

A SURVEY ON ANATOMICAL STRUCTURES: IN FUNDUS RETINAL IMAGES

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Abstract

Diabetic retinopathy is a disease which arises due to small damage of the retina in the eye. The affected eye doesn't show any early symptoms, and it takes over a period of time to identify the disease. The disease analysis is carried out using optic disc (OD), blood vessels (BV), macula for quick and early identification of the disease. The determination of the Optic Disc (OD) boundary is the primary process in the analysis of digital Diabetic Retinopathy (DR) systems. OD is a disc which looks similar to circular or oval shape where all the blood vessels which carry the blood to the retina originates and ganglion cell axons exit the eye. The circulation of blood throughout the body and to the eye is carried out by blood vessels. Detecting the location of macula is an important role in diabetic retinal analysis. The detailed report of eye can be found by the structure of blood vessel, optic disc, macula changes caused in the blood circulation of eye make us to identify the diseases affected in the eye.

Index Terms: Diabetic Retinopathy, Disease, Optic Disc, Blood Vessels, Macula, Fovea

1. INTRODUCTION

Fundus is the interior surface of the eye, opposite to the lens. It includes retina optic disc, macula and fovea shown in figura1. In fundus images, the vascular area, optic disc, macula region are the main landmarks. The eye fundus is the only part of the human body where the microcirculation can be observed directly. Most detection methods reported the anatomical knowledge in terms of relative location of the vasculature geometry and image features. It will help to identify and locating the structure of the retinal fundus images.

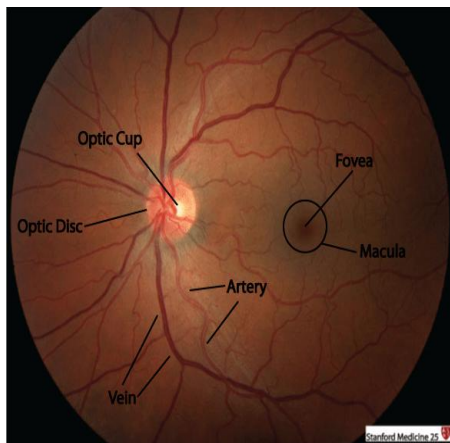


Fig-1: Anatomical structures

2.OPTIC DISC

Optic disc or optic nerve head is the location where axons exit the eye to form the optic nerve. There are no light sensitive rods or cones to respond to a light stimulus at this point. This causes a break in the visual field called blind spot. It is also the entry point for the blood vessels, and is placed 3 mm to 4 mm to the nasal side of the fovea. It is a vertical oval with average dimensions of 1.76 mm horizontally by 1.92 mm vertically.

Most of the OD detection techniques make use of the anatomical structures of the OD, macula, and retinal blood vessels. For example, some methods are based on the anatomical structure that all major retinal blood vessels originate from the OD. Few other methods make use of the relative position between the OD and the macula that often varies within a small range. Retinal parameters, such as exudates are often appears in retina as clusters of regions with size and pixel intensities comparable to the optic disk. This makes the optic disc detection challenging, since some of the common features such as region size and pixel intensities are unreliable for segmenting the optic disc. A successful segmentation of the optic disc (OD) in digital eye fundus images plays an important role for the development of an automated DR diagnosis system.

3. LITERATURE REVIEW

Table -1 : Summary of optical disc detection

S. No	Method	Author	Year	Pre Processing	Segmentation /Feature Extraction	Dataset	Performance Measure
1	Automated localization of optic disk in retinal images	Deepali .A.Gods, Dr.Dattatraya,S. Borman	2013	Green Channel	Thresholding	DIRET DB0, DIRET DB1, DRIVE, LOCAL	Accuracy = 98.45%
2	Optic Disc localization in Retinal Images using histogram matching	Amin Dehghani,Hamid Abrishami	2012	RGB	Histogram equalization	STAR E, DRIVE, Local	Success rate=100%,91.36%,98.9% respectively
3	Comparison and evaluation of computerized methods For Optic disk localization and detection in retinal images	Kiranyaseen, Anam Tariq,usman Akram	2013	RGB to Gray Scale, average filtering	Edge Detection, Houff transform, brightness region method,Log filtering	STAR E, DRIVE, Local	Hough: STARE=93.8%, DRIVE=100%, Log: STARE=80%, DRIVE=85%
4	Locating the optic disc in retinal images using morphological techniques	Angel Suero, Dego Marin,	2013	Resized, RGB to I channel of HIS	Morphological operations, Enhancing Brightness and centroid	MESSI DOR	Accuracy = 98.17%, Time=1.53 Sec
5	Automatic optic disk detection and removal of false exudates for improving retinopathy classification accuracy	G.Ferdic mashak Ponniah. Dr.Santhosh baboo	2013	Normalizing the pixel color at the neighborhood(8/8)	Genetic Algorithm	DIRE CT, DB1	Specificity =78.0%, Sensitivity =90%
6	Intelligent diabetic retinopathy diagnosis in retinal images	Marziezahnatkeh,Alirafiee	2013	Resized, Green channel, Median filtering CLAHE	Morphological top hat operation, background subtraction	DIRE CT, DB0	Accuracy DIRECT DB0=87.59%, DIRECT DB1=86.51%
7	A novel optic disc detection scheme on retinal images	Guanminglin, chen – chung liu	2013	RGB to Gray	Source and sink seed selection, Random walk	DIRE CT, DB1	Sensitivity =100%

					Scheme			
8	Optic disc detection from normalized digital fundus images by means of a Vessel direction matched filter	Aliaa Abdel-Haleim Abdel-Razik Youusif	2008		RGB to Gray AHE(Adaptive Histogram Equalization)	Matched Filter	STAR E, DRIVE	Success rate=100%
9	Automatic Extraction of the Optic Disc Boundary for Detecting Retinal Diseases	Muhammed Salman Haleem, Liang xiu Han	2013		Red Channel	Active Shape Modeling, Point distribution modeling		Accuracy =92%
10	Segmentation of Optic Disc in Fundus Images	Mrs.S.V asanthi, R.Ananth	2012		Average Filter	Gradient Vector flow model/Active Contour Model	local	Better Performance
11	Automated segmentation of optic disk region on retinal fundus photograph: Comparison of contour Model name and pixel classification methods	Chisako, nura mat su,toshia ki nakagawa	2011		Red channel Resized, fixed Thresholding	Active Contour model Fuzzy c means clustering Artificial neural network	STAR E, DRIVE	Accuracy =ACM provides best result
12	Detection of Optic Disc in Retinal Images	V.Vijay akumari, N.Suriyanarayanan	2009		clustering	Principle component Analysis, Propagation through Radii	Local	Accuracy =88%
13	Retinal Blood Vessel Segmentation with Optic Disc Pixel Exclusion'	Randy Cahya Wihandika, Naik Suciati,	2013		RGB	LINE OPERATOR	DRIVE	Accuracy =94%
14	Detecting the Optic Disc Boundary in Digital Fundus Images using Morphological, Edge Detection and Feature Extraction Techniques.	Aquino A, Gegundez – Arias, Marin	2010		RGB	Morphology, edge detection, circular hough transform	MESI DOR	Efficiency =86% Computational time=5.69 s
15	Detecting Optic Disc on Asians by Multiscale Gaussian Filtering	Bohzhang Jane You and Fakhri Kassay.	2012		Gaussian filtering, double Thresholding	Vessel direction matched filter	HIT database	Accuracy =99.25%
16	Fast localization and segmentation of optic disc in Retinal images using Directional filtering and level sets.	Yu, ES. Bassiga, C. Agurto, S. Echegaray	2012		Red channel, background normalization	Directional filter, Fast hybrid level set segmentation	MESSI DOR	Success rate =99%

4. BLOOD VESSELS:

The circulation of blood throughout the body is carried out through the blood vessels in the circulatory system. At the back of the eye retina is located, which requires constant blood

supply. So that the blood vessels provide all the ingredients that the retina needs. When the retinal cells are working it produces wastes which are also removed by blood vessels. The blood vessels in the eye consist of two major parts as in rest of your body namely Arteries and Veins. The fresh blood from the heart and the lung is carried to the eye with the help of arteries. The blood used by the eye is ejected out and is carried to the heart and the lung with the help of veins. This process is carried out every time when your heart beats so that we make sure that always the fresh stream of blood is flown through the eye. When compared to other parts of your body the arteries and veins size in the eye is small. But it does the same job as it does in other parts of the body. The arteries and veins tend to be blocked sometimes and lead to many medical problems. The blockage can happen throughout the body. When the artery or veins get blocked then it would be referred either retinal artery occlusion or retinal vein occlusion. If you diagnosed with retinal occlusion and if you want to find whether it is artery or vein then you want to consult a ophthalmologist to detect which part gets involved in it.

Table -2 : Summary of blood vessel extraction

S. No	Method	Author	Year	Pre Processing	Segmentation /Feature Extraction	Data set	Performance Measure
1	Retinal Blood Vessel Segmentation with optics pixel exclusion	Randy Cahya Wihandhi k, Naik Suciati	2013	Green Channel	Line detection(BV)& OD	Drive Data set	Aaccuracy-94.2% Area Under Curve (AUC)-95.21%
2	Detection of retinal blood vessels for disease diagnosis	K.Jayasreep,subathara,Annasam.K	2013	Green Channel	CCA(Connected Component Analysis)		PSNR=32.93%,MSE=5.7526% TPR=98.9%, FR=4.5%, Accuracy=96.85%
3	Retinal Blood vessels segmentation algorithm for diabetic retinopathy and abnormality detection using Image subtraction	Nikil Amruthkar, Sharad chitalkar Yogesh Bandhgar S.L.Trade	2013	Green Channel Median filterin g Adaptive Histogram	Thresholdin g Contour Detection	local	Better result
4	An improved ANT colony system for retinal blood vessels segmentation	Ahmed Hanza Asad Ahmed Taher	2013	Green Channel Linear Tran formati on	Ant colony system	STARE, DRI VE	Sensitivity=88.0% Specificity=93.58%,Accuracy=92.92%
5	A new supervised method for blood vessels segmentation in retinal images by using gray level moment invariant based features	Diego marim, Arturo Aquino Manula Emilio	2011	Vessel central light reflex removal Moment invariant based features	Gray level based	STARE, DRI VE	Accuracy for STARE=94.48% Accuracy for DRIVE=95.26%
6	A comparison and evaluation of computerized methods for blood vessels enhancement and	Saif shabbier, Anam Tariq,Usman Akram	2013	Gaussian Filterin g Log Filterin g	Adaptive Thresholdin g, Global Thresholdin g	STARE, DRI VE	Gabor Average=95% Log Average=91

S. No	Method	Author	Year	Pre Processing	Segmentation /Feature Extraction	Data set	Performance Measure
7	Retinal Blood vessels segmentation using an Extreme learning Approach	Vasanthi shanmuga m,R.S.D. Wahid Banu	2013	Green Channel	Grey level based feature moment invariant Vessel central light reflex removal Extreme learning machine	STARE, DRI VE	Sensitivity=81.94% Specificity=96.79%
8	Segmentation of retinal blood vessels using a novel clustering algorithm	Sameh.A.salem, Nancy, Ashok.k.naidu	2017	Clustering	KNN, Radial based	LOC AL	KNN Specificity=94.01%,sensitivity=84.46% RBC Specificity=99.14%,sensitivity=86.79%
9	Identification of the Diabetic retinopathy by detecting new retinal using fundus image	S.Nithya, S.karthikeyan	2012	Green Channel CLAH E	Watershed Transform Vessel Segmentati ons	Abirami Eye care hospital	Accuracy=94.7%
10	Blood Vessel Extraction using wiener filter and morphological operation	V.Vijayakumari,Dr. Suriyanarayanaa	2010	Resized, Green channel, Histogram Equaliz ations	Morphological operation, Weiner Filter,	LOC AL	Average PSNR=5.8025%(morphology) PSNR(wien er)=5.68%

5. MACULA

Macula is located temporal to the optic disc and is bounded by the temporal superior and inferior vascular arcades. The macula occupies only 4% of the retinal area, but it has the major responsibility of photopic vision. the darkest macula is responsible for the sharpest vision . Fovea is the center of the macula. It lies at the utilized in activities that require discerning sharp details such as reading.

Table-3 Summary of macula

S. No	Method	Author	Year	Pre Processing	Segmentation /Feature Extraction	Data set	Performance Measure
1	Automatic assessment of macular Edema from color retinal images	Sai Deepak, Jayanthi Sivaswamy	2012	Green channel Thresholding	Region of interest extraction, Generation of motion patterns, Single class classification	MESSI DOR	Accuracy-75%
2	Macula precise localization using a digital Retinal Angiography	C.Mar, S.Penna, M.G.Penedo	2008	clustein n g	Hu's circular model Candidate Region Selection	Complejo Hospit alario univers ity	Accuracy=99.26% Average time=0.88sec
3	Detection of hard exudate and Red Lesions in the macular using	Carlo agurto,H onggang yu,Victor	2012	Shade correctio n techniqu e mean	AM/FM binary mapping Parameter Optimization Linear	Univer sity of Texas health science	Sensitivity-100% Macula with hard

	a Multiscale Approach			average filter Contrast limited Adaptive	regression Classifier	center	Exudates Sensitivity-92% Macula with red lesion
4	Detection of Anatomical structures in optical Fundus images	S.Lavanya	2013	Green channel Thresholding Morphological operation	Geometrical analysis	Database image	Accuracy-60%
5	Detection of Exudates and Macula in Fundus images to estimate severity of Diabetic Retinopathy	S.Kavitha, K.Duraiswamy	2012	RGB to Lab Color Space(L channel) CLAHE	Binary image smoothing Top Hat detection	Local image	Comparable accuracy
6	Automated localization of Optic disc and Macula from Fundus images	JASPER EETKA UR, Dr. H.P.Sinha	2012	RGB to Grey, morphological operations	Geometric active contour model	Local	Sensitivity-96.6%
7	An efficient integrated approach for the detection of Exudates and diabetic maculopathy in color fundus images	D.Ramasubramanian, G.Maheendran	2012	Green Channel Median Filter CLAHE	BottomHAT Top HAT transform	Vasan Eye Care	Accuracy-100%
8	Graph based detection of optic disc and fovea in retinal images.	Laszlo Kovacs, Rashid jalal qureshi	2010	Gaussian LPF, Threshold up	Macula: Morphological erosion/dilation Fovea: Centroid of blob	Diaret db0 Diaret Db1 DRIVE	Accuracy= 96.8% 98.8% 89.3%
9	Automated system for Macula Detection in Digital Retinal Images	Maryam Mubbasar, Anam Usman, M.Usman Akram	2011	Gabor wavelet	Thresholding method	STAR E and DRIVE	Accuracy for DRIVE - 98.7 STARE- 99.1
10	Statistical Techniques for detection of optic disk and macula and parameters measurement in retinal fundus images	Camal Kose, Cevat I kibas	2010	green channel	Background subtraction Weighted Distance method	STAR E	Accuracy=97%

6. CONCLUSION

Our aim is to cover and analyze the anatomical structure of retinal images through various researchers of universities. This paper gives the theoretical support to the young authors about the retina analysis. This paper do not exactly cover all the works related with anatomical structure of the retinopathy images, but definitely it will make the reader to

understand the techniques, and methods for detecting the optic disc, blood vessels, macula.

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