Diagnose Glaucoma in Retinal fundus Images

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Abstract: Glaucoma is one of the leading causes of blindness worldwide. It is due to the increase in intraocular pressure within the eyes. The detection and diagnosis of glaucoma is very important. In this paper the glaucoma is detected using the cup to disk ratio. The optic cup-to-disc ratio (CDR) in retinal fundus images is one of the principle physiological characteristics in the diagnosis of glaucoma. The algorithm’s effectiveness is demonstrated manually on segmented retina fundus images. By comparing the automatic cup height measurement to ground truth, we found that the method accurately detected neuro-retinal cup height. This work improves the efficiency of clinical interpretation of Glaucoma in fundus images of the eye. The tool utilized to accomplish the objective is MATLAB.

Keywords: - Glaucoma: Cup to Disc Ratio; neuro-retina; Region of Interest;

1. INTRODUCTION
Glaucoma is a disease that can damage the eye’s optic nerve and result in vision loss and permanent blindness. Some of the alarming facts about glaucoma are: (1) Glaucoma is the leading cause of blindness, (2) There is no cure for glaucoma, with medication it is possible to halt further loss of vision and (3) Everyone is at risk from babies to senior citizens. It is one of the common causes of blindness with about 79 million in the world likely to be afflicted with glaucoma by the year 2020. Glaucoma produces gradual and progressive visual field loss that results from a progressive loss of optic nerve fibers.

This nerve fiber layer can be damaged when the pressure of the eye (intraocular pressure) becomes too high. Vision loss and blindness will likely result if glaucoma is left untreated. Clinically, the diagnosis of Glaucoma can be done through measurement of CDR, defined as the ratio of the vertical height of the optic cup to the vertical height of the optic disc. Figure 1 shows an anatomy of human eye and figure 2 Shows glaucoma affected retina fundus image and figure 3 shows Healthy Retina fundus Image.
2. Glaucoma Detection Flow Diagram

- RETINAL FUNDUS IMAGE
- ROI EXTRACTION
- IMAGE ENHANCEMENT USING HISTOGRAM EQUALIZATION
- THRESHOLDING AND BINARIZATION
- REMOVAL OF NOISE BY LABELING METHOD
- OPTIC DISC AND CUP EXTRACTION
- DISC AND CUP BOUNDARY SMOOTHING BY ELLIPSE FITTING
- CDR CALCULATION
- GLAUCOMA DIAGNOSIS

Figure 4: Simplified work flow of glaucoma diagnosis through image processing method.

In this research paper the CDR of 10 there are 10 healthy retinal fundus images and 10 affected images are compared for the output.

3 Retina Fundus Images.
3.1 Retina fundus images are collected from the standard Database from the website https://www5.cs.fau.de/research/data/fundus-images. This standard database contains of both normal and Glaucoma affected Retina Fundus Images.

3.2 Region of Interest.
Here the ROI is the central part of the Retina fundus image i.e. Optic Disk and Optic Cup.
To obtain this first of all from the original image is resized to 256*256 and then convert it to the gray scale image. After that the Green plane is extracted.

3.3 Optic-Cup Segmentation

Fig.5 a) original Image B) Gray Scale Image C) Contrast Stretched image D) Histogram

The optic Cup segmentation is obtained by the using Decomposition method.
Step 1. The Gray scale image is decomposed by using Mother wavelet Decomposition (db6). This reduces the size of the Image to half of the original size and give us Four Component Viz. 1) Approximation (2) Horizontal (3) Vertical and (4) Diagonal Component. Step 2. Further It is Decomposed and it reduces the size and again give us four component i.e (1) Approximation (2) Horizontal (3) Vertical and (4) Diagonal Component.
Step 3. Find the Histogram of Wavelet Components. Here in fig 6 there are four approximation components are shown.

Fig 6. Histogram of wavelet component
Step 4. Now the inverse two dimensional wavelet compressions are done to reconstruct the original Image. In this process the size becomes double the composed image. There may be some losses in this process. This process is repeated as much no of times as the decomposition is done.

3.4 Thresholding
We will get six thresholds by wavelet and hence we will calculate the global threshold by taking the average of six thresholds. The adaptive thresholding is obtained by wavelet on horizontal, vertical and diagonal components.

3.5 Optic Disc Segmentation
To calculate the vertical cup to disc ratio, the optic cup and disc first have to be segmented from the retinal images. The optic disc extraction is straight forward and various approaches have been previously proposed for segmentation of the disc. In this paper, the disc boundary is detected using optimal color channel as determined by the color histogram analysis and edge analysis.

Optic Disc Smoothing
The disc boundary detected from the above step may not represent the actual shape of the disc since the boundary can be affected by a large number of blood vessels entering the disc. Therefore, ellipse fitting is performed to reshape the obtained disc boundary.

3.6 Optic Cup Segmentation
Compared to the extraction of the optic disc, cup segmentation provides an even greater challenge, as the cup disc boundary is usually less pronounced than that of the disk region and is further compounded the increased visibility of blood vessels across the cup-disc boundary. To extract the cup from the optic disc, more robust image processing techniques are normally used to segment the cup.

3.7 Optic Disc Smoothing
After the cup boundary detection, ellipse fitting is again employed to eliminate some of the cup boundary’s sudden changes in curvature. Ellipse fitting becomes especially useful when portions of the blood vessels in the neuro retinal rim outside the cup are included within the detected boundary. The CDR is consequentially obtained based on the height of detected cup and disc.

3.8 Ellipse Optimization for optic disc and cup
Ellipse fitting algorithm can be used to smooth the disc and cup boundary. Ellipse fitting is usually based on least square fitting algorithm which assumes that the best fit curve a given type is the curve that has the minimal sum of the deviations squared from a given data points (least square error). Direct Least Square Fitting Algorithm is chosen to fit the optic and cup over other popular ellipse fitting algorithms like Bookstein Algorithm and Taubin Algorithm.

4. Image Analysis
To evaluate the performance of proposed approach, the neuro-retinal images are obtained from standard database. The Cup to Disc ratio for each neuro-retinal image was provided by the ophthalmologist using stereographic viewers and images were set as ground truth against which the performance of our proposed method was evaluated. The performance of a CDR based glaucoma diagnosis system is largely dependent on how accurate a CDR is measured. The CDR of 10 healthy retina fundus images are compared with 10 glaucoma affected retina fundus images in this experiment. It is found that CDR of normal retina fundus images are smaller than the affected images. The risk of glaucoma is assessed based on CDR value. The CDr value Greater than 0.1411 indicates glaucoma. From the comparison table shown in (Figure ), it is observed that, our new algorithm increases the chances of correct diagnosis. For segmentation of the disc. In this paper, the disc boundary is detected using optimal color channel and two dimensional wavelet(Motherwavelet) db6 decomposition as determined by the r histogram analysis and edge analysis.

Comparison Table

<table>
<thead>
<tr>
<th>Sr. No</th>
<th>CDR Normal Retina</th>
<th>CDR Affected Retina</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>0.11607</td>
<td>0.19176</td>
</tr>
<tr>
<td>2</td>
<td>0.098446</td>
<td>0.20107</td>
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<td>3</td>
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<td>4</td>
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<td>8</td>
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<tr>
<td>10</td>
<td>0.11921</td>
<td>0.20698</td>
</tr>
</tbody>
</table>

Fig. 7 Comparison Table
Conclusion
This paper presented and evaluated for a more accurate estimation of neuro-retinal optic cup to disk ratio. In this paper 10 normal and 10 affected retina fundus images are compared for the cup to disk Ratio. It is found that the CDR Value greater than 0.1411 indicate Glaucoma. For this we used the method of two diamentional wavelet decomposition and inverse decomposition, histogram, thresholding .Including labeling method, and ellipse fitting methods. Comparing with the clinical values, the new approach achieves a better CDR value, which results to more accurate Glaucoma Diagnosis. The good performance of the new approach leads to a large scale clinical evaluation and will be able to report large clinical findings in the future.

REFERENCES