JOURNAL FOR INNOVATIVE DEVELOPMENT IN PHARMACEUTICAL AND TECHNICAL SCIENCE

Volume-1,Issue-1 (Oct-2018)
ISSN (O) :- 2581-6934

OPTIC DISC SEGMENTATION USING SUPERPIXEL CLASSIFICATION

V.M.Sriram[1],A.Arivazhagan[2]
[1]Assistant Professor in ECE and [2]Assistant Professor in CSE,
M.A.M School of Engineering Engineering, Trichy

Abstract— In this project an automatic segmentation tool for the detection of optic disc is used to assist clinician to prevent visual loss due to DIABETIC retinopathy, hypertension, glaucoma, and macular degeneration. A Superpixel generation and Principle Component Analysis (PCA) based algorithm is proposed for Optic Disc (OD) segmentation. It makes use of different operations such as generalized distance function (GDF), a variant of the watershed transformation, the stochastic watershed, and geodesic transformations. The Optic Disc (OD) segmentation is done in three steps. In the first step, RGB fundus image is acquired from patient data base and the image is pre-processed by superpixel generation, to divide the image into superpixels and by PCA, where the gray level image is obtained. In second step, it employs the gray-image centroid and Stochastic Watershed transformation is used. In the third step, Circular Approximation is done in Post processing process and the Optic Disc-contour has been estimated.

1. INTRODUCTION

Glaucoma, Diabetic retinopathy, hypertension are the most common causes of blindness [1], [2], with about 80 million people in the world are likely to be afflicted with this causes [3]. Glaucoma cannot be completely cured but by treatment the progression can be slowed down. However population growth, physical inactivity, aging are the factors to increase glaucoma diseases. So, for automatic recognition of optic disc provide a great efficient. The key process of this algorithm is designed to extract infromation from retinal image. This paper presents on automation algorithm for optic disc segmentation using superpixel generation and PCA. is required. The algorithm automatically selects the optic disc by circular approximation using centroid calculation. First , the fundus image is preprocessed by superpixel generation is generated by SLIC algorithm [4] and principal component analysis (PCA), is to reduce interrelated variables present in the fundus image. Second, the OD segmentation process is done by stochastic watershed transformation. The Figure. 1 shows block diagram of optic disc segmentation using superpixel and principal component anlaysis. followed by centroid calculation. Finally, in post processing the circular approximation taken place to dectect the optic disc (OD). No clnicial intervention

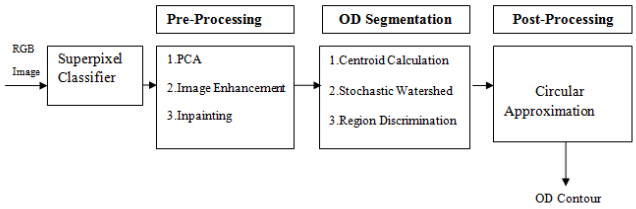

Figure. 1. Block diagram optic disc segmentation

II. METHOD

A. Preprocessing

1) Superpixal generation: Superpixel are local and coherent and it capture image redundancy and reduce the complexity of the processing. Superpixel gives relationship between pixels, so the process of image classification is more accurate and understandable . The superpixel is generated to get accurate detail results for OD segmentation. This paper uses the simple linear iterative clustering (SLIC) algorithm [4] to calculate nearby pixels into superpixels in the given retinal

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fundus image. Compared with other superpixel alforithm, the SLIC algorithm is very simple, fast and memory efficient. It uses only one parameter, the number of desired superpixels k. Figure 2 shows that superpixel image is generated from retinal fundus image.

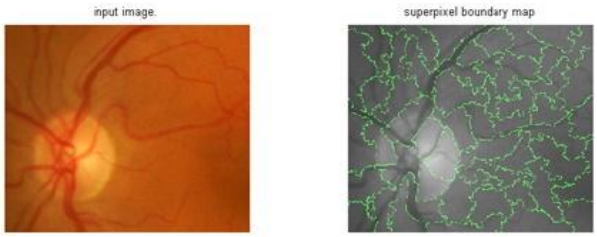

Fig 2. Superpixel pixel generation.

2) Principal Component Analysis: The PCA is the process of transforming input retinal fundus image into gray scale image. The PCA is used to reduce the dimensionality of the data consisting to reduce the variables are interrelated. This is done by transforming a new set of variables is called principal components. It transforms three components RGB in a single image to get more appropriate result for optic disc segmentation. The transformed three channel image, the first one has the more contrast and high details. So it is taken for further process. The other image has least amount of information and presence of noise and image artefacts [5]. And Figure 3 shows that PCA image is obtained from superpixel image. And image is enhanced to correct the non illumination of the grey scale image and it increase the contrast of the image.

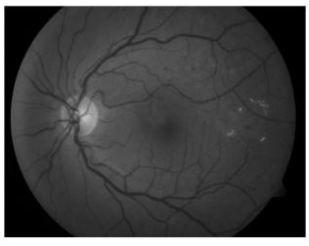

Fig 3. Principal components image from superpixel image.

3) Inpainting: For restoration and replacement of selected objects are the process is done in inpainting algorithms. For structure continuity this algorithm gives external information by propagation of selected parts of an image [6]. The grey scale image has the number of vessels are crossing between the optic disc which makes its difficult. So, the vessels are painted and removed to extract the OD boundary.

B. Optic disc segmentation

4) Centroid calculation: The centroid of grey level image can be calculated by generalized distance function (GDF). This algorithm is used to find the two pass sequential distance function [7] by calculating the edge cost. The GDF is computed by unit stability for each pixel. Then the image is scanned in raster and anti-raster order to find maximal value and threshold is calculated using maximum edge distance.

5) Stochastic Watershed Transformation: Stochastic watershed transformations [8] is a grey-scale image segmentation technique used for on image segmentation. The gradient image is obtained by the difference between unitary dilation and unitary erosion. If gradient image is considered as input image there is a problem of over segmentation so to overcome this problem marker-controlled watershed transformation is used. The random makers N is used to estimate the probability density function [9]. The centroid of the image is chosen by external marker. The circle for OD contour is related to the fundus image, so its approximated by a 18% of the size of input image. The grey-image centroid is respect to edge distance. To calculate the centroid of a retinal image using watershed , it must be sure that the OD is a bright compared to background of the image.

6) Region Discrimination: Based on average intensity of the region, the region is discriminated between the significant and nonsignificiant regions. The number of pixels of the corresponding regions is calculated to represent the intensity of the each region. The region will be bright around the darker regions for that residue of close hole operator is calculated. The threshold value is calculated using the formula $u = m – 2s$, where m is the mean and s is the standard deviation .

7) Postprocessing: The OD contour has estimated as a circle [10], [11], for fitting the OD by a circle is to perform vessel diameter measurements of the retina concentric of the OD-

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margin [12]. For accurate calculation of radius of the circle is obtained by Kasa's method [13]. The figure 4 shows that contour of final region is obtained by circular approximation.

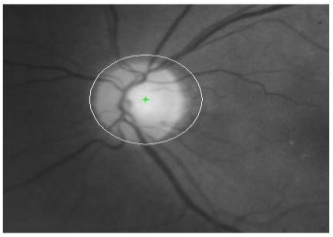

Fig. 4. Postprocesing – Circular Approximation Of The OD Contour

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