

Identification of glaucoma disease using optic disk and cup segmentation from retinal images

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Abstract: Glaucoma is one of the major causes of blindness and it is most commonly found in diabetic patients. Many people suffer from eye diseases throughout the world. Glaucoma leads to cause of permanent blindness worldwide. The method proposed for the detection of glaucoma includes optic disc segmentation and cup segmentation techniques considered relevant by glaucoma experts. The aim of this paper is to find the cup to disc diameter ratio of glaucoma patient and check the level of glaucoma. If the cup to disc ratio is more than 0.3 it indicates high glaucoma for the tested patient .

Keywords: Glaucoma, optic disk, optic cup, OD segmentation, cup segmentation, cup-to-disk diameter ratio.

I. INTRODUCTION

Glaucoma is a prolonged eye disease in which the optic nerve is highly advancing to destruction. It is known as the silent thief of sight because the symptoms of glaucoma occur when it is in advanced stage. Therefore, detecting glaucoma in time is difficult. They patients having glaucoma are unaware of the disease until it has reached its advanced stage.. Since glaucoma increases with few signs or symptoms and the vision loss from glaucoma is irreversible, screening of people at high risk for the annually. However, manual assessment is subjective and time disease is important. Various methods to detect glaucoma m required is more and costly. Therefore, automatic optic nerve head assessment would be very helpful. Diabetic retinopathy, hypertension, glaucoma, and retinal degeneration are some of today's most common cause of blindness. The optic disc is the region where ganglion cell axons exit the eye to from the optic nerves.

The optic disc (OD) segmentation is a crucial process in many algorithms designed for the automatic extraction of anatomical ocular structures for finding of retinal lesions, and the identification of other fundus features [1]. Initially, the OD location helps to avoid fake positives in the detection of exudates associated with diabetic retinopathy, since both are spots with similar intensity. Secondly, the OD margin can be used for forming standard and common centered areas in which retinal vessel diameter measurements are done. Thirdly, the relation between the size of the OD and the cup (cup-disc-ratio) has been generally used for glaucoma diagnosis. The normal cup to disc ratio is 0.3 if the ratio is more than 0.3 then the patient is a glaucoma patient otherwise a normal patient.

The method proposed in this paper is mainly based on OD segmentation and cup segmentation .The aim is to extract the relevant structures of an image and to expand the light or dark regions, implying the size and shape of the structuring elements. Optic disk and cup boundary is analyzed and their diameters are calculated. Cup to disk diameter ratio is obtained.

This obtained value is compared with the normal value of cup to disk diameter ratio. If the obtained value is greater than the normal value then it can be concluded that the patient who is tested is having glaucoma.

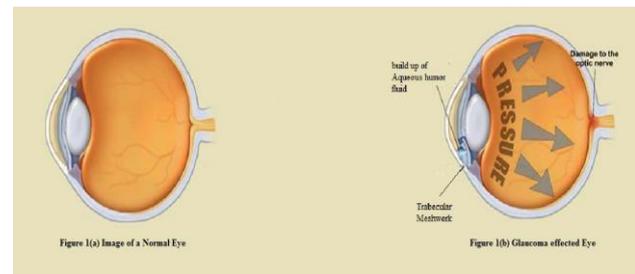


Fig. 1. Formation of glaucoma

II. EXISTING SYSTEM

Diagnosing glaucoma is not too easy, and careful assessment of the. optic nerve continues to be essential to diagnosis and treatment. The most important concern is to keep your sight safe. Doctors look at many factors before making decisions about your treatment. If your condition is difficult to diagnose or treat, you may be referred to a glaucoma specialist. A second opinion is always beneficial if you or your doctor become concerned about your diagnosis .

Five famous tests to detect glaucoma:

A. *Tonometry*: It measures the inner pressure of the eye.

The range of normal pressure is 12-22 mm Hg.

B. *Ophthalmoscopy*: It examines the shape and color of the eye.

C. *Perimetry*: It is a visual field test that produces a map of your complete field of vision.

D. *Gonioscopy*: It measures the angle of the eye where the iris meets the cornea.

E. *Pachymetry*: It measures the thickness of the cornea.

III. PROPOSED SYSTEM

The proposed system mainly focuses on OD segmentation and cup segmentation. These are described as follows:

A. OD segmentation:

It is basic task for glaucoma detection as well as for diabetic retinopathy diagnosis. The performance of these method is highly dependent on differentiation of edges and peripapillary atrophy ,i.e., PPA [3]. PPA is most confusing part of disc because it looks similar to the disc and its crescent shape makes it forms another stronger ellipse like structure along with the disk hence a super pixel based classification method is used which uses various features such as intensity, texture, etc from each pixel and its nearest region to find the disk.

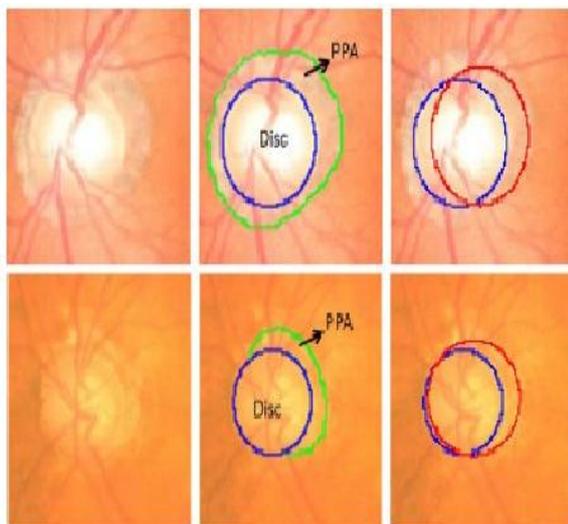


Fig. 2. OD Segmentation.

B. Cup Segmentation

The major difficulty in cup segmentation is to determine the cup boundary. In such cases we lack certain factors such as intensity changes and edges to estimate the cup boundary. It is also sometimes difficult to analyze the vessel bends that mark up the cup boundary.

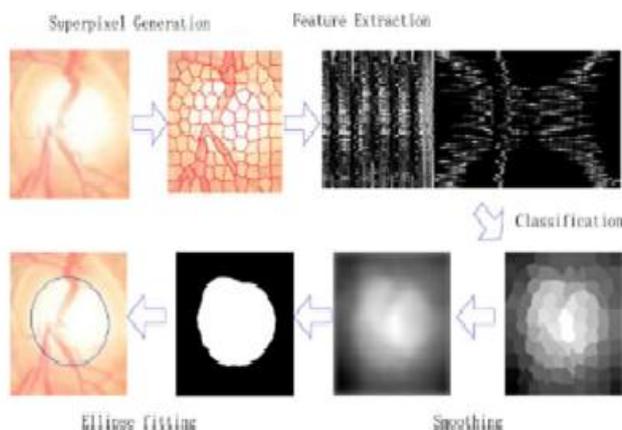


Fig. 3. Cup Segmentation

Hence we randomly obtain the equal no. of super pixels from the cup and non-cup regions from a of images and a mean filter is applied to compute the smoothed decision

values. The biggest connected object is acquired and its boundary is used as the raw estimation and finally the best fitted ellipse is computed as the cup boundary [5].

IV. SUPERPIXEL GENERATION

This paper uses one fold pixel grouping algorithm to aggregate nearby pixels into super pixels in retinal images As compared to other super pixel methods, it is fast, memory efficient and has excellent support for boundary cause.

This algorithm can be used only with one parameter i.e. the no. of desired super pixels.

The details of the one fold pixel grouping algorithm is described below:

The One Fold Pixel Grouping Algorithm:

1. Sampling is applied on pixels of the image to indicate the cluster center at regular step s .
2. Cluster centers are reorganized in an $n \times n$ neighborhood, to the lowest inclined position.
3. For every cluster center C_k , the best matching pixels from a $2S \times 2S$ square neighborhood are allocated around it according to the weighted distance between the pixels.
4. New cluster centers and also error E (Distance between previous centers and recomputed centers) are calculated.
5. Step (3) and (4) are performed constantly until proper aggregation of pixels is obtained.

V. CDR (CUP-TO-DISK RATIO)

The vertical cup-to-disc ratio (CDR) is one of the most important factors in the diagnosis of glaucoma .It can be defined as the ratio of the vertical cup diameter over the vertical disc diameter. The optic disc is the region where the optic nerve connects to the retina. As more and more optic nerve fibers degenerate, the OC larger with regard to the OD, which is equivalent to an increased CDR value [1].For a normal subject, the CDR value is around 0.2 to 0.3. Typically, subjects with CDR value becomes greater than 0.6 or 0.7 are suspected of having glaucoma and further testing.

VI. FEATURE EXTRACTION

It is the process of identifying and extracting region of interest from the image. Many features such as color, appearance,gist ,location and gesture can be extracted from super pixel classification. It is important to consider features that differentiate between the PPA region and the disc region [3].

Since the texture from the PPA region is normally involved in a large region, the features from neighbouring super pixels are also taken into consideration in the classification of the current super pixel.

VII. BLOCK DIAGRAM

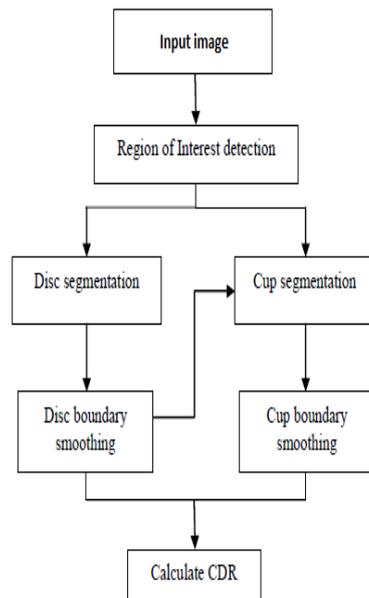


Fig. 4. Block diagram for glaucoma detection

VIII. NEED AND SIGNIFICANCE

The detection of glaucoma is significant since it allows timely treatment to prevent high level of visual field loss. The diagnosis of glaucoma can be done through measurement of CDR (cup to disc ratio).The cup to disc ratio is evaluated by this super pixel Classification technique .This helps in early detection of glaucoma disease without extra overhead of medical technologies and also it is less expensive than manual methods which are used for the detection of glaucoma disease.

IX. RESULTS

We took the retinal images and performed OD and cup segmentation to detect the optic disk and cup boundaries. We performed Superpixel generation for the images and extracted the important features such as minor and major lengths, color, size, shape and thickness of optic cup and disk. we obtained the diameters of optic cup and disk and calculated it's ratio ,i.e.,CDR(cup-to-disk ratio).We compared the calculated value with the normal range of CDR which is 0.3to 0.4. If the calculated value exceeds the normal range then the patient is detected with glaucoma disease. Hence we got the expected results.

X. CONCLUSION

This paper addresses the diagnosis of glaucoma disease by image analysis technique. In the existing system detection of glaucoma disease is not easy. A variety of tests are required to observe the symptoms of glaucoma. Symptoms of glaucoma can not be easily detected in early stages therefore accurate analysis of various parts of the eye such as optic disk and optic cup is required.The five major tests used to analyze various parts of the eye are tonometry, perimetry, ophthalmoscopy,gonioscopy, pachymetry.With the help of this project early detection of glaucoma disease is possible.

This paper allows derivation of various geometric parameters of optic disk. It focuses on the estimation of optic cup to disk diameter ratio (CDR) which varies considerably within normal. The CDR is calculated and if it exceeds the normal range that means it indicates glaucoma disease.Overall, the obtained result of this method establishes the potential for an effective solution for glaucoma screening.

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