Glaucoma Detection using the Fundus Retinal Images

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***Abstract*—Glaucoma is the medical condition which can result in blindness and vision loss. In Glaucoma, optic nerve which connects the eye to brain, is damaged which leads to progressive, irreversible vision loss. This disease does not cause any symptoms in early stages. Due to this people don't realize about the Glaucoma. Glaucoma is a common cause of eye blindness in India and abroad. Majority of people still don't know that they have Glaucoma. It can be detected in early stages through only routine checkup. So we need a simple and effective automated method to detect the Glaucoma at the starting stages.**

We proposed an effective and precise method for mass screening of people to detect the Glaucoma in early stages. In this approach we segmented the optic disk and the optic curve from the color retinal images of eye using image processing. By analyzing the segmented disk and cup, we have calculated the cup to disk ratio. The result of the proposed method has good accuracy with high sensitivity.

Keywords—color retinal images, segmentation, Neuroretinal Rim, optic disk, optic cup, blood vessels, hough transform

I. INTRODUCTION

Glaucoma is the second leading cause of world blindness. According to the recent survey, more than 60 million of people have the Glaucoma worldwide. India contributes the one fifth of it the worldwide. Glaucoma is occurring due to the damage of the optical nerve which is irreversible. If once the damage is done then no treatment is possible. With the early detection, we can slow down the damaging factor of optic nerve. There are several factors which is responsible for the damaging of the optic nerve. One of the factors is intra ocular pressure (IOP) which is generated when the aqueous humor's flow disturbed. This enlarges the optical cup in the eye. Due to this the cup to disk ratio is changes.

The color retinal images are taken by a good fundus camera. These retinal images have the good quality of visual information. In the proposed method our aim is to segment the optic disk and the optic cup. Cup to disk ratio give the important variation to detect the Glaucoma. In the proposed method, for the accuracy segmentation of the optic disk and optic cup is important.

This paper is organized in the following way. Section II will give the information about the important medical term related to retinal images. Section III describes the processing steps. Next section describes the calculation of the cup to disk ratio. Next section will give the conclusion and the future possibility for the improvement of the proposed method.

II. IMPORTANT MEDICAL TERM AND FACTORS TO DESCRIBE THE RETINAL IMAGES

Color retinal images are used as the input for the segmentation. The photo of the eye is taken from a special type of camera. These color retinal fundus images are the photograph of the internal surface of the eye. These photographs give the precise information about the retinal vessels macula, optic disc and optic cup. A fundus camera is able to provide an upright and magnified view of the fundus. A typical camera provides the views from 30 degree to 50 degree of the retinal area with magnification.

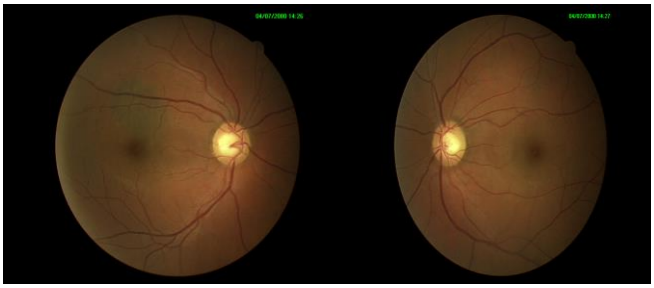


Fig. 1 Left retinal image and Right retinal image

In this section I am going to describe the various factors that are changes due to the Glaucoma. These factors are indicators for the Glaucoma. On measuring these indicators we can perform the detection and its classification. These factors may be quantitatively analyzing the Glaucoma disorder. The possible indicator is optic disc size, cup to disc ratio, rim disc ratio and retinal nerve fiber height (RNFLH) etc.

Neuroretinal Rim (NRR): Neuroretinal rim is defined as the area of bending of the axon from disk margins to the edge of the optic cup.

Optic disk: optic disc is an elliptic region which is brightest part from the back ground. This part contains the very important specification about the Glaucoma.

Optic cup: optic disk has an orange pink rim with a pale centre called the optic cup.

Cup to disk ratio: cup to disk ratio is evaluate as the ratio of the cup diameter to disk diameter. This parameter is very much changes due to Glaucoma. Cup to disk ratio is adopted

as the basic feature for Glaucoma detection in the proposed method.

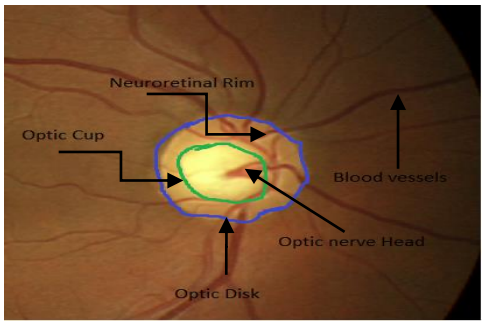
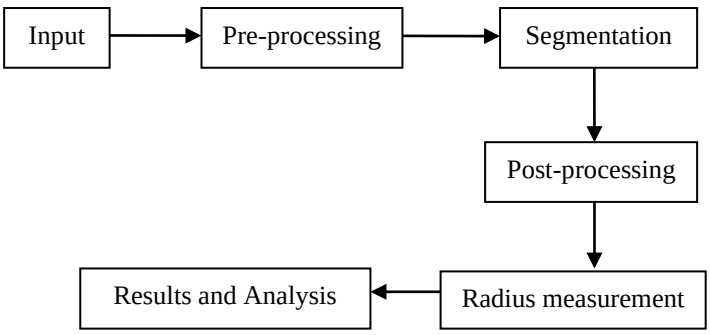


Fig.2 various content of fundus retinal image.

Fig.3 left image glaucomatous eye and right image shows the healthy eye.

III. PROPOSED ALGORITHIM

I have proposed a method in which the optic cup and the optic disc are segmented by image processing technique in MATLAB TOOL. Color retinal images are used as input. Flow chart for the proposed method is given below.



Fundus Retinal Images: color retinal images are used as the input for the segmentation. Fundus is a Latin word which is anatomically referring to the part of an organ.

Pre-Processing: The proposed method performs the some pre-processing step. In healthy image the boundary of the optic disk and the cup is clearly visible. But in case of glaucoma affected eye, the cup and disk boundary is not clearly visible. So we optimize the image for the further segmentation and the evaluation of the ratio. There are the following challenges in the segmentation of the cup and optic disk.

- Inhomogeneous background
- Blood vessels with varying width

Due to the following challenges the pre- processing is necessary for the correct segmentation. From the histogram I concluded that pixel which is belonging to the optic disk and the cup has the higher intensity. For separation of the background, I have used an optimal threshold which reduces the effect of background and blood vessels.

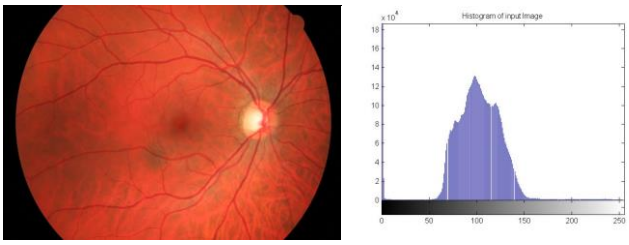


Fig.4 input image and histogram of the input image

Initial threshold in retinal images, I have calculated by weight sum of two or more probability densities with normal distribution.

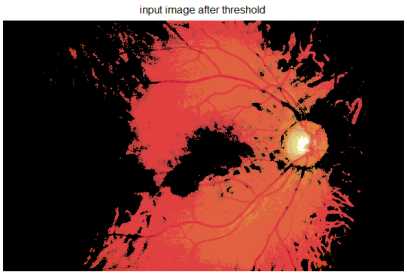


Fig.5 threshold of the input image

In further pre-processing step, we obtain the green channel image, red channel image and blue channel image of the threshold image. The red channel image is used for the optic disk segmentation because in the red channel image, the optic disk is clearly visible. The segmentation of the optic cup, I have used the green channel image. Green channel image has higher intensity pixels and the region of the interest also has the higher intensity value. Blue channel image is used for making the artificial image by the histogram equalization of green channel and the blue channel image. We make an artificial image in case of when the optic cup has not good visibility.

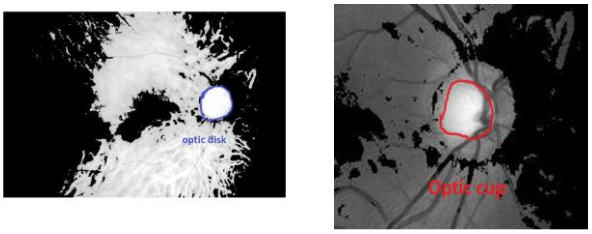


Fig.6 the optic disk and the optic cup

It is clear the optic cup and the optic disk contains the highest intensity pixels in comparison of the back of the background pixels. Our aim is to segment these higher intensity pixels for obtaining the optic cup and disk.

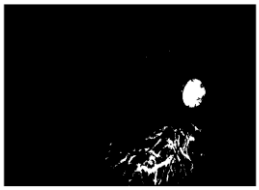


Fig.7 segmentation stage: segmented optic disk and cup

IV. Conclusion And Future Work

In the proposed method, the optic cup and the optic disc is segmented by image processing technique in MATLAB TOOL. Color retinal images are used as input. Red channel image is used for disc segmentation. Green channel image is used for the disc segmentation. In green channel the cup and disc boundary is clearly visible. Then the boundary is extracted by using the HOUGH transform. After the boundary extraction the cup to disc ratio is calculated for detected of Glaucoma. The obtained results are verified by experts. On the basis of these analysis and results the proposed method has high potential for Glaucoma detection.

A substantial amount of work has already done in the field of the detection and classification of Glaucoma. But none of the existing techniques are able to give accurate result. There are the several factors which get change due the Glaucoma disease. Several researchers have taken different factors for the detection of the Glaucoma and its classification. There are the wide area of change around the optic nerve fiber layer and visual field region. So it is covers the wide area of research field and a lots of research work has to be done by the researchers.

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