International Journal of Engineering Science Invention (IJESI)
ISSN (Online): 2319 – 6734, ISSN (Print): 2319 – 6726
www.ijesi.org ||Volume 8 Issue 02 Series. I || Feb 2019 || PP 70-73

Sparse Dissimilarity-constrained Coding for Glaucoma Screening

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Abstract *-Eye disease which harms the optic nerve that conveys data from the eye to the brain is Glaucoma. It is the second reason of visual deficiency, recognizing the disease in time is critical on the grounds that it can't be restored. Numerous methodologies are done in distinguishing Glaucoma; those are insufficient for population based glaucoma screening. Optic nerve head evaluation in retinal fundus image is both all the more encouraging and unrivaled. This paper proposes image preparing strategy for the early identification of glaucoma. Glaucoma is one of the significant causes which cause blindness yet it was difficult to analyze it in beginning times.*

Keyword : *cup to disc ratio, glaucoma screening, sparse dissimilarity-constrained coding.*

Date of Submission: 26-01-2019 Date of acceptance: 09-02-2019

I. Introduction

Glaucoma is an irreversible eye syndrome. According to reports in 2010, it is second primary reason of blindness in the world [1].Studies have been shown that increase in intraocular pressure (IOP) of the eye is one the cause for glaucoma [2]. To maintain healthy vision, eye produces a small amount fluid called aqueous humour the same amount fluid will be thrown out of eye [2]. This balance keeps the IOP in limit. If the balance is not maintained the IOP increase and damage the optic nerve head which make irreversible vision loss. So, the early precise detection and treatment of glaucoma will control the progression of the disease. Although glaucoma cannot be cured currently, it can be slowed down through treatment. This makes the screening of people at high risk of glaucoma for timely detection very meaningful Currently , the air-puff intraocular pressure (IOP) measurement, visual field test, and optic nerve head (ONH) assessment are often used in glaucoma assessment. However, the IOP measurement provides low accuracy in glaucoma detection and a visual field examination requires special equipment only present in specialized hospitals.ONH assessment is more promising for glaucoma screening. In recent years, automated algorithms for ONH assessment have received much attention digital image processing is the use of computer algorithms to perform image processing on digital images. The2D continuous image is divided into N rows and M columns. The image can also be a function other variables including depth, color, and time. An image given in the form of a transparency, slide, photograph or an X-ray is first digitized and stored as a matrix of binary digits in computer memory. This digitized image can then be processed and/or displayed on a high-resolution television monitor. Jun Cheng focuses on computing the cup to disc ratio (CDR) from the disc [1]. In order to compute the CDR using Sparse dissimilarity constrained coding(SDC), it is important to locate and segment the disc[1].The disc localization focuses on finding an approximate location of the disc, very often the disc centre. Jun Cheng develop segment the disc using the self-assessed disc segmentation method, which is acombination of three approaches (Super pixels Segmentation, Edge Detection and CircularHough Transform)[3].The discnormalization 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. The 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 blood vessels (BV), uneven illumination within each disc image, and the illumination changes between different images. 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 [3]. CDR is computed for glaucoma screening.

II. Literature Survey

In this section, we present some of the most suitabletechniques that are used for the detection ofglaucoma. There are manual and automatic detectionmethods available. The survey is conducted ondifferent glaucoma detection methods in imageprocessing.

1. Sparse Dissimilarity Constrained Coding for Glaucoma Screening

In this paper author presented CDR computation using the method of Sparse Dissimilarity-Constrained Coding (SDC) to locate and segment the disc from the image [1]. The location of disc is finding approximately and sometimes very often to the disc which is based on their anatomical structures and brightness among the macula, blood vessels of retina and those anatomical structures .In [3] paper, author proposed the self assessment disc segmentation method of state-of-the art is used [3]. It gives more accurate result of screening the glaucoma in retinal fundus image [4].

2. Superpixel classification based segmentation of optic disc and optic cup

The superpixel classification is a technique to classify the image based on their category as well as segment they don't have proper blood vessel (BV) bends in there retina thus it can unable to process with abnormal retina. Most of the glaucomatous optic disc (OD) Cup will have anomalous blood vessels.This paper mainly proposed the technique of segmentation which is used to segment the optic disc and optic cup in the given retinal image by using the superpixel classification technique [5], [6].

3) Segmentation of optic disc and cup from monocular color retinal images

Regarding survey this paper presents about the assessment of glaucoma from monocular color retinal images done by Optic Disk and Cup Segmentation [3].Contour model method which is used to segment the OD cup based on anatomical evidence like vessel bends at the boundary of cup [4].Cup to Disc Ratio (CDR), area of Neuro Retinal Rim (NRR) and different regions of BV.

Fig1. Normal retina with Vessel bends inside OD.

Fig. 2 Abnormal retina with no vessel bends inside OD

4) Segmenting the Optic Disc in Retinal images using Adaptive Thresholding

This survey paper presents automatic approach for segment the optic disc in retinal fundus image using adaptive thresholding technique and boundary extraction. Here the retinal images are converted into grayscale image and the image enhancement is done by histogram equalization [7].The segmentation is done by using adaptive thresholding technique and the optical disc is extracted by morphological operators. It gives more efficient segmentation process which is compared by others.

Fig.3 Results of segmented optical disc after the thresholding a) left column are input image, b) right column is threshold image.

5)Glaucoma detection using Deep Convolution Neural Network

Glaucoma is a chronic and irreversible eye disease, which leads to deterioration in vision and quality of life [1]. In this technique author developed a deep learning (DL) architecture with convolutional neural network for automated glaucoma diagnosis. Deep learning systems, such as convolutional neural networks (CNNs), can infer a hierarchical representation of images to discriminate between glaucoma and non glaucoma patterns for diagnostic decisions [7]. The proposed DL architecture contains six learned layers: four convolutional layers and two fully-connected layers. Dropout and data augmentation strategies are adopted to further boost the performance of glaucoma diagnosis. Extensive experiments are performed on the ORIGA and SCES datasets. The results show area under curve (AUC) of the receiver operating characteristic curve in glaucoma detection at 0.831 and 0.887 in the two databases [1] [9].

6)????

Firstly we have to consider retinal image of a patient as input image, this image is subjected to pre-processing in that retinal image is converted into gray scale image and for image enhancement will make use of CLAHE pre-processing algorithm [7], from the enhanced image optic disc is detected and optic disc normalization is done by calculating the blood vessel content and remove those vessels for better image quality. Next, will go for super pixel classification by using SLIC algorithm and edge detection by using canny edge detection algorithm and by keeping the standard threshold value as a reference one will apply circular Hough

transform technique to find out the status of the disease [10]. Next, by calculating cup to disc ratio and comparing it with the standard threshold value will decide the affected area and also result will be based on the CDR ratio and threshold value [1].

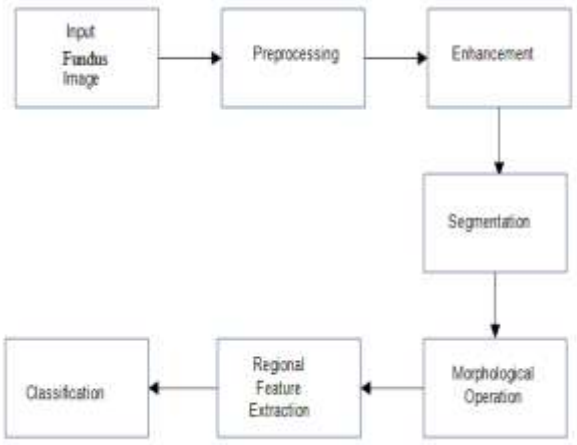

Fig 4 Glaucoma Identification System

1. Preprocessing:

Firstly consider retinal image of a patient as input image, this image is subjected to pre-processing in that retinal image is converted into gray scale image and for image enhancement will make use of CLAHE pre-processing algorithm [7] from the enhanced image optic disc detected and optic disc normalization is done by calculating the blood vessel content and remove those vessels for better image quality.

2. Enhancement:

Image enhancement is the process of adjusting digital images so that the results are more suitable for display or further image analysis. For example, you can remove noise, sharpen, or brighten an image, making it easier to identify key features[1].

3. Segmentation:

In segmentation use the simple linear iterative clustering algorithm (SLIC) to aggregate nearby pixels into super pixels in retinal fundus images.[3][6] Compared with other super pixel methods, SLIC is fast, memory efficient and has excellentboundary adherence. The number of desired super pixels is the main parameter why we used SLIC and it is simple also only because of this parameter. They adopted a new super pixel algorithm, simple linear iterative clustering (SLIC), which uses a k-means clustering approach for proper generation of super pixels. This algorithm is best when compared to other conventional methods [9]. Along that, it is faster and more memory efficient, improves segmentation performance, and is straight forward to extend to super pixel generation. SLIC is simple to use and understand.

Other segmentation method-

- Structural Segmentation Techniques -The structural techniques are those techniques of image segmentation that relies upon the information of the structure of required portion of the image i.e. the required region which is to be segmented
- Edge based segmentation method-The edge based segmentation method are based on rapid change of intensity value in an image because a single intensity value does not provide good information about image [10].

4. Morphological Operation:

Actual shape of the disc and cup will not represent the disc and cup boundaries which are detected from the segmentation methods, because the boundaries can be affected by a large number of blood vessels entering

the disc [1]. So the morphological operations are implemented to reshape the obtained disc and cup boundary. Then CDR is calculated by taking the ratio of the area of cup to area of disc [1]. For accurate measurement of optic disc and the cup areas, blood vessels are removed from the image. Morphological operation such as erosion, dilation, opening and closing are implemented on the image. The Morphological erosion operation erodes away the regions of foreground pixels and for dilation was to gradually enlarge the regions of the foreground pixel, therefore this techniques help to remove unwanted bright spots or boundaries present in the image. A disc shaped structuring element of size 15 was created and a closing and opening operation was performed on both the red and green component images. A value of 1 (white) was obtain for the region that contains the optic disc and cup, whereas a value of 0 (black) for the background.

5. Regional Feature Extraction and Classification

A mask is drawn over the cup and disc. The orientation of the blood vessels around the circle is identified. Blood vessel orientation analysis is done by the distribution of blood vessel into four quadrants of the image. If majority of the blood vessels belong to one or two quadrants then it is classified as advanced stage glaucoma image and if they spread in all the three or four quadrants then it is identified as early glaucoma or normal image. To strengthen the accuracy, the CDR is computed [1]. If the ratio is greater than 0.3, it is identified as glaucoma affected image, otherwise a normal eye image.

Other feature Extraction Technique-Glaucoma is a chronic and irreversible eye disease, which leads to deterioration in vision and quality of life. In this paper, we present a deep learning (DL) architecture with convolutional neural network for automated glaucoma diagnosis [9].Deep learning systems, such as convolutional neural networks (CNN) can infer a hierarchical representation of images to discriminate between glaucoma and non glaucoma patterns for diagnostic decisions.

III. Conclusion

Glaucoma is a silent disease that comes with no symptoms and warning. Here we presented with some segmentation and classification technique to segment the optic disc and classifies the image based on their feature selection of the image. We have presented literature survey of some techniques about the detection of glaucoma in 2D fundus retinal images with using several techniques.

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Aarti B.Shere" Sparse Dissimilarity-constrained Coding for Glaucoma Screening" International Journal Of Engineering Science Invention (Ijesi), Vol. 08, No. 02, 2019, Pp 70-73