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Segmentation of Retinal Images for Glaucoma Detection

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***Abstract:*—Automatic analysis of retinal images by the segmentation is evolving as an effective method for prior detection of eye diseases .Glaucoma is a very common and irreversible eye disease .Glaucoma can be prevented in its early stages. Its detection and treatment is important in its early stages to prevent permanent vision loss. Manual examination of retinal image is a conventional procedure used by ophthalmologist for glaucoma detection .For mass screening this manual method is not easy and sufficient. In this paper we propose a automatic method for analysis of retinal image which make use of region based segmentation to the segment a optic disk (OD) and optic cup .Then ratio of optic disk to optic cup is calculated which is used for detection of glaucoma.**

Keywords— Active contour, cup, cup-to-disk ratio (CDR),glaucoma, neuroretinal rim, optic disk (OD), retinal images, segmentation, vessel bend.

I. INTRODUCTION

Glaucoma is a common eye disease which leads to permanent vision loss. Nearly 79 million peoples are going to affect up to coming year of 2020.Once affected by glaucoma cannot be cured .There is no remedy for glaucoma.

Hence early detection and treatment on time is very important. The glaucoma causes a slow vision loss. Symptoms of Glaucoma in its early stages are difficult to understand and identify.

Glaucoma is characterized by a continuous damage of optic nerve fiber over a period of time. Optic nerve fiber carries information from photoreceptor to brain. Optic disk is a location where optic nerve fiber originates and carries information to brain. Optic disk (OD) can be separated in two different areas a central bright area called cup and an outer surrounded area called neuroretinal rim.

The enlargement of this central bright zone called cup is caused by the damage of this optic nerve fiber which lead to the structural changes in optic disk. Assessment of these structural changes manually is the procedure used to detect glaucoma. Our aim is to develop an automatic glaucoma detection system which is useful for large scale screening.

There are some prior attempts made in the direction of glaucoma assessment. Jun Cheng et al.propose a method for

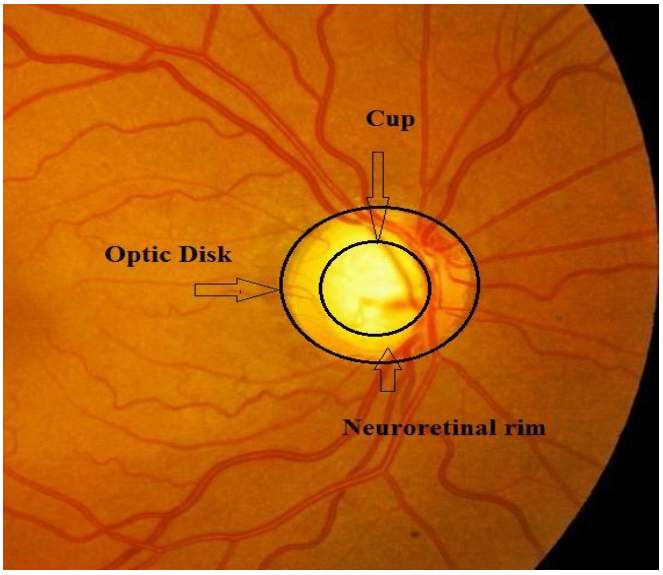

Fig. 1. OD and Cup in retinal image.

CDR evaluation by using 2-D retinal fundus images [1] .In this Method Optic Disk is segmented first then reconstructed using a Sparse Dissimilarity -Constrained Coding (SDC) .This will consider both the dissimilarity and sparsity constrain from a set of reference disk with a known CDR. J liu et al.proposed a variational level set method which uses a colour intensity and threshold level set [2]. Gopal Joshi et al.proposed a method which make use of anatomical evidences such as vessel bends and local image parameters [3]. Jun Cheng et al. devloped method based on super pixel classification by the use of histogram and centre surround statistics [4].

II.OD SEGMENTATION.

Optic disk segmentation from a retinal image is a fundamental task in most of the diagnosis method related to retinal image. Features of Optic disk are more useful for number of eye disorder identification including glaucoma. In the determination of CDR ratio first we have to segment

an optic disk and then cup .Here we propose a region based segmentation method for extraction of optic disk and cup.

Fig. 2. Retinal image with the defined ROI in the outlined rectangle.

The first step is to determine The Region of Interest, as the size of optic disk compared to retinal image is small .If we compute on a complete retinal image then the accuracy and
efficiency of method will reduce. Therefore ROI is selected by only considering optic disk at a centre as shown in figure.
The contour initialization is the next step to initiate an active contour evaluation. We initiate a contour based on an OD region in an image. Pixel intensity and simple edge operators can be used to generate local image features [4].

It has been observed that these localized contours perform segmentation with heterogeneous feature profile which is difficult to capture using a standard global method.

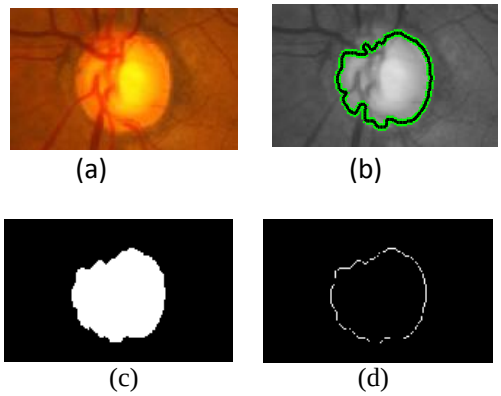

Fig.3.(a)colour retinal image.(b)detected disk boundary (c) and (d)Segmented optic disk.

Above figures shows a segmentation of the optic disk in which Fig (b) shows a results of an active contours with region based approach this image is then morphologically processed and output is shown in fig (c), the segmented optic disk is shown in figure (d).

III.CUP SEGMENTATION

Cup is a centre bright zone of optic disk .This brightness make change in colour in optic disk and we can identify cup boundary. Cup segmentation is not a simple task because of presence of blood vessel on large scale at the boundary point of an optic cup .Depth discontinuity base segmentation approach is useful for 3D images [6].

In the segmentation of optic cup from 2D retinal image the contour initialization is a important task .We are initializing the contour from the centre part of the optic disk by keeping the iteration minimum . In cases where the object which need to be segmented cannot be easily distinguished in a global image in this case the region-based active contours gives good results. The localization of a contour instated of global values gives a significant parameter. Degree or localization is used for better results. The localization of contours gives information about local energies separately which is very useful in a fine selection and further for local region segmentation [11].

It has been observed that this method has captured a central bright zone and estimated a cup boundary. This boundary is accurate and matches with cup boundary and the clues given by ophthalmologist.

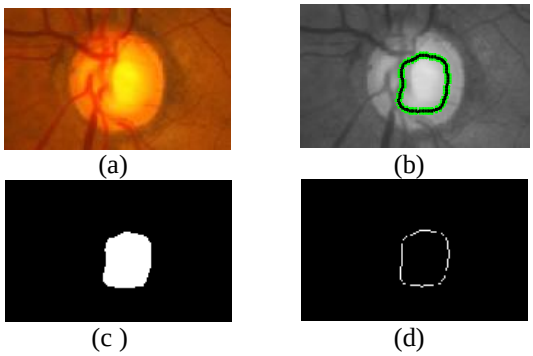

Fig.3. (a) colour retinal image. (b) cup boundary (c) and (d)Segmented optic cup.

Above figure shows a successful result of a segmentation of optic cup from retinal image.

IV.EXPERIMENTS AND RESULTS

A group of 50 retinal images is selected and a region of interest is determined by keeping optic disk at a centre .These images are processed by using above explained methods.

Optic disk and cup is segmented by a region based segmentation method. Cup –to –disk ratio of each image is then calculated. Further, based on studies undertaken by researchers it was found that the CDR greater than 0.65 indicates a risk of glaucoma [2].by using these values we have categorized the retinal images in two group on the basis of their calculated CDR values. A normal group having a CDR less than 0.65 and another High risk of glaucoma images having CDR greater than 0.65.

TABLE I: CLASSIFICATION OF RESULTS BY USING CDR

Total retinal images	Normal (CDR < 0.65)	High risk (CDR > 0.65)
50	39	11

V.CONCLUSION

In this paper we present a method to segment an optic disk and a cup boundary from retinal image. The cup to disk (CDR) ratio is important in the detection of glaucoma in an individual. A region based active contour model is used for segmentation of optic disk and optic cup. This model is implemented on 50 retinal test images and CDR is calculated out of that 78% are normal and 22 % are found to be high risk images. It has been found that the use of this region based segmentation produce a better estimation of CDR for both high risk and low risk retinal images. These promising results suggest use of region based active contour model in automatic detection of glaucoma in mass screening.

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