A Review on: Detection of Vascular Changes In Retinal Images Using Automatic A/V Classification

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Abstract— **The retinal vessels are affected by several diseases such as diabetes, hypertension and cardiovascular. The vessels are reliable for the calculation of characteristic signs with vascular changes are measured & accessing the stage and severity of some retinal condition. The classification of arteries and veins in retinal images is an important phase for the automated assessment of vascular changes and calculation of characteristics signs with several diseases such as diabetes, hypertension & cardiovascular condition. The proposed of A/V classification method based on the images of INSPIRE-AVR, DRIVE & VICAVR databases demonstrate the independence of this method in A/V classification of retinal images with different properties, such as differences in size, quality, and camera angle. The AVR value can provide an indicator of diabetic retinopathy and retinopathy of prematurity so, A/V classification proposed AVR ratio for Proper measurement of vascular changes. Any changes in retinal blood vessels, such as dilation and elongation of main arteries, veins and their branches can provide frequently associate with hypertension and other cardiovascular diseases and also, reduce the subjectivity & time than current observer-based techniques.**

Index Terms— **Artery/vein classification, vessel segmentation, graph modification, graph generation & analysis.**

I. INTRODUCTION

Artery/ vein classification is a relevant task in digital image analysis has allowing a large number of images & reduced the subjectivity than current observer-based techniques. In A/V classification extract the graph from vessel tree & diagnostic indicators as the Arteriolar-to-venular diameter Ratio (AVR) [1]. The AVR value is used for calculation of blood vessels extraction and detection of the bifurcation point of the vessels like diabetic retinopathy and prematurity. So, in other images processing operations, the AVR requires segmentation, vessel width measurement & artery/vein (A/V) classification [2]. Therefore, the AVR measurement system must identify which vessels are arteries and veins. Retinal vessels are affected by several diseases namely as diabetes, hypertension and vascular disorder.

In diabetic retinopathy, the blood vessels show vessel diameter alteration [3] & show abnormalities in early stages [4] as well as any changes in blood vessels such as significant elongation and dilatation of main arteries, veins and branches [5] are frequently associated with hypertension and cardiovascular pathologies. In retinal images automatic detection of vascular changes and calculation of several characteristic signs are measured and assessing the stage of some retinal conditions.

The graph extracted from the retinal images is classifies the vascular tree & deciding the type graph nodes (intersection point) & assigning one of two labels to graph links. Finally, the combination of the graph-based labeling with a set of intensity features of the vessel segment are measured for assigning the final artery/vein class.

II. LITERATURE SURVEY

The following sections explain the survey of various papers. Different methods are used for the graph extracting from the segmented retinal vasculature and classify the vessels are arteries & veins.

GMM+EM :

D.Relan et. al. [6] explains the biomarker in the retinal vessels based on color features which combines a Gaussian Mixture model (GMM) with Expectation-Maximaization (EM) unsupervised classifier & quadarant-pairwise approach. First, the GMM-EM classifier used for determining a three parameters such as Mean, Covariance & Mixture Coefficient from the given dataset & pick up the background noise which were not classify either arteries or veins. Then, Quadrant pairing and feature extraction based on the images was divided into four quadrant & found a four color features such as Mean of Red , Mean of Green, Mean of Hue & variance of Red were extracted from the channels & works on separately and locally on each of them. After feature extraction consider a four pair of quadrant ((I, II), (II, III), (III, IV), (IV, I)). Then, each pair of quadrant was representing the points & classifying the vessels.

PCA:

C. Kondermann el. al [7] study the Diabetic Retinopathy (DR). The DR is very often seen in loss working age people. So that, it was used a two approaches such as feature extraction and classification method. In feature extraction method compare between profile based and ROI based feature vectors. In profile based, determined each skeleton in orthogonal direction of the vessels at region of interest around centreline position & then draw a line across the vessels. In ROI based feature vector to define a quadratic region of interest around each skeleton pixel & to reduce the

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dimensionality of feature vectors, they used to analysis of multiclass principal component (PCA). The classification method is used for feature vector after reduced the dimensionality such as support vector machine and neural network. In support vector machine was compared the result between four kernels such as linear, polynomial, RBF, sigmoidal with various parameters & In Neural network was used for multilayer or large data with back-propagation algorithm

SEMI-AUTOMATIC METHOD:

Martinez-Perez et al. [8] explains the analyzed the vascular tree using semi automatic method. So, in this method to describe topological and geometrical properties of a single vessel & also, sub-tree are calculated. First, skeleton is extracted from the vascular tree and describe a geometrical properties and also, significant points are detected. Then, the user should labelling the point to the root segment of the vascular tree and search for its unique terminal points (starting point & ending point) and describe if the segment artery or vein.

RULE-BASED ALGORITHM:

Rothaus et. al. [9] classify the vessels are either artery or vein using Rule-based algorithm. In this algorithm to propagate the vessel to provide labels as either arteries or veins throughput the vascular tree. This method is used for existing result of vessel segmentation and provide a manually labels on starting point to ending point of blood vessels.

COLOR-BASED CLUSTER:

Vazquez et al. [10] combines a color-based clustering algorithm with a vessel tracking method. This method is used for classify by voting of the vessel i.e. choose a shortest path. First, in clustering divides the retinal images into four quadrants & found a four color features such as Mean of Red , Mean of Green, Mean of Hue & variance of Red were extracted from the channels & classifies separately the vessels detected in each quadrant and finally ,it combines the result. Then, in vessel tracking method based on minimal path i.e. shortest path approach is applied and joins the vessel segment. Then, this vessel segment is located at different radii to support the classification by voting.

TRACKING A/V CLASSIFICATION:

Grisan et.al [11] developed a tracking artery/vein classification. This technique classifies the vessels in concentric zone around the optic disc. Then vessel structure reconstructed by tracking and classification is outside this zone where, no information is available to arteries from veins. This algorithm is not designed to zone divides the retinal images into four quadrants & found a four color features such as Mean of Red, Mean of Green, Mean of Hue & variance of Red were extracted from the channels & classifies separately the vessels detected in each quadrant.

AUTOMATIC METHOD:

Niemeijer et.al [12] explains the automatic method. In this method used a centerline feature and k-nearest neighbor (KNN) classifier for classify retinal vessels into arteries and veins. A set of centerline features is extracted from vessels tree assigned a label to each centerline & indicating a vein pixel. Then, find the average of the labels of centerline pixel to each centerline pixel. Finally, tested different classifier & found k-nearest neighbor classifier.

PIECEWISE GUASSIAN METHOD:

Li et.al [13] describes a piecewise Guassian model. This model describes the intensity feature or distribution of vessel profiles. A minimum distance classifier based on a minimal distance classifier based on the Mahalanobis distance was used to differentiate between the vessels types using feature derived from estimated parameters.

III EVALUATION AND DISCUTION

Table I. Represent the comparative analysis of various approaches along with techniques and features selection

Sr. No	Studies	Techniques Used	Features Selection	Objectives
1.	D.Relan, T.MacGillivray, L. Ballerini & E. Trucco [6]	Gaussian Mixture model(GMM) with (EM) model & Quadrant Pair-wise classifier	Biomarker feature	Each pair of quadrant representing the points& classifying the vessels.
2.	Claudia Kondermann and Michelle Yan [7]	Feature extraction & Classification method	Profile based ROI based feature, Support vector machine	Skeleton in orthogonal direction of the vessels at region interest around centreline position
3.	Martinez-Perez et al.[8]	Semi-automatic method	Topological & geometrical feature	Used for geometrical & topological properties of vessel segmentation and sub tree calculated.
4.	Rothaus et.al [9]	Rule based algorithm	Vessel segmentation	Used for vessel labels as either artery or vein
5.	Vazquez et al. [10]	Color based clustering method	Vessel tracking feature	Used to support the classification by voting.
6.	Grisan et.al [11]	Tracking A/V classification	Quadrant & color feature	Classifies the vessels in concentric zone around the optic disc.
7.	Niemeijer et.al [12]	Automatic method (LDA only)	Centerline feature & k-nearest	Used for labels on centerline pixel to each centerline

			neighbor classifier	pixel.
8.	Li et.al [13]	piecewise Guassian model	Intensity feature	Describe the intensity distribution of vessel profile

CONCLUSION

The classification of arteries and veins in retinal images mentioned drawbacks such as that use intensity features to discriminate between arteries and veins. The retinal images are non-uniformly illuminated and exhibit local luminosity and contrast variability which affect performance of intensity-based A/V classification method. Hence, to overcome this problem our system using a graph-based method which will use additional structural information extracted from a graph representation of the vascular network.

REFERENCES

[1] N. Patton, T.M. Aslam, T. MacGillivray,I.J.Deary, B. Dhillon, R. H. Eikelboom, K.Yogesa and I. J. Constable, " Retinal image analysis: Concept application &Potential ," Progr. Retinal Eye Res., vol. 25, p. 99-127, Jun, 2006.

[2] Behadad Dashtbozorg, Ana Maria Mendonca, Senior Member IEEE & Aurelio Campilho Member IEEE , " An automatic graph based approach for artery/vein classification in retinal images " IEEE transaction on image processing , vol. 23, no.3, march 2014.

[3] K.Guan , C. Hudson, T.wong, M. Kisilevsky, R.K. Nrusimhadevara, W.C. Lam, M Mandelcorn, R.G.Devenyi and J.G. Flanagan,"Retinal hemodynamics in early diabetic Mascular edema," Diabetes, Vol. 55, pp. 813-818, Mar. 2006.

[4] T.T. Nguyen and T.Y. Wong, " Retinal vascular changes and diabetic retinopathy," Current Diabetes Rep., vol. 9, pp. 277-283, Aug. 2009.

[5] L.D. Hubbard, R.J. Brothers, W.N. King,L.X. Clegg, R. Klein, l.S. Cooper, A. Sharrett,M.D.Davis and J. Cai, " Methods for evaluation ofretinal microvascular abnormalities associated with hypertension/ sclerosis in the atherosclerosis risk in communities study," Ophthalmology, vol. 106, pp. 2269-2280, Dec. 1999.

[6] E. Trucco, L. Ballerini, D. Relan, et al.,"Novel VAMPIRE algorithm for quantitative analysis of the retinal vasculature", Proc. IEEE Intern. Conf. on Biosignal an Biosystems, Rio de Janeiro, Brazil,Feb 2013.

[7] C. Kondermann, D. kondermann, and M. yan," Blood vessel classification into arteries and veins in retinal images ," Proc. SPIE, Progr Biomed. Opt. Imag., vol. 6512, no. 651247, Feb. 2007

[8] M.E. Martinez-Perez, A.D. Hughes, A.V. Stanton, S.A. thom, N. Chapman, A.A.Bharath and K.H. Parker, " Retinal vascular tree morphology: a semi-automatic quantification," IEEE Trans. Biomed. Engg., vol. 49, no. 8, pp. 912-917, Aug.2002.

[9] K.Rothaus, X. Jiang and P.Rhiem, "Separation of the retinal vascular graph in arteries and veins based upon structural knowledge," Image Vis. Comput., vol.27, pp. 864-875, Jun. 2009.

[10] S. Vazquez, B. Cancela, N. Barreira, M. Penedo and M. Saez, " On the automatic Computation of the arterio-venous ratio in retinal images: Using minimal paths for the artery/vein classification," in Proc. Int. Conf. Digital Image Comput., Tech. Appl., 2010, pp. 599-604

[11] E.Grisan and A. Raggeri, " A divide strategy for automatic classification of retinal vessels into arteries and veins," in Proc. 25th Annu. Int. Conf.IEEE Eng. Med. Biol. Soc., Sep. 2003, pp.890-893.

[12] M. Niemeijer, B. Van Ginneken, and M. D. \ Abramoff, " Automatic classification of Retinal Vessel into arteries and veins, " P Proc. SPIE, Progr. Biomed. Opt. imag., vol. 7260,no. 72601F, Feb. 2009.

[13] H. Li, W. Hsu, M. Lee and H. Wang, " A piecewise Gaussian model for profiling and Differentiating retinal vessels," in Proc. Int. Conf. Image process., vol. 1, Sep. 2003, pp. 1069-1072.