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Discernment of Retinal Anomalies in Fundus Images for Diabetic Retinopathy

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Abstract— Retinal abnormalities can lead to permanent blindness hence retinal analysis plays a critical role in diagnosis of retinal anomalies. This paper highlights a very simple and straight forward approach to identify the retinal disorders such as diabetic retinopathy. The drusen clearly shows the presence of diabetes and other retinal disorders. The results can be further extended for clinical suites.

Index Terms— Fundus image, Diabetic Retinopathy, drusen, threshold.

I. INTRODUCTION

The human eye is composed of retina being the posterior region of eyeball is a thin layer which is highly responsible for visual recognition. Any damage to retina can cause permanent blindness hence early precautionary steps are necessary. The major important parts of retina are Macula, Optic disc and blood vessels. The typical anatomy of retina is shown is Fig.1.

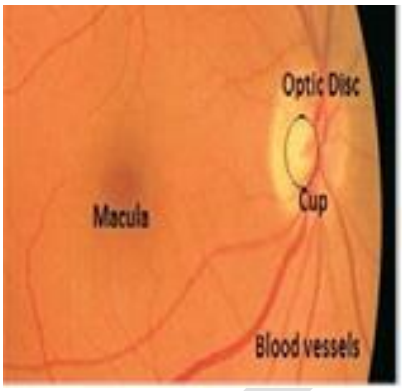


Fig.1Anatomy of retina

Retinal disorders such as Glaucoma, Cataract, Diabetic Retinopathy and AMD are the most commonly found retinal anomalies in a human eye. Such diseases require early diagnosis and immediate medical measures. The studies show that almost 75% of the people have eye correction where 64% use glasses and 11% use contact lenses. Visual impairment due to retinal disorders is a significant cause around the world. Apart from medical measures, awareness and wider knowledge regarding retinal disorders seems to be mandatory. Recent studies show that about a decade ago the risk factor for retinal diseases prevailed more for aged people than the youngsters. But now the younger generation aged 30- 40 is more prone to the retinal disorders due to their sophisticated day today lifestyle. Irreversible blindness is becoming a serious issue around worldwide [15]. A typical diseased retina commonly called as drusen is depicted in Fig.2.

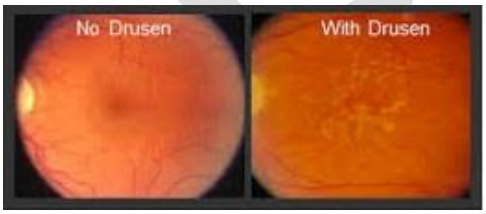


Fig.2. Normal Retina- Diseased Retina (Drusen)

The people with diabetes are at high risk for retinal disorders such as Diabetic Retinopathy (DR). DR is the most commonly found retinal disorders in human beings leading to Age-related Macular Degeneration (AMD) by gradual progression in disease. The diabetic retinopathy can be progressed into various stages such as Micro-aneurysms, hemorrhages, hard exudates and cotton wool spots [13][14]. Due to the presence of these anomalies the Macula can be disrupted for visual representation by leading to AMD or

even disappearance of macula. A typical diabetic Retinopathy with degenerated macula is shown in Fig.3. This paper highlights the segmentation of retinal diseases.

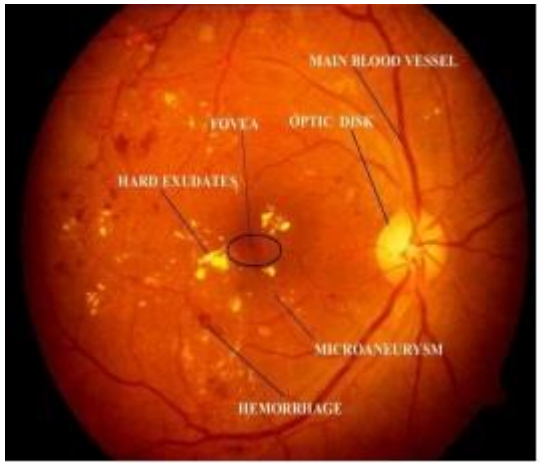


Fig.3. Diabetic Retinopathy

II. EXISTING WORK

Niemeijer, M., et al (2008) presented localization of optic disc and fovea in retinal images. Ziyang et.al (2010) presented the automatic detection of AMD using Grading overlay techniques. Soumitra Samanta., et al (2011) presented a simple and fast algorithm using Mathematical morphology in retinal images. Priya R., et al (2013) presented the diagnosis of DR in retinal images using Wavelett transform and Fuzzy C-means segmentation. Nyni K A, et al (2014) presented Macula detection using morphological operations in retina. Charu sharma., et al (2014) presented segmentation using Fuzzy C-means and Neural Networks and diagnosed the presence of DR. Dhiravidachelvi E., et al (2015) presented the diagnosis of DR in fundus images. Raju Maher., et al (2015) automatic detection of DR using Fuzzy C- means in fundus images. Jadhav A.S., et al (2015) presented calculation of blood vessel area and identified the presence of DR in fundus images using morphological operations. Kanchan Nemade., et al (2015) presented the detection of retinal abnormalities and graded the severity of disease. Dhariti deka., et.al (2015)presented the detection of Macula and fovea using Haar wavelet transformation. Jyh haur., et al presented the history of AMD in India and its surrounding regions.

III. PROPOSED METHODOLOGY

This paper focuses on the segmentation of retinal diseases from a retinal image and to identify the presence of Diabetes and AMD. Although existing work shows many techniques and methodologies [3], [6],[11],[14] this articles focuses on the segmentation of DR with an unpretentious approach.

The retinal image is enhanced in the pre-processing stage by applying binarization techniques. The segmented image clearly shows the various diseases such as Micro-aneurysms, hemorrhages, hard exudates and cotton wool spots. The stages of DR extraction are shown in Fig.4.

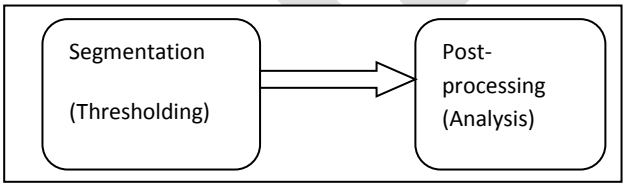


Fig.4. Steps of DR processing

IV. RETINA PROCESSING

V. SEGMENTATION

A. Binarization

A Binary image has only two possible values, zero's and one's which are normally displayed as black and white. The retinal image is binarized where the 8 bit gray image is transformed into a 1 bit image. The image is transformed into black and white colour, where the darker regions become black and the rest of the region with white colour. The binarized image is shown in Fig 5(b)[1][2][5].

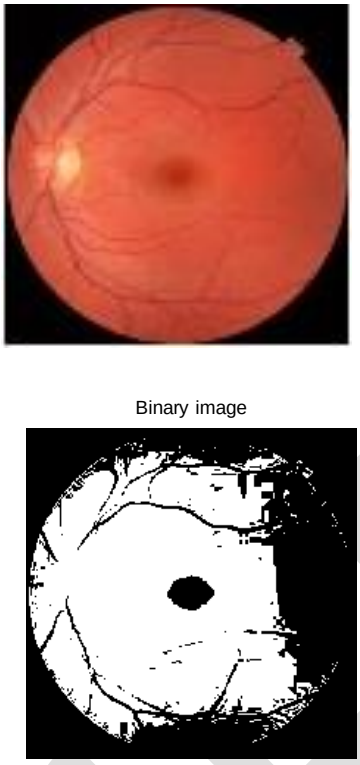


Fig.5(a). Original images 5(b). binarized image

VI. RETINA POST-PROCESSING

The fundus image is segmented and analyzed for further studies. The segmented retinal image shows various disorders such as cotton wool spots, Micro-aneurysms, hemorrhages, hard exudates. Fig.6(a). clearly depicts the presence of cotton wool spots and Fig.6(b) shows the segmented cotton wool spots from its original image.

Fig.6(a). Fundus image with cotton wool spots

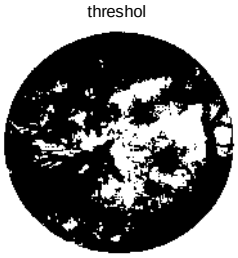


Fig.6(b). Cotton wool spots extracted after thresholding

VII. SIMULATION RESULTS

Table I represents a sample of five retinal images taken from the DRIVE database, representing the abnormal human retina. About twenty five sample images were tested and the

Table I

results were satisfactory where few examples are shown in Table I.

Table I shows the original image and its binarized image with its corresponding threshold values are also shown in Table II

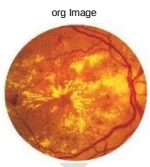
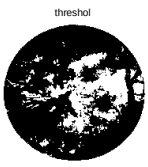
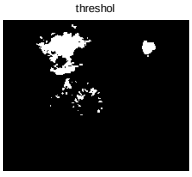
Image Name	Original Image	Binarized image
Disease6		
Disease5		

Table II

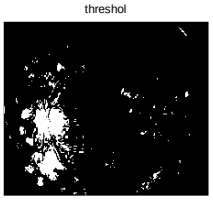
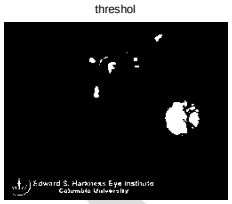
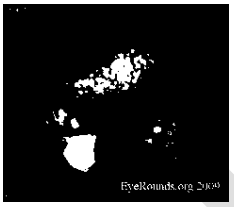
Disease4		
Disease3		
Disease7		

Image Name	*Threshold value*
Disease6	150
Disease5	150
Disease4	120
Disease3	150
Disease7	150

CONCLUSION

The results clearly show that the severity of DR can be diagnosed using the results obtained from the images. So it's concluded that the various retinal disorders can be identified which can be considered as the initial step. This can be further used for screening processes in eye clinics. The images can be explored further to study various abnormalities caused by DR.

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