ISSN: 2278 – 909X
International Journal of Advanced Research in Electronics and Communication Engineering (IJARECE)
Volume 5, Issue 5, May 2016

AN EFFICIENT APPROACH OF OPTIC DISC NORMALIZATION AND SEGMENTATION FOR GLAUCOMA DETECTION

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ABSTRACT

Glaucoma is a chronic eye disease that leads to vision loss. As it cannot be cured, detecting the disease in time is important. Current tests using intraocular pressure (IOP) are not sensitive enough for population based glaucoma screening. Optic nerve head assessment in retinal fundus images is both more promising and superior. This paper proposes image processing technique for the early detection of glaucoma. Glaucoma is one of the major causes which cause blindness but it was hard to diagnose it in early stages. In this paper, we propose a method for cup to disc ratio (CDR) assessment using 2-D retinal fundus images. In the proposed method, the optic disc is first segmented and reconstructed using a novel sparse dissimilarity constrained coding (SDC) approach which considers both the dissimilarity constraint and the sparsity constraint from a set of reference discs with known CDRs. Subsequently, the reconstruction coefficients from the SDC are used to compute the CDR for the testing disc. The segmented optic disc and optic cup are then used to compute the cup to disc ratio for glaucoma screening. The Cup to Disc Ratio (CDR) of the color retinal fundus camera image is the primary identifier to confirm Glaucoma for a given patient.

***Index terms**: IOP, Cup to Disc Ratio, Sparse Dissimilarity Constraint*

INTRODUCTION

This paper focuses on computing the CDR from the disc. Motivated from the observation that similar discs often have very similar CDRs and the fact that many discs do not have obvious boundary between neuroretinal rim and the optic cup, we propose a sparse dissimilarity-constrained coding (SDC) to estimate the CDR for a new disc image. In comparison with the LLC method which uses the Gaussian distance, the pro- posed method computes the dissimilarities between the testing disc images and the reference disc images from their overall intensity changes and use them as the dissimilarity constraint in the SDC-based disc reconstruction. Several major factors that often affect the disc dissimilarity computation and the disc re- construction have been considered, including BVs, uneven illumination within each disc image, and the illumination changes between different images. In addition, a sparsity constraint is also included in SDC inspired from the observation that a few reference disc images closest to the testing disc image are usually sufficient to estimate its CDR.

Optic disc segmentation from retinal fundus image is a fundamental but important step in many applications such as automated glaucoma detection. Very often, one method might work well on many images but fail on some other images and it is difficult to have a single method or model to cover all scenarios. Therefore, it is important to combine results from several methods to minimize the risk of failure.

However, it has a bias of underestimating large cups and overestimating small cups due -to the dominance of medium sized cups used to train the model. Very often, these methods rely on the contrast between the cup and the neuro-retinal rim to find the cup boundary for CDR computation and can be challenging to use effectively when the contrast is weak.

EXISTING SYSTEM

Assessment of raised intraocular pressure (IOP) is the method previously used to detect glaucoma.In the previous work on “Classifying glaucoma with image-based features from fundus photographs”, the features are normally computed at the image-level and we use image features for a binary classification between glaucomatous and healthy subjects.

PROPOSED SYSTEM

This paper is for the automated CDR assessment from 2-D fundus images. This paper focuses on computing the CDR from the disc. In order to compute the CDR using the proposed SDC, it is important to locate and segment the disc. The disc localization focuses on finding an approximate location of the disc, very often the disc center. In this paper, we segment the disc using the self-assessed disc segmentation method, which is a combination of three approaches (Superpixels Segmentation, Edge Detection and Circular Hough Transform).The disc normalization process which includes background removal and the Disc Uneven Illumination Correction is also to be done. It has been shown that the self-assessed approach achieves more accurate disc segmentation than the individual methods. Motivated from the observation that similar discs often have very similar CDRs and the fact that many discs do not have obvious boundary between neuro-retinal rim and the optic cup, we propose a sparse dissimilarity-constrained coding (SDC) to estimate the CDR for a new disc image.

PROPOSED TECHNIQUE

- Contrast Limited Adaptive Histogram Equalization (CLAHE)
- Simple Linear Iterative Clustering (SLIC) Algorithm
- Canny Edge Detection
- Circular Hough Transform
- Sparse dissimilarity-constrained coding (SDC)
- Thresholding and Morphological operations

OPTIC DISK NORMALIZATION

All disc images from right eyes are flipped horizontally to avoid the difference between the left and right eyes. The mean intensity is also removed to avoid the difference due to different illuminations in different disc images. Besides that, we also conduct Blood Vessel (BV) removal and within disc uneven illumination correction.

OPTIC DISK SEGMENTATION

The optic disk is segmented by using Otsu

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thresholding algorithm. The thresholding level was computed. Based on the thresholding level, the grayscale retina image was converted to black and white image in which, the centre portion, i.e., the optic disk alone will be in white color and the background will be in black color.

OPTIC CUP SEGMENTATION

The cup is present inside the disk region. It was segmented by using morphological operations such as morphological opening, closing, dilation and erosion.Dilation-technique used to expand the pixel area in the image.Erosion-used to erode/reduce the pixel area

CUP TO DISK RATIO (CDR)

- Based on the Area occupied by the segmented disk and the cup, CDR is computed. The optic disk and optic cup segmented image is given as the input. The CDR ratio is obtained at the output.
- CDR=Area of cup/Area of Disc.

PROPOSED ADVANTAGES

The proposed method computes the dissimilarities between the testing disc images and the reference disc images from their overall intensity changes and uses them as the dissimilarity constraint in the SDC-based disc reconstruction. Several major factors that often affect the disc dissimilarity computation and the disc reconstruction have been considered, including BVs, uneven illumination within each disc image, and the illumination changes between different images. we segment the disc using the disc segmentation method in which first preprocessing such as image filtration, color contrast enhancement are performed which is followed by a combined approach for image segmentation and classification using texture, thresholding and morphological operation for segmenting the Optic Cup. Based on the segmented disc and cup, CDR is computed for glaucoma screening.

EXPERIMENTAL RESULTS

For the below given input retinal image the obtained result is as follows:

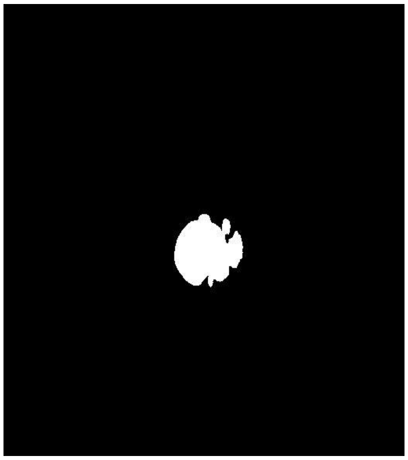
Area of Optic Disc:3470

Area Of Optic Cup:2390

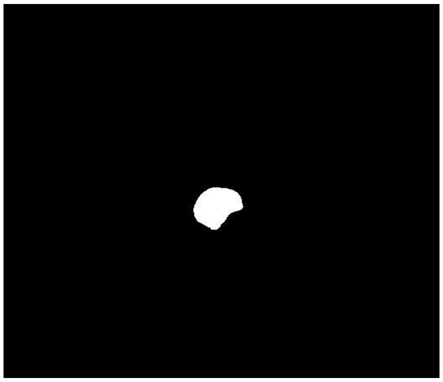
Cup to Disc Ratio:0.6888

According to the CDR value it has been diagnosed as severe Glaucoma.

Fig: Input Retinal Image



(a) Extracted Disc



(b) Extracted Cup

CONCLUSION

Glaucoma is one of the major causes which cause blindness but it was hard to diagnose it in early stages. The proposed method for cup to disc ratio (CDR) assessment using 2-D retinal fundus images approach is modular, we can expect further improvements by adding more preprocessing methods and normalization techniques. However, a proper screening system should contain other components, which is expected to increase the performance of this approach, as well.

ACKNOWLEDGEMENT: I wish to express gratitude to my guide Mrs.Tejaswini M.L. who has helped me in preparing this paper.

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