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Statistical And Computational Analysis of Eye Images For Understanding of Glaucoma

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ABSTRACT
There are so many eye diseases which causes the vision problem. Glaucoma is one of the eye diseases which destroy the optic nerve which causes the loss of vision. This can be preventing by early detection and treat. The manual procedure of the Glaucoma detection is time consuming and possible of the errors. In the proposed approach, the ratio of the cup to disk is used to decide the glaucomatous images. The proposed approach achieves good results.
Keywords :- Cup to disk ratio (CDR), Glaucoma, Multi-thresholding

I. INTRODUCTION

Eye consists of optic nerve which is one of the major parts of an eye. The glaucoma is one of them which affects on the optic nerve which is comparatively sensitive part of an eye. The main purpose of this optic nerve is that it provides the images to our brain. There are 1 million of nerve fibers in the optic nerve which connects retina to brain, so that damage to the optic nerve create blind spot and finally leads to blindness as well as brain damage. There are so many techniques to treat the glaucoma disease. Glaucoma is second largest cause of blindness in the world, which also leads to vision loss. Detection of glaucoma disease in early stage is essential. For detection of glaucoma disease in the early stage the screening examination techniques are used which uses fundus images to minimize the vision loss.

In normal condition, the aqueous humor maintains the pressure on the wall of eye. An equal quantity of this liquid flows out of the eye through microscopic drain called a trabecular meshwork in the drainage angle.

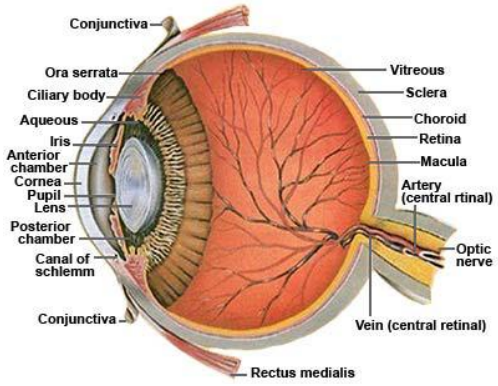

Fig. 1 Human Eye

In glaucoma patient the abnormality found in the drain. In which the liquid does not flow properly through pores. Due to this fluid pressure inside the eye increases which generates large amount of force in optic nerve so that optic nerve portion of an eye gets damaged

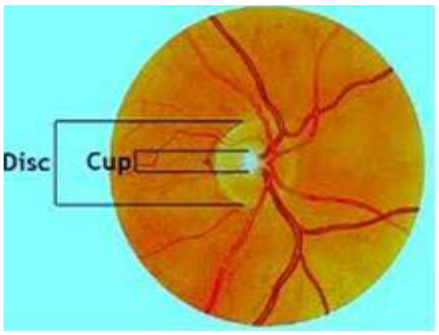

Fig. 1. Cup and disk of fundus image

The centered pale which is free from neuro-retinal tissue is called as cup. CDR is a cup to disc ratio which is used while detection of glaucoma disease. For normal eye the ratio is found to be 0.3 to 0.5 if this value exceeds than 0.5 then problem of glaucoma is observed there is no specific technique which completely removes the effect of glaucoma but it can be treated.

The paper is organized as follow: Section II explains the different techniques to detect glaucoma disease. The proposed system is explained in section III. Results are explained in section IV and finally paper is concluded in Conclusion section.

II. LITERATURE SURVEY

Mohammad Aloudat et al. [1] present the approach to detect glaucoma disease. The red area percentage is calculated. They create a database by collecting images from Princess Basma Hospital. The database contains hundred facial images divided into 50% healthy and 50% unhealthy image. From the experimentation it is observed that the Red area percentage for Normal, High eye pressure and Glaucoma is found to be 0.24, 0.89 and 0.97 respectively. Future works will be an effort to investigate our techniques further to support more accurate results in monitoring and detecting Glaucoma by using a neural network system.

Gayathri Devi T. M. et. al. [2] presented DWT based glaucoma disease detection system. They uses different filters such as symlets, daubechies and bi-orthogonal. The energy signature obtained from DWT is used to classification of normal and abnormal images. The performance evaluation is carried on 75 normal and 75 glaucomatous images. The obtained values for features sym3, db3, bio3.3, bio3.5, and bio3.7 for each classifier were recorded and used for classification as shown in table.1. That is used for training the system that is the classifiers like SMO, random forest, naïve bayes, SVM and ANN. The Index value for the SVM, SMO, naïve bayes, random forest, and probabilistic neural network classifier set as 0.59, 0.47, 0.39, 0.52, as determined.

Lekshmi Shyam [3] used high pass filtering for vessel segmentation. The accuracy of the proposed segmentation method is about 0.931 with a sensitivity and specificity of 0.742 and 0.943 respectively. Whereas the method in [9] that utilizes the threshold probing has an accuracy of 0.927.

Manish. M. Kawde [4] proposed system is using CDR and Blood vessel calculation with the help of SLIC super pixel classification and Hue transform for the non-evasive contribution to the study and research for Glaucoma Disease is proposed. The process consist of incorporate image acquisition, image grouping, and image separation, highlight removal, image enhancement, morphology, design coordinating, image order, examination and factual estimation. Toward the finalization of the exploration work, we will acquire the optimum precision of 97% for the location of Glaucoma Disease. By watching the components of the fundus Image by the strategies for CDR and Blood vessel furthermore relying on the yield of the classifier, we will be able to distinguish Glaucoma. Subsequently, early detection of this sickness will assist us to take deterrent evaluation and estimation to predominate the infection in its initial course.

Madiha Naveed [5] The proposed system is using Layer segmentation Method, Discrete wavelet transform, Otsu method for ILM, RPE - Layers, Morphological techniques etc. Different methods are proposed and discussed in the literature for reliable glaucoma screening. The mostly used state of art techniques used for glaucoma diagnosis in OCT images. CDR is the mainly used feature to detect diseased subject to be treated. The increment in CDR is the main factor to classify glaucoma patients. Increase in cup region also increases the cup depth. This causes the retina to be affected and also decrease the retinal thickness.

III. PROPOSED SYSTEM

Block diagram of the proposed system is shown in Fig 3.

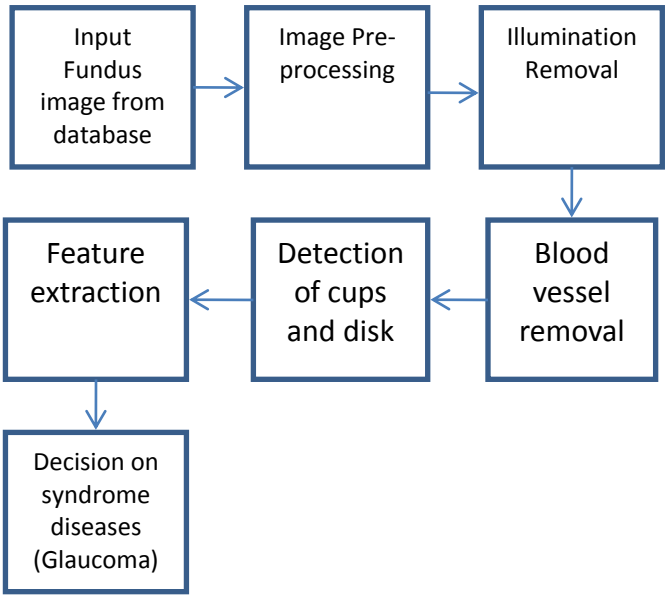

Fig. 2. Block diagram of proposed system

In the proposed work, disk and cup are found out using different thresholds. Each step to detect the glaucoma is explain in detail below

A. Input Images

The images to detect the glaucoma and normal images are taken from the High-Resolution Fundus (HRF) Image Database [6]. It contains normal (15) as well as abnormal (15) images in RGB format.

B. Pre-processing

In this step, the color fundus images are converting into grayscale to minimize the computation. The grayscale image contains salt and pepper noise which is removed by applying median filter of size 3X3 on grayscale image.

C. Multi-thresholding

The intensity of disk part and cup part is different. The cup part is brighter than the disk hence the threshold value for disk is less than that of cup. In this work, threshold value for disk is decided as 110 and for disk it is consider as 130.

D. Morphological Operation

Morphological operators are used to fill or erode the shape of the binary object. The morphological operations such as

erosion and dilation are applied over the binary image to get the proper shape.

E. Cup to Disk Ratio

Once the cup and disk is obtained, the ratio of cup area to disk area is calculated. From the observation it is found that the ratio of cup to disk area for glaucomatous images found to be greater than 0.5 while it is less than 0.5 for healthy images. The formula for cup to disk ratio (CDR) in given by

$$CDR = \frac{Area\ of\ cup}{Area\ of\ Disk} \quad (1)$$

The computed CDR is used for glaucoma screening. When CDR is greater than a threshold, it is declared as a glaucomatous, else normal eye.

IV. RESULTS

The result of the proposed approach is shown as below.

a. Healthy Image

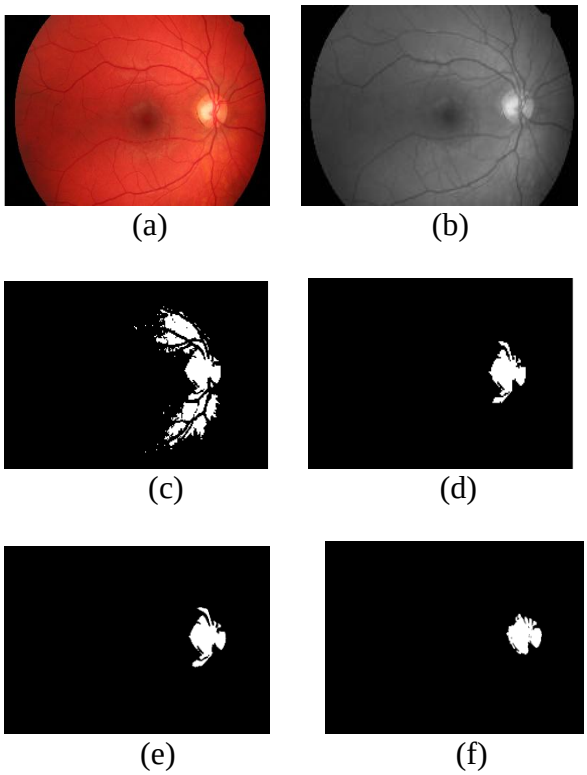

Fig. 3. Output of the output Healthy images: (a) Input Image (b) Median Filter output (c) Binary output (d) biggest object (e) cup detection (f) Disk detection

b. Glaucomatous Image

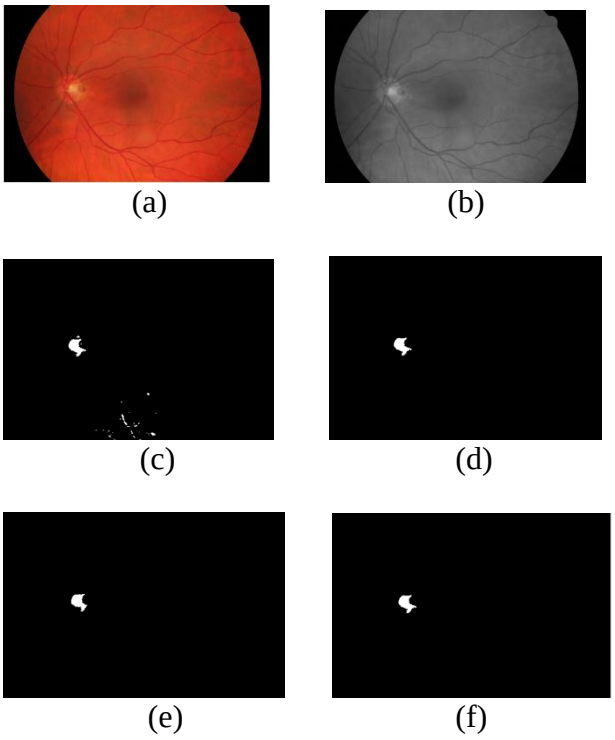

Fig. 4. Output of the output glaucoma images: (a) Input Image (b) Median Filter output (c) Binary output (d) biggest object (e) cup detection (f) Disk detection

For Disc:

Images	Mean	Standard deviation	Variance
1 (Healthy)	0.0664	0.1269	0.0489
2 (Healthy)	0.0547	0.1084	0.0427
3 (Healthy)	0.0159	0.0415	0.0137
4(Healthy)	0.0399	0.0801	0.0306
5 (Glaucoma)	0.0029	0.0121	0.0028
6 (Glaucoma)	0.0075	0.0222	0.0067
7 (Glaucoma)	0.0075	0.0214	0.0066
8 (Glaucoma)	0.1414	0.1650	0.0727

For Cup:

1

Images	Mean	Standard deviation	Variance
1 (Healthy)	0.0937	0.1568	0.0631
2 (Healthy)	0.0961	0.1526	0.0657
3 (Healthy)	0.0189	0.0449	0.0157
4(Healthy)	0.0399	0.0801	0.0306
5 (Glaucoma)	0.0031	0.0131	0.0029
6 (Glaucoma)	0.0086	0.0264	0.0077
7 (Glaucoma)	0.0084	0.0239	0.0074
8 (Glaucoma)	0.2106	0.1901	0.0819

V. CONCLUSION

In this approach, multi-thresholding based approach for glaucoma disease detection has been proposed. CDR is used to classify the normal and glaucoma images from the fundus

image. The proposed approach gives promising accuracy on the High-Resolution Fundus (HRF) Image Database.

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