Detecting The Optic Disc Using Morphology And Histogram based Thresholding

Amandeep Kaur
Department of electronics & communication engineering
M.Tech Student, Punjabi University,
Patiala, Punjab, India
Email id:aman08feb@gmail.com

Reecha Sharma
Department of electronics & communication engineering
Assistant Professor, Punjabi University,
Patiala, Punjab, India
richa_gemini@yahoo.com

Abstract— Optic disc (OD) detection is the most important step while developing an automated screening systems for certain diseases. However, it is a cumbersome task to locate Optic disc in all types of retinal images including normal, healthy images as well as abnormal images (images affected due to disease). This paper presents a method to automatically locate the Optic disc in digital retinal fundus images. The method adopted for the extraction of the optic disc contour is mainly based on mathematical morphology along with appropriate thresholding. This particular method follows multiple steps – in initial steps, pre processing of image is done using filtering and morphology operations, then optic disc is detected using thresholding. Pre processing techniques based on morphological operations includes dilation and erosion. The proposed algorithm gives excellent results and avoids false OD detection. This method is tested on standard databases (DRIONS-DB) provided for researchers on internet.

Keywords—*OPTIC DISC,RETINAL,MORPHOLOGY, THRESHOLDING, SEGEMENTATION*

I.INTRODUCTION

The retinal fundus photograph is widely used in the progonosis, diagnosis and treatment of various eye related ailments such as diabetic retinopathy and glaucoma. A computer-assisted fundus image analysis could provide an immediate and accurate detection and characterization of retinal features prior to specialist inspection.

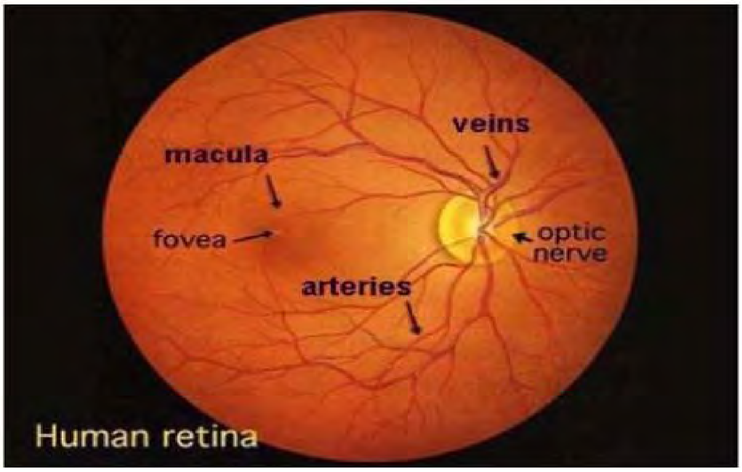


Figure.1. Retinal Fundus Image With Main Anatomical Structures[5]

With the increasing size and number of medical images of eye, the use of computers in their processing and analysis has become very essential. Augmented to this, optic disc (OD) segmentation is a key process in many algorithms designed for the automatic extraction of anatomical structures (as shown in figure 1), the detection of retinal lesions, and the recognition of other fundus features. First, the OD location helps to avoid false positives in the detection of exudates associated with diabetic retinopathy, since both of them are spots with similar intensity. Also, the relation between the size of the OD and the cup (cup-disc-ratio) has been widely utilized for glaucoma diagnosis. In addition, the relatively constant distance between the OD and the fovea is useful for estimating the location of the macula, area of the retina related to fine vision. Moreover, the centre, or even the border, of the OD also serves as initial point for vessel tracking algorithms due to the fact that all retinal vessels are originated from there[1][4][10].

II. LOCALIZATION OF OPTIC DISC

The OD localization is important for many reasons. Some of them are mentioned here:

To successfully find abnormal structures in a retinal image, it is often necessary to mask out the normal anatomy from the analysis. An example of this is the OD, an anatomical structure with a bright appearance, which should be ignored when detecting bright lesions. The attributes of OD are similar to attributes of hard exudates in terms of colour and brightness. Therefore it is located and removed during hard exudates detection process, thereby avoiding false positives. Secondly, optic disc centre and diameter are used to locate the macula in the image. In a colour retinal image the optic disc belongs to the brighter parts along with some lesions. The central portion of disc is the brightest region called optic cup, where the blood vessels and nerve fibres are absent. Applying a threshold will separate part of the optic disc and some other unconnected bright regions from the background. In this work an optimal thresholding method is applied to separate brighter regions from dark background as follows[2].

III. MATERIAL

The dataset used in this paper is the DRIONS-DB dataset ,it gives the relative studies on retinal segmentation. The dataset consists of a total of 110 color retinal images which is used for creating genuine diagnosis. Some of the images were taken from publicly available MESSIDOR.

IV. METHODOLGY

This section presents proposed Optic Disc detection technique. Here, we have divided this section in three sub parts, which deal with retinal image pre processing, thresholding and third is post processing.

A. Retinal Image Pre-Processing

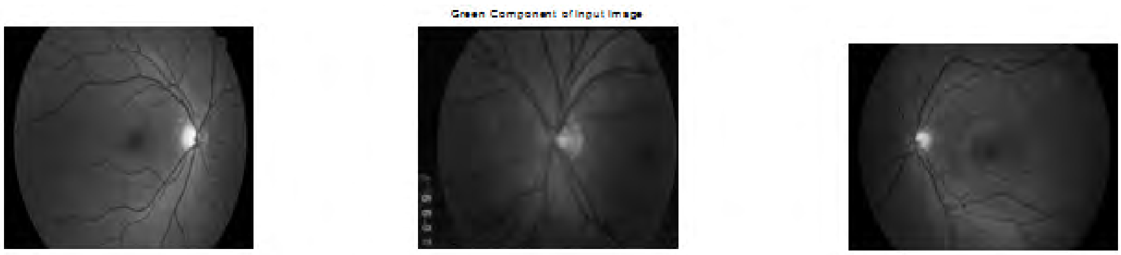
Retinal images are first pre-processed in case of optic disc detection. Further, Pre-processing consists of two steps:

The first step is to resize the input image into the fixed size of 256×256. The resized image is the RGB image.

Second step is to extract the green channel from the resized image, so that the image is Gray. Green channel image shows better contrast than red channel or blue channel image. It is observed that OD appears most contrasted in the green channel compared to red and blue channels in RGB image. Therefore, only the green channel image is used for the subsequent processing. The results for the resized input images and their corresponding extracted green channels are as shown in figures 2 and 3.

(a) **(b)** **(c)**

Figure 2.Resized Input Retinal Images



(d) (e) (f)

Figure 3.Green Channel Extracted Images for inputs in figure 2.

B. Image Enhancement

The resized image is then subjected to filtering for removing noise and image sharpening. Unsharp mask filter is used for image sharpening. Medical images were usually having poor quality in contrast. Unsharp filtering is an uncomplicated sharpening process that gains its name from the study which it improves edges and other high frequency components in images through a process that deducts a smoothed or unsharp version of images from the input images. Here, we have used the classical unsharp masking filter to sharpen the edges[2][7].

C. Thresholding

The optic disc is brighter than all other features in the retinal image, and it is observed that it appears most contrasted in the green channel (compared to red and blue channels in RGB image) that is shown in the figures 2 and 3. Therefore, only the green channel image is used for the effective thresholding of the optic disc[3]. Histogram Thresholding is based on partitioning an image into regions that are similar according to a predefined criteria. Histogram is a graph showing the number of pixels at each different intensity value found in an image. As illustrated below, we use the histogram for three images for optic disc localization[2].

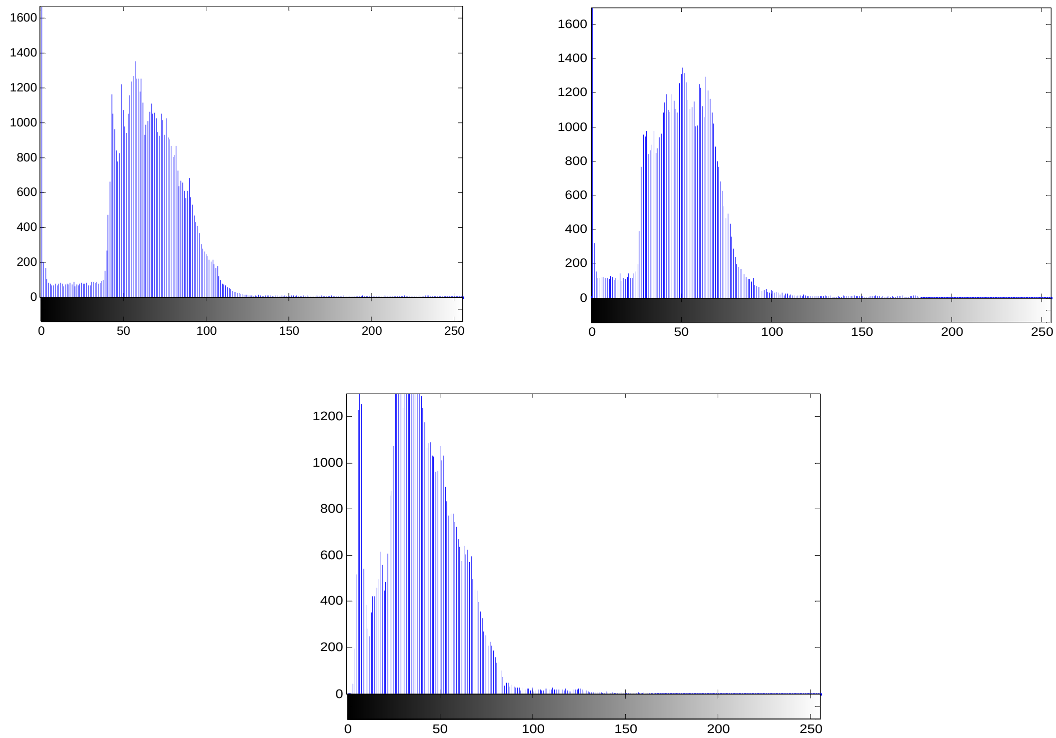


Figure 4.Histograms for resized Input Retinal Images a, b and c respectively

Step 1: Estimate the value for Threshold.

Step 2: Apply Threshold on the basis of histograms shown above.

Step 3: Select candidate regions which satisfy area criterion and density criterion.

Step 4: If no candidate region is selected, reduce threshold

Step 5: If threshold is greater than zero, apply steps 2 through 5.

Step 6: Stop.

To obtain an optimal threshold, the histogram derived from the source image is scanned from highest intensity value to the lowest intensity value. The scanning stops at intensity level T when scanned pixels are greater than the estimated OD pixels Thus, the optimal threshold is calculated as follows[2] :

Step1: Initialize total_pixel_count=0,opt_detect=0,len = 256 and num = 0

Step2: Total_pixel_count_threshold=450+increment

Step3: If total_pixel_count<=total_pixel_count_threshold

Step4Total_pixel_count=total_pixel_count+pixel_count(len)

Step5: len = len-1

Step6: Threshold, T = len

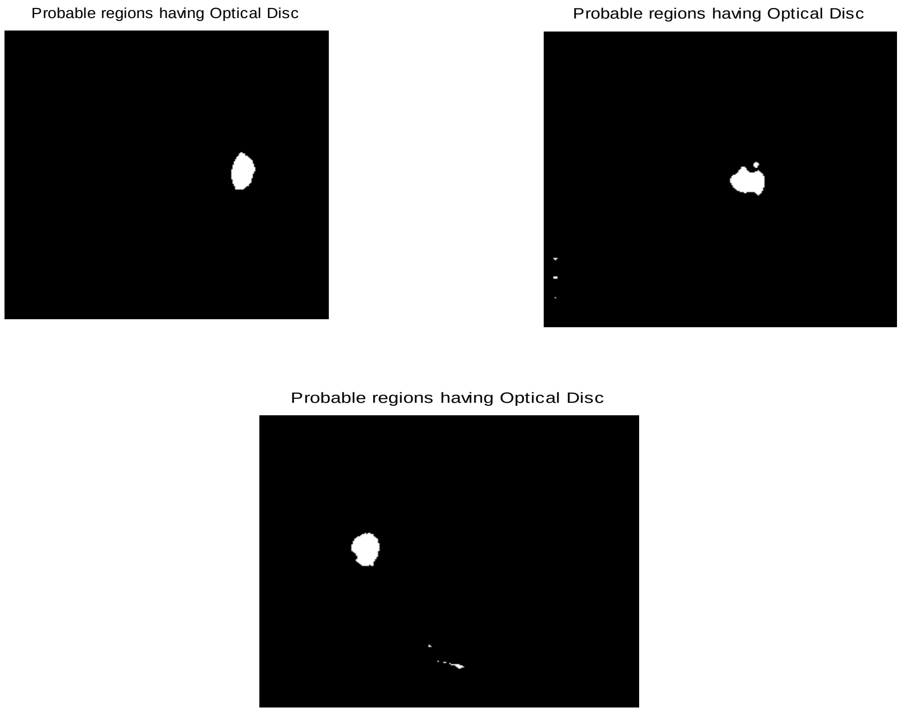


Figure 5.Thresholded images for resized Input Retinal Images a, b and c respectively

The optimal threshold when applied to the image results in one or more isolated connected regions (clusters). These clusters are then checked for area and density criterion by considering total area, length and ratio of major and minor axis[2].

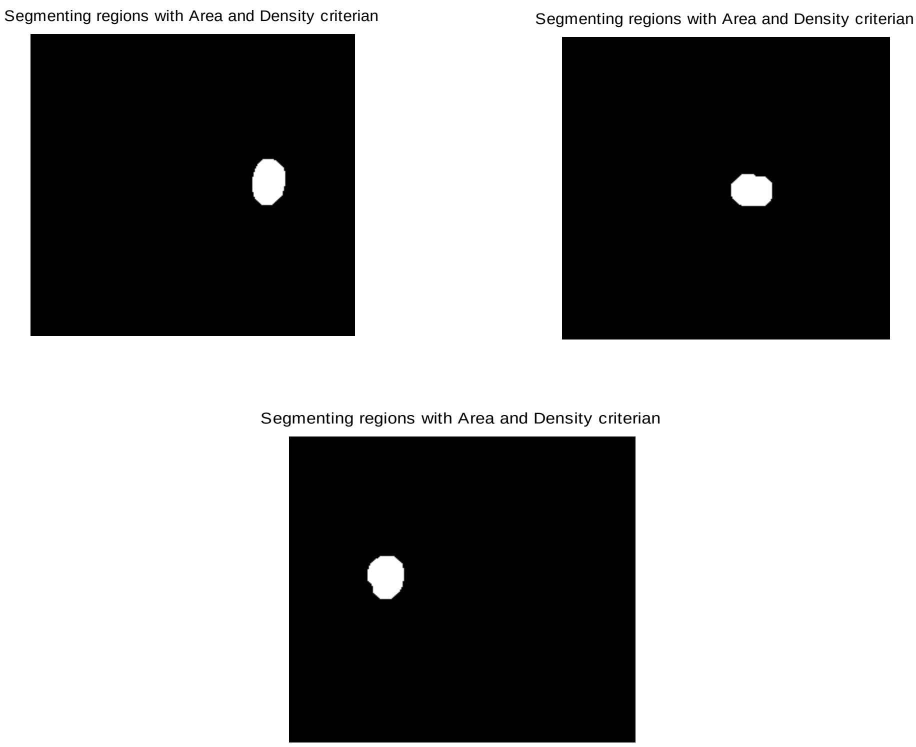


Figure 6.Segmented regions with area criterion for resized Images in figure 5 respectively

D. Mathematical Morphology

After detecting optic disc in previous section, we apply Mathematical Morphology (MM) on the segmented image by using disc shape structuring element. In MM images are considered as geometrical objects that are examined with other geometric object. The MM is based on set theory. Therefore, with the help of this set operation many useful operators can be defined in MM. Sets in MM represents objects in images [8]. Morphological operation can be clear by stirring a structuring element over the binary image. The Morphological operation is defined as dilation and erosion. Dilation is a method in which the binary image is stretched from its original shape that is it widens the image whereas erosion shrinks the image. Morphological dilation applied in this proposed algorithm is disc shape structuring element because the original size of the optic disc is circular in shape[5][9].

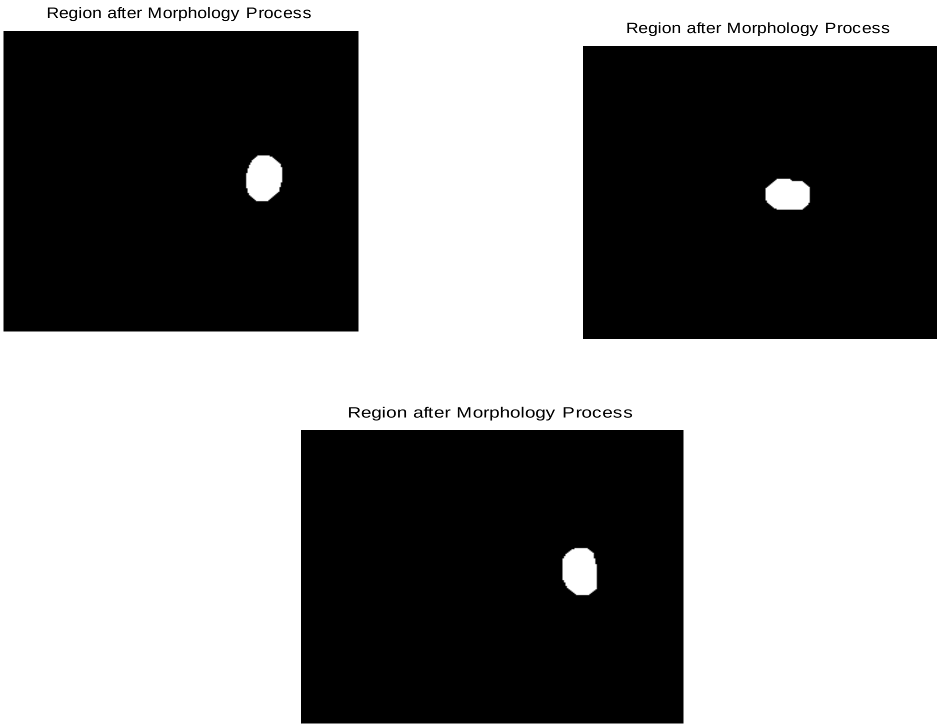


Figure 5 Previous Images after Morphology process

IV.RESULTS

We have shown the results for three retinal images in to obtain their histograms as template. The proposed algorithm developed here is tested on a set of retinal images of DRIONS-DB dataset data set. In Figure 5, some retina images in datasets and the results of locating the optic disc are shown in figure 6.

Figure 6.Optic disc detected for retinal images

REFERENCES

[1] Sandra Morales*, Valery Naranjo, Jesús Angulo, and Mariano Alcañiz . "Automatic Detection of Optic Disc Based on PCA and Mathematical Morphology" IEEE Transactions on medical imaging", Vol. 32, No. 4, April 2013,pp:786-796.

[2] Deepali A. Godse, Dr. Dattatraya S. Bormane, " Automated Localization of Optic Disc in Retinal Images",International Journal of Advanced Computer Science and Applications, Vol. 4, No. 2, 2013,pp.65-71.

[3] Siddalingaswamy P. C.,Gopalakrishna Prabhu .K, "Automatic Localization and Boundary Detection of Optic Disc Using Implicit Active Contours" International Journal of Computer Applications,2010.

[4] Sandra Morales, Valery Naranjo, David Perez, Amparo Navea, Mariano Alcaniz "Automatic Detection of Optic Disc Based On PCA And Stochastic Watershed",20th European Signal Processing Conference (EUSIPCO 2012) , August 27 - 31, 2012,pp-2605-2609.

[5] Arushi Sharma,Nita Nimabrte,Sapana Dhanvijay, "Localization Of Optic Disc In Retinal Images By Using An Efficient K-Means Clustering Algorithm", Proceedings of IRF International Conference, 15th February 2014, Cochin, India

[6] Siddalingaswamy P. C.,Gopalakrishna Prabhu .K, "Automatic Localization and Boundary Detection of Optic Disc Using Implicit Active Contours" International Journal of Computer Applications,2010

[7] Hanan Saleh S. Ahmed and Md Jan Nordin, "Improving Diagnostic Viewing of Medical Images using Enhancement Algorithms", Journal of Computer Science 7 (12): 1831-1838, 2011

[8] http://www.opticdisc. org/tutorials/optic_disc_basics/page12.html.

[9] Rafael C. Gonzalez and Richard E. Woods, Digital Image Processing, Prentice-Hall

[10] Arturo Aquino, Manuel Emilio Gegúndez-Arias, and Diego Marín. "Detecting the Optic Disc Boundary in Digital Fundus Images Using Morphological, Edge Detection, and Feature Extraction Techniques", IEEE Transactions On Medical Imaging,2010, pp:1860-69.

[11] Kyungmoo Lee, Meindert Niemeijer, Mona K. Garvin, Young H. Kwon, "Segmentation of the Optic Disc in 3-D OCT Scans of the Optic Nerve Head", IEEE Transactions On Medical Imaging, Vol. 29, No. 1, January 2010,pp:159-168