ADVANCED TECHNIQUE TO DETECT GLAUCOMA USING IMAGE PROCESSING

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ABSTRACT

Retina is one of the important parts of eye that helps us to see the things around. When it is affected with diseases, there may be many problems including vision threatening. The most common problem found in recent years is Glaucoma. It is caused due to an increase in intraocular pressure within eye, resulting in the damage of optic nerve. Due to increase in intraocular pressure, the disc cup size begins to increase which consequently increases the Cup to Disc Ratio and affects the Neuroretinal Rim which slowly leads to vision loss if not diagnosed earlier and treated. Glaucoma usually causes no symptoms and warnings; it can only be diagnosed by regular eye examination. There are many existing methods used in automatic detection glaucoma such as Simple Linear Iterative Clustering, Hough transform, Super pixel Classification, K-means Clustering, Multithresholding Segmentation, to detect the optic cup, optic disc and Cup to Disc Ratio (CDR). The methods used in the existing systems to find CDR is complex due to unclear color texture between the optic cup and optic disc or the cup boundary at the nasal side of the cup is often difficult to determine due to the presences of blood vessels. This is resolved in the current work and it focuses on automatic detection of glaucoma by segmenting optic disc and optic cup using pixel intensity and morphological operations.

Keywords: Cup to Disk Ratio (CDR), fundusimage, Inferior Superior Nasal and Temporal (ISNT),Classification

INTRODUCTION

The modern living of the mankind is leading to different kinds of diseases to the retina and which is leading to vision loss. Glaucoma, age-related macular degeneration and diabetic retinopathy are some of the diseases which occurs in human beings.

An increase in intraocular pressure within eye causes is a particular optic nerve disease which is known as Glaucoma. It does not show any symptoms or warnings. Regular eye examination is the only way to be diagnosed. It causes decrease of vision at initial and at later stage which is why it is the third largest disease in India. Blindness is caused due to the permanent damage of the optic nerve head which carry information from the retina to the brain.

Glaucoma is a specific optic nerve disease caused by an increase in intraocular pressure within eye. Optic nerve carry the image information to brain. “Aqueous” is a liquid flowing inside the eye continuously. 14 to 20 mmHg is the pressure range for the normal eye. If the range is between 20 to 24mmHg symptoms of glaucoma is shown. If the pressure range is greater than 24 mmHg, then it is declared as glaucoma. In normal eyes, there is balance between the fluids, one of which is produced in the eye and the another one leaves through eye’s drainage system. Inter Ocular Pressure (IOP) is constant due to the balance in the fluids in the eye. But when the balance of fluids is not maintained then, there is an increase in IOP and the optic nerve is damaged which then causes Glaucoma Disease. Figure 1.1 shows comparison of normal eye and eye with glaucoma.

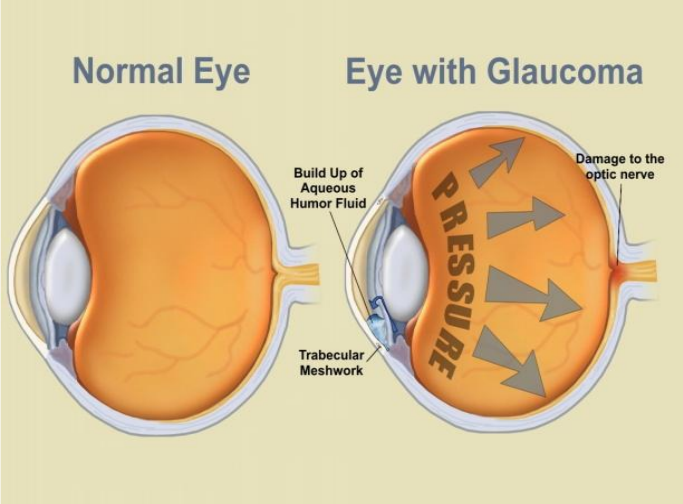

Figure 1.1 Comparison of Normal eye and eye with Glaucoma

The disc cup size starts to increase with increase in IOP, which as a result increases the Cup to Disc Ratio. The Optic Disc Structure is shown in Figure 1.2. Optic disc (OD) is a part of optic nerve that is visible in retinal fundus image. It is also known as Optic Nerve Head (ONH). OD radiates out the optic nerve fibers and Blood vessels. The neuro retinal rim includes nerve fibers. The pale center is liberated from the nerve fibers.

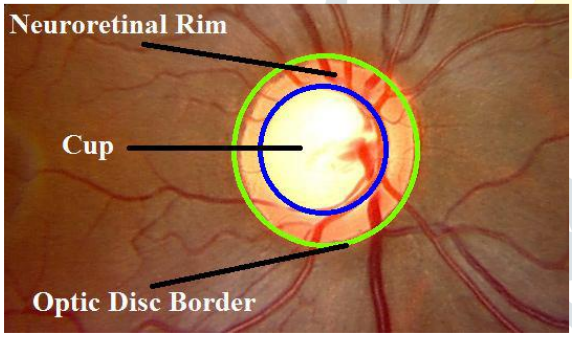

Figure 1.2 Optic Disc Structure

MATERIALS AND METHOD

The main objective of this project requires to achieve the following task:

- In this project the main objective is to detect the glaucoma and analyze it, using fundus images. The technique uses image processing.
- Using pixel intensity and mathematical morphological operation for identifying and extraction of disc and cup region.
- Determine disc and cup diameter and ratio of cup to disc to classify between normal and glaucomatous image.

The ratio of the size of the cup to the size of the disc is called as Cup-to-Disc Ratio(CDR). It gives the amount of the disc occupied by cup. If the CDR is less than 0.3 then it is said to be normal optic but if it is greater than 0.3 then it is the case of glaucoma. theNeuroretinal Rim (NRR) gets affected if the cup size increases.

In India, total blindness due to Glaucoma is 12.8%. About 90% of Glaucoma cases go untreated. 12 million people are affected by glaucoma in India. It is estimated that it will be 16 million by 2020. According to the statistics one out of eight persons whose age is 40 years or more is affected by glaucoma or they are in danger of disease. Until today there is no treatment for Glaucoma. Glaucoma has slow affecting condition, if it is detected at earlier stage then it can be cured completely. The key for preventing blindness is early detection.

There are different types of glaucoma that can occur and progress without obvious symptoms or sign.

1. Primary open angle glaucoma
2. Angle closure glaucoma

- The intellectual aim of this project is for developing the analysis and performance of Glaucoma.

Proposed methodology

- Extraction of disc and cup region.
- Determine disc and cup diameter and ratio of cup to disc to classify between normal and glaucomatous image.
- The intellectual aim of this project is for developing the analysis and performance of Glaucoma.

The proposed method uses the following procedure to find optic disc and optic cup and compute cup to disc ratio for detecting glaucoma. Firstly, the retinal images are

acquired. Here DRIVE database is used. The acquired images are preprocessed. In this preprocessing stage the image is normalized to increase the contrast and brightness. Later the segmentation is performed. Here segmentation of images is done based on the pixel intensity. Segmentation is performed to locate optic disc and optic cup and find diameter of cup and disc. Later cup to disc ratio is computed. Based on this cup to disc ratio, the images are identified as either Normal or glaucomatic.

The proposed system for the automatic detection of glaucoma is composed of five different stages: Preprocessing, Region of Interest (ROI) Extraction, Feature Extraction, Calculation of CDR and Classification.

INPUT RETINAL FUNDUS IMAGE: Retina Fundus Images (CFI) taking from the medical image camera provide data can be effectively form of a fundus image that can be used for the automated identification of glaucoma.

IMAGE PRE-PROCESSING: In the preprocessing stage, the input retinal image is preprocessed to correct clarification and achieve intensity homogeneity and also remove noise from the image for further processing.

REGION OF INTEREST (ROI) EXTRACTION: Cup and disc of optic is the portion of retina, whose analysis helps to detect glaucoma. So, the fairly accurate region around the brightest part has to be selected as ROI. After the analysis entire image can be taken and resized to image of 400X 600 pixels around the brightest region along with a small part of other regions is considered as ROI.

FEATURE EXTRACTION: Features such as disc and cup in optic are extracted. Figure 3.2.2 shows optic disc and optic cup in retinal image. Diameter of cup and disc of optic for calculating ratio Cup to disc are extracted from the segmented disc and cup in optic.

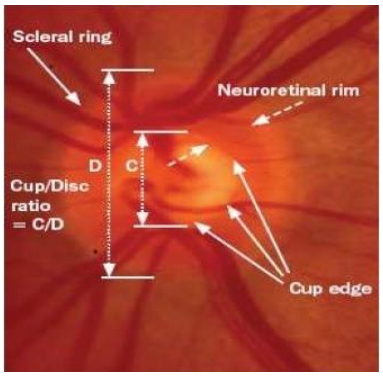

Figure 3.2.2 Disc And Cup In Fundus Image

RATIO OF CUP TO DISC(RCD):The Ratio of Cup to Disc is measured using the formula:

RCD=Cup Diameter/Disc Diameter

CLASSIFICATION: In this stage, classification into normal image or glaucomatous image is done using the Ratio of Cup to Disc.

EXPERIMENTAL RESULTS

Following table and image shows the values of the cup size, disc size, cup to disc ratio for different images. In Run 1, the input image is a normal image. This image is passed through preprocessing to improve the image. The improved image is then segmented based on pixel intensity value to detect disc and cup of the eye. The output can shows the diameter of disc and cup of optic using lines. A red line represents diameter of optic disc and green line represents diameter of optic cup. The image of optic disc diameter is 14 and that of cup is 61. Based on the cup to disc ratio that is 0.2295, this image is a normal image.

Similarly in Run 2, glaucomatous image is considered. Same steps are carried out as mentioned in Run 1. The output displayed shows that the image is glaucomatous as it has the cup to disc ratio as 0.9277.

CONCLUSION

This synopsis presents a study of detection of glaucoma. Cup to disc ratio is an important indicator to check the presence of glaucoma in an individual. Automated analysis of optic disc can be a valuable diagnostic resource for clinicians. The computed cup to disc ratio

value show good compatibility and nearness when compared with results from HRT and ophthalmologists. If the proposed approach is combined with existing ophthalmologist's technique, it can prove to be a breakthrough in field of ophthalmology.

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