ELL715
Assignment 9 Report

Ankit Kumar (2017MT10727) , Naman Jhunjhunwala (2017MT10737)

May 19, 2020

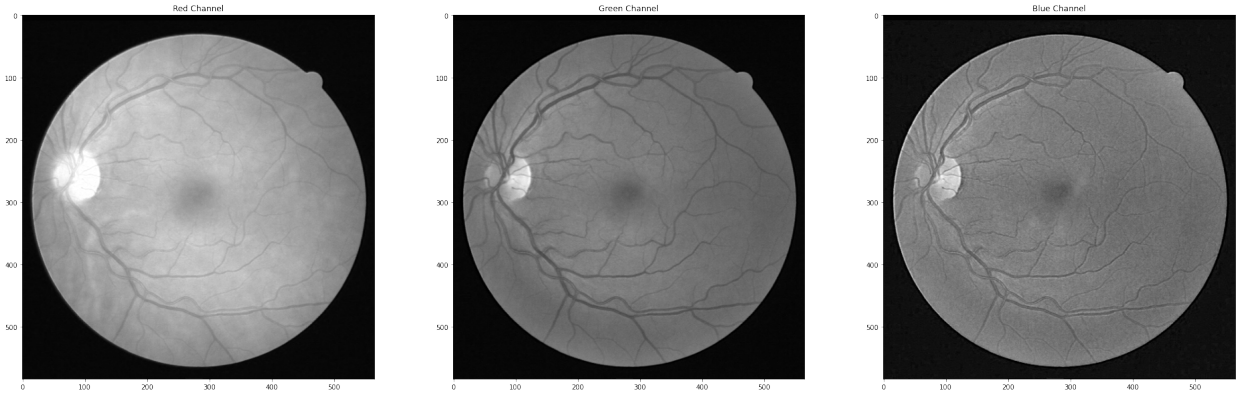
1 Original Image

Unless otherwise stated, all the results shown in this document correspond the input image below:

2 Optic Disk Center

2.1 Channel Extraction

The image has three channels: R, G and B.



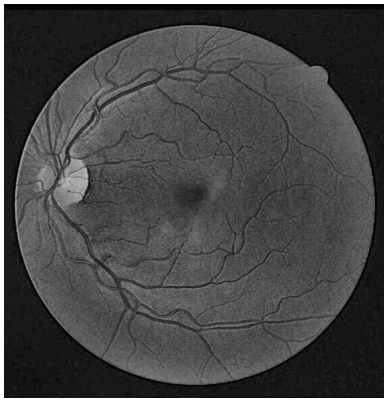
(a) Red Channel (b) Green Channel (c) Blue Channel

Figure 1: Images showing different channels corresponding to the input image

For extraction of optic disk center, we choose the blue channel, because it provides us with a better contrast between the optic disk and other components of the image.

2.2 CLAHE

After this, we applied contrast limited adaptive histogram equalization (CLAHE) on the blue channel to adjust the non-uniform illumination. The output of the same is:



2.3 Smoothing

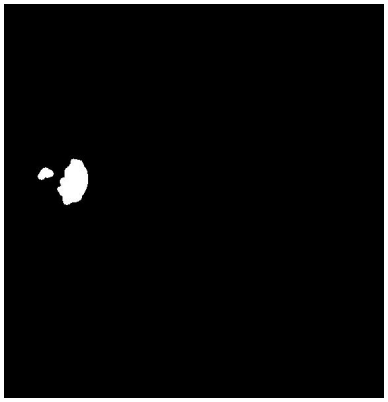
Then, we applied Median Filtering (5 5 blocks) to the CLAHE output, since it's noisy and causes issues in further steps if not resolved now itself. The output of the same is:

2.4 Opening

In the above figure, note that the optic disk has much higher intensity compared to the components in the image. The shown image is a grayscale image. The main effect of grayscale opening is to remove small, bright features from the image, while leaving the overall brightness unchanged. With that in mind, we perform opening on the above smoothed image with a disk kernel of radius 5 (an ellipse kernel of (9, 9)).

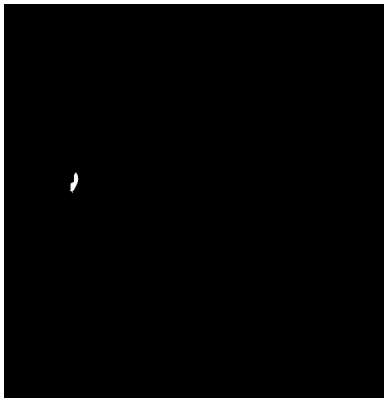
2.5 Thresholding

Now, we perform binary thresholding with parameter 127 (all pixels with intensity less than or equal to 127 are assigned 0, and the rest are assigned 255).



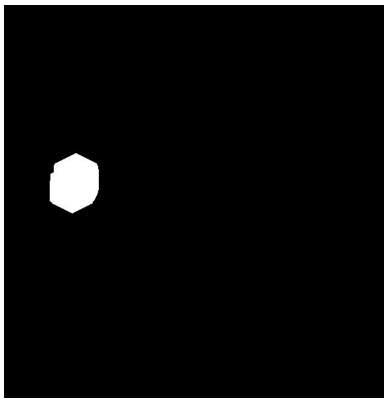
2.6 Eroding

Now we have optical disk but we also have a small patch of noise , To remove it we eroded image with a disk kernel of size 3.



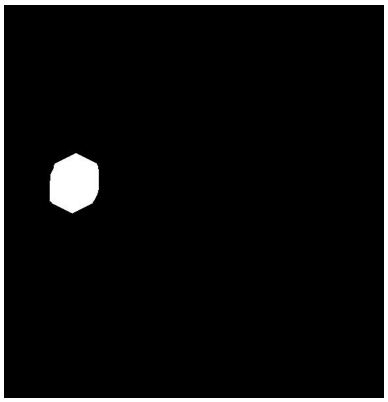
2.7 Dilation

Due to erosion disc became too small so to increase its size we dilated the previous output using disk kernel of size 3.



2.8 Closing

To fill the holes on surface of disk in previous output we performed closing on the previous output with disk kernel of size 5

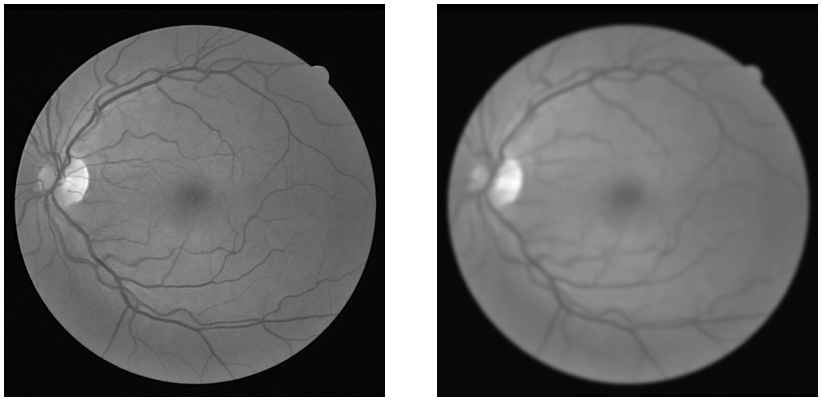


2.9 Centre coordinates

To find the centre coordinates of the disk in previous image we used contour finding algorithm and then found the centre of that contour.
Centre: $x = 103$, $y = 264$

3 Active Contour

Now, we use the green channel in our further analysis.



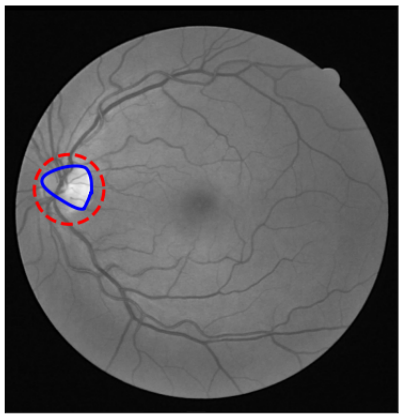
(a) Green Channel (b) Output of gaussian Blurring

Figure 2: Images showing green channel and gaussian blurring

First, we perform blurring with a Gaussian kernel of size 3. This step is important so as to reduce the noise present in image, and hence causing lesser errors in the subsequent active contour algorithm.
Then, we use active contour algorithm, using the (x, y) coordinates obtained above as the center, and $r = 50$ as the radius. For this particular image, we have used the following parameters:

- alpha (α) = 0.01
- beta (β) = 1
- gamma (γ) = 0.0001

Thus, we get the following output for the active contour algorithm for the given input image:



In the above image:

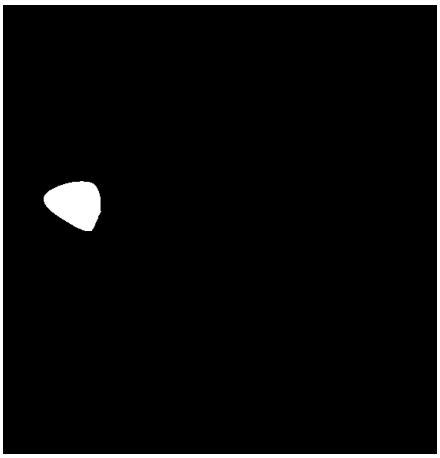
- The red ticks indicate the initial boundary used in the active contour algorithm
- The blue ticks indicate the final boundary obtained using the algorithm

4 Segmentation

Finally, we are left with two more steps:

- Extraction of the pixels in the region formed by the blue boundary. Convert the output to a binary map, with the optic disk being 1 and the rest of the image pixels 0.
- In case there are any holes, we fill those using closing with an ellipse kernel with parameters $(9, 9$.

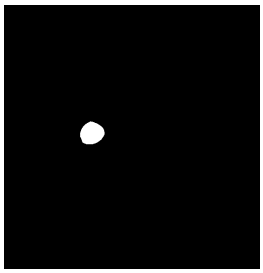
The final output (the segmented binary mask) of our algorithm is:



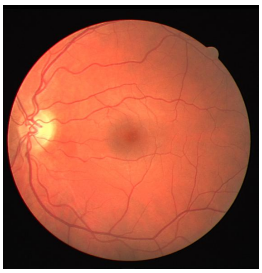
5 Additional Images: Extra Credits

(a)

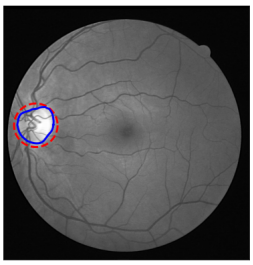
(b)



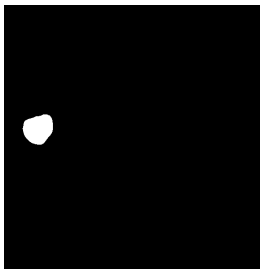
(c)



(a)

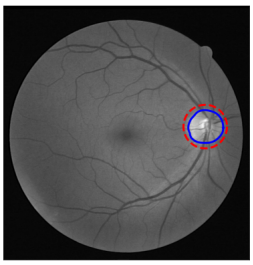


(b)

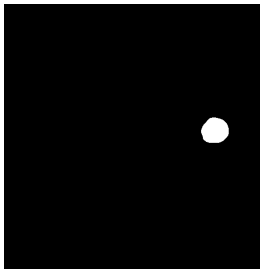


(c)

(a)



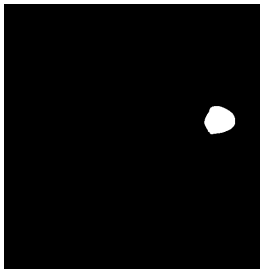
(b)



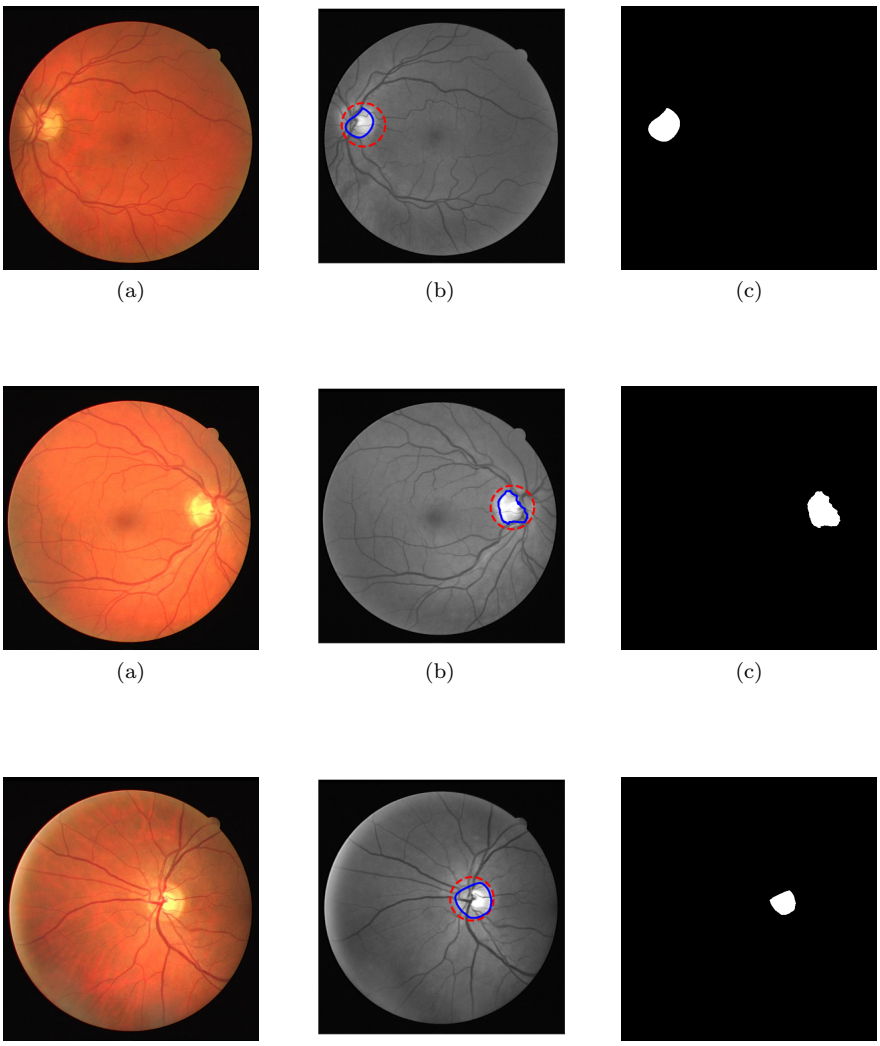
(c)

(a)

(b)



(c)



(a) (b) (c)

(a) (b) (c)

(a) (b) (c)

Figure 3: Images showing: (a) Input image (b) Output of Active contour (c) Segmented binary mask