artery or vein classification since it can be affected by diseases [3].
2. Martinez- Perez et al. (2002) In semi automatic method [4] geometrical and topological features of single vessel segments and subtrees are calculated. Significant points are detected through the skeleton extracted from the segmentation result. For labeling purpose root segment of the tree is tracked and then algorithm will search for its unique terminal points and decide if the segment is artery or vein.
3. Grisan et al.(2003) In optic disc zone arteries rarely cross arteries and veins rarely cross veins[5] hence by using vessel structure represented by tracking the classification is propagated outside this zone where little information is available to discriminate between arteries and veins. Partitioned a concentric zone around the optic disc into quadrants performs more robust local classification analysis 'a divide at impera' approach is used.
4. S.Vazquez et al.(2009) In color based clustering algorithm with a vessel tracking method[6] retinal images are divided into four quadrants and then it combines the result. Then by using tracking strategy based on minimal path vessel segments are joined to support the classification by voting.

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5. C. Kondermann, D. Kondermann et al.(2007) Two feature extraction methods and two classification methods[7], based on support vector machine and neural network to classify retinal vessels. One of the feature extraction methods is based on ROI (Region Of Interest) around each centerline point while the other is profile based. To reduce dimensionality of feature vectors principal component analysis is used.
6. M. Niemeijer, B. van Ginneken et al.(2009) Image feature and classifier is an automatic method which is used for classifying retinal vessels into arteries and veins[8]. A set of centerline features is extracted and a soft label is assigned to each centerline, indicating it's being a vein pixel.
7. R.Estrada, C.Tomasi et al.(2012) present a methodology[9] for vessel structure in human retina using Dijkstra's shortest-path algorithm. The method requires no manual intervention, preserves vessel thickness and follows vessel branching naturally and efficiently.
8. M. Niemeijer, X. Xu, A. Dumitrescu, P. Gupta et al.(2011) In the classification method[10] is considered as a step in calculating AVR value. The estimation of AVR requires vessel segmentation, accurate vessel width measurement and artery vein classification hence slight error can produce large influence on the final value.

III. METHODS FOR A/V CLASSIFICATION

Proposed method has mainly four steps to perform. They are as follows.
1) Vessel Extraction and Segmentation.
2) Graph Extraction and Generation.
3) A/V Classification.
4) AVR Calculation.

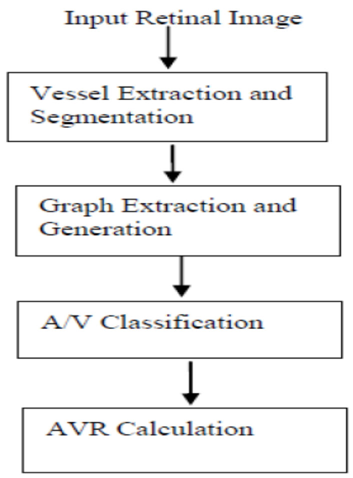

Fig. 1. Block Diagram of Proposed method

IV. GRAPH GENRATION

A graph is nothing but a representation of the vascular network, where each node denotes an intersection point in the vascular tree in which each link corresponds to a vessel segment between two intersection points.

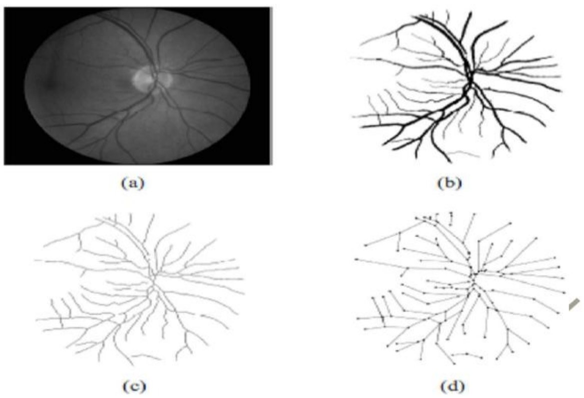

Fig. 2 Graph Generation (a) Original Image; (b) Vessel Segmentation Image (c) Centerline Image (d) Extracted Graph

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For generating the graph, we have used Minutiae Extraction method. The nodes are extracted from the centerline image by finding the bifurcation points which are detected by considering pixels with more than two neighbors and the endpoints or terminal points by pixels having just one neighbor. In order to find the links between nodes (vessel segments), all the bifurcation points and as result we get an image with separate components which are the vessel segments when u removed their neighbors from the centerline image. On the other hand, any given link can only connect two. Here bifurcation points and terminal points are marked by blue and red color respectively.Fig.2 (d) shows the graph obtained from the center line image of Fig.2(c).

V. A/V CLASSIFICATION

Here automatic graph based approach is used for classifying retinal vessels into arteries and veins. The features get extracted on the basis of centerline extracted image and a label is assigned to each centerline, indicating the artery and vein pixel. Based on these labeling phase, the final goal is now to assign one of the labels with the artery class (V), and the other with vein class (A). In order to allow the final classification between A/V classes along with vessel intensity information the structural information and are also used. Classification is done with the help of SVM classifier. In the recent years, SVM classifiers have demonstrated excellent performance in a variety of pattern recognition problems. The input space is mapped into a high dimensional feature space. Then, the hyper plane maximizes the margin of separation between classes which is constructed further. The points that lie closest to the decision surface are called support vectors directly affect its location. When the classes are non-separable, the optimal hyper plane is the one of the technique that minimizes the probability of classification error. Initially input image is formulated in feature vectors. Then these feature vectors mapped with the help of kernel function in the feature space. And finally division is computed in the feature space to separate out the classes for training data. A global hyper plane is sought by the SVM in order to separate both the classes of examples in training set and avoid over fitting. This phenomenon of SVM is more superior in comparison to other machine learning techniques which are based on artificial intelligence. Here the important feature for the classification is the width of the vessels. With the help of SVM classifier we can easily separate out the vessels into arteries and veins.

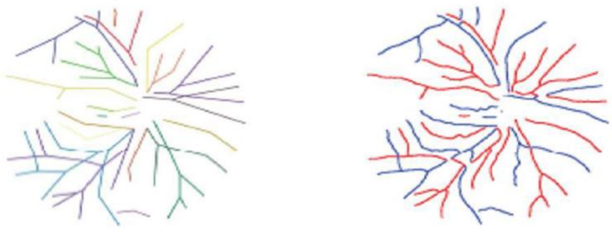
(a) (b)

Fig. 3 (a) Graph analysis result; (b) A/V Classification result (Red: Correctly Classified Arteries, Blue: Correctly Classified Veins).

VI. FEATURE EXTRACTION

Feature extraction is used to reduce the dimensionality and considering the interesting parts of an image as set features called as feature vector. This approach is more useful when the image sizes are large and using lot of memory then it is required to extract features to quickly complete tasks such as image matching and retrieval. Here common feature extraction techniques include Histogram of Oriented Gradients, Speeded Up Robust Features, Local Binary Patterns, Haar wavelets, and color histograms etc. So we can say transforming the input data into the set of features is called feature extraction. Feature extraction involves simplifying and resolving the amount of resources needed to represent a large set of data accurately. Here in the proposed method the input data should be transformed into a reduced representation of set of features such as Intensity, Area, Perimeter, Centroid and Diameter. Here diameter is the important feature to classify the retinal blood vessels. These features are extracted by using the region properties for retinal image.

These features are explained below.
1. Area: The actual number of pixels in the region.
2. Centroid: 1-by-Q vector that specifies the center of mass
3. Diameter: Scalar that specifies the diameter of a circle with the same area as the region.
Computed as sqrt (4*Area/pi).

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VII. RESULTS

The automatic methods described in the previous sections were tested on the images of three databases, DRIVE, INSPIRE-AVR, and VICAVR. The images in the DRIVE dataset were captured with 768 × 584 pixels, with 8 bits per color plane. about 40 high resolution images of the INSPIRE-AVR database have resolution of 2392 × 2048 pixels and are optic disc-centered. At the end, the 58 images of the VICAVR database were acquired using a Top connonmydriatic camera NW-100 model with a spatial resolution of 768 × 584, and are optic disc-centered also.
Results of automatic vessel segmentation were available for the manual artery/vein labeling and three datasets was performed by an expert on the 20 images of the DRIVE test set & for the40 images of the INSPIRE database also. The VICAVR database includes the caliber of the vessels measured at different radii from the optic disc also the vessel type (artery/vein) labeled based on the agreement among three experts. The following subsections gives the results of applying the proposed A/V classification method on the images of these databases. The accurate values are obtained for centerline and vessel pixels in the entire image & for the pixels inside the region of interest that is usually defined for the calculation of the arteriolar-to venular ratio; the ROI is the standard ring area between range 0.5 to 1.0 disc diameters from the optic disc margin [10].

VIII. CONCLUSION

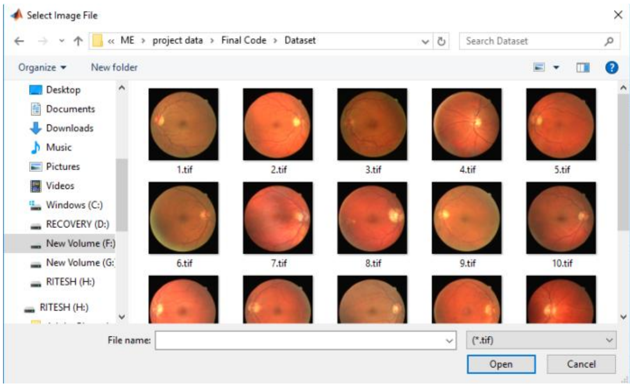

Fig.4. Different types of Retinal Images

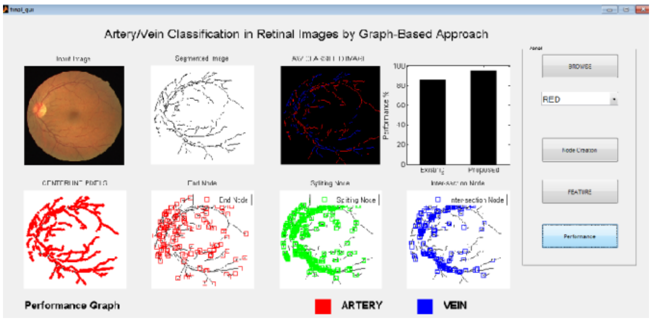

Fig.5 Retinal Images after segmentation

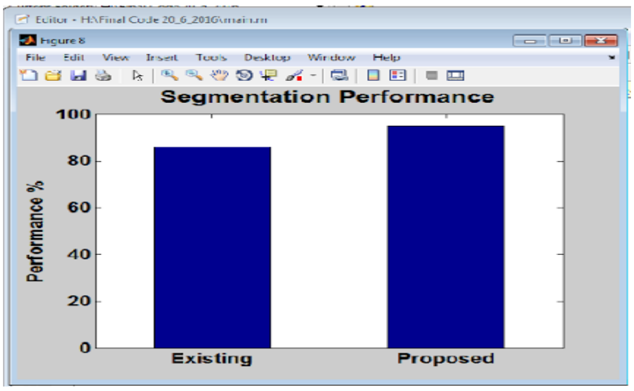

Fig 6. Result of Retinal Images Using Graph based Approach

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It is essential to do the classification of arteries and veins in retinal images for f the automated assessment of vascular changes. We have mentioned a new automatic methodology to classify retinal vessels into arteries and veins. In old days used method is intensity features for discriminating between arteries and veins, our method uses additional information taken from a graph which represents the vascular network. Proposed methods give the high accuracy achieved by our method, especially for veins, the largest arteries and confirm that this A/V classification methodology is reliable for the calculation of various characteristic signs related with vascular alterations.

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