Detection Of Vessels In Eye Retina Using Line Tracking Algorithm

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1 Introduction & Motivation

In clinical ophthalmology colour retinal images acquired from digital fundus camera.These images are widely used for detection and diagnosis of diseases like diabetic retinopathy, hyper-tension and various vascular disorders.Retinal images provide information about the blood supply system of the retina. The retinal images, often noisy, poorly contrasted and non-uniformly illuminated suffer from brightness variations both along the same image and between different images.Blood vessel is one of retinal features which can show the retina pathologies. It can be extracted from retinal image by image processing.

2 Problem Description

We extract vessels from retinal image using line tracking algorithm. We used retina image from DRIVE dataset. The data is needed to be preprocessed before applying the algorithm. For vessels extraction we applied mainly Convolution Based Technique.

3 Dataset Description

- We collect the dataset from "Image Science Institute" [**2**] which are given for research purpose.
- The size of each image is 565*584*3
- TIF(Tagged Image File) format image is used here which are high quality graphics image file.

4 Line Tracking Algorithm

Line detection is an algorithm that takes a collection of n edge points and finds all the lines on which these edge points lie. The most popular line detectors are the Hough transform and convolution based techniques.

The Hough transform [**3**] can be used to detect lines and the output is a parametric description of the lines in an image. If there is a line in a row and column based image space, it can be defined p, the distance from the origin to the line along a perpendicular to the line, the angle of the perpendicular projection from the origin to the line measured in degrees clockwise from the positive row axis. Therefore, a line in the image corresponds to a point in the Hough space. [**4**].

5 Proposal

Here we give our proposed model which is based on line tracking algorithm. At first we take the input image. We pre-processed the image. After pre-processed we use line tracking algorithm. After some post-processing we get the our desired image.

The algorithm accomplishes image processing firstly, then recognizes the line by edge detection and scanning model.

The algorithm is verified by quadrotor platform and achieves great line-tracking effect by tuning parameters [**5**].

It is used to detect lines.

We propose a model for our work.Given in the flow chart-

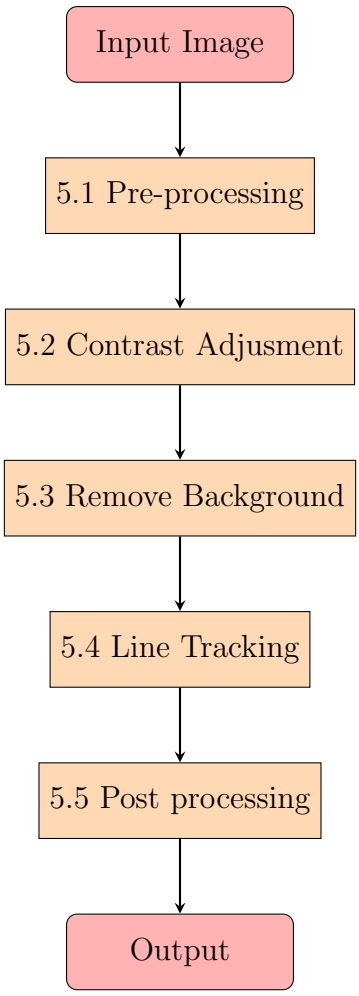

Figure 1: Simple Model

5.1 Pre-processing

Pre-processed model working procedure:

i **Local normalization with green channel:** Local Normalization with green channel which smooths the image removing the noise or other data that is not needed. The reason for using green channel image is that it gives a better and clear view of the vessels [**1**].

ii **Median filter:** De Noise preprocessed image with median filter. The Median Filter is a non-linear digital filtering technique, often used to remove noise from an image or signal[1]. A Median Filter operates over a window by selecting the median intensity in the window. The function 'medfilt2(image)' was used.

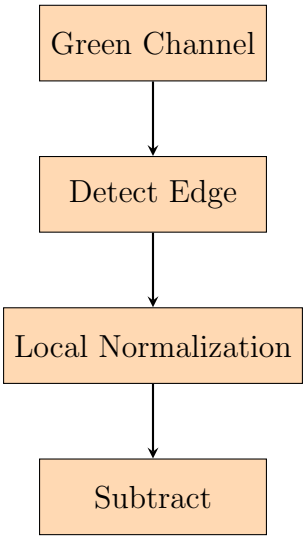

Figure 2: Pre-processing

5.2 Contrast Adjustment

Contrast adjustment remaps image intensity values to the full display range of the data type. After applying this we get a darker version of the input image.

i **Compliement:** We get an image where the veins are dark and the background is brighter so to make the veins foreground we compliment the image with compliment function 'imcomplement(Image)'.

ii **Histogram Equalization:** Matlab function "adapthisteq(Image)" is used to get a better version of the complimented image by enhancing the contrast of the image.

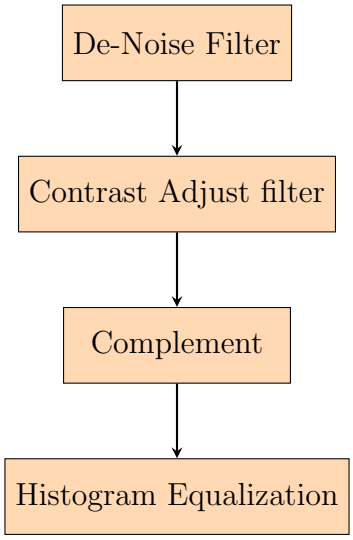

Figure 3: Contrast Adjustment

5.3 Remove Optical Disk

Here we apply a number of operations in this step Firstly we apply opening with a ball type Structuring element. Then with a line type Structuring element we apply ersion to the previous output. Lastly we subtract this erored image from the equilized image. It removes the bright background behind the vessels which is known as the optical disk. At the end we apply median filter and adjust the contrast to get a better output.

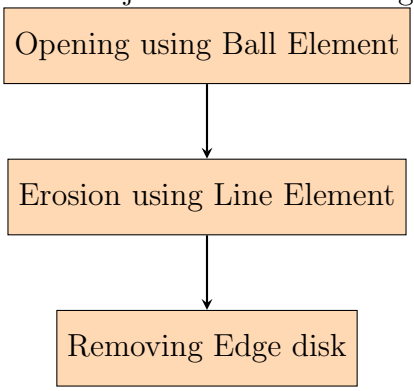

Figure 4: Remove Optical Disk

5.4 Line Tracking

In image processing, line detection is an algorithm that takes a collection of n edge points and finds all the lines on which these edge points lie.he most popular line detectors are the Hough transform and convolution based techniques.

In a convolution based technique, the line detector operator consists of a convolution masks tuned to detect the presence of lines of a particular width n and a theta orientation. Here are the four convolution masks to detect horizontal, vertical, oblique (+45 degrees), and oblique (-45 degrees) lines in an image

i **Horizontal mask(R1)**

ii **Vertical (R3)**

iii **+45 degree(R2)**

iv **-45 degree(R2)**

Then, R(x, y) = max(—R1 (x, y)—, —R2 (x, y)—, —R3 (x, y)—, —R4 (x, y)—)

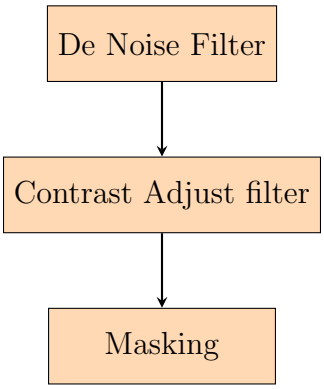

Figure 5: Line Tracking

5.5 Post processing

i **Gray thresholding and Binarization:** The graythresh function uses Otsu's method, which chooses the threshold to minimize the intraclass variance of the black and white pixels [4]. The function 'graythresh(image)' was used. 'imbinarize(image,T)'creates a binary image from image using the threshold value T. T can be gray threshold.

ii **Bwareaopen and Edge subtract:** Remove small objects from binary image.'bwareaopen(BW,P)' removes all connected object that are smaller than P pixels from the binary image BW, producing another binary image. then for edge subtraction we subtract dilate image form binary image.

iii **Box Filter:** The Box Filter operation is similar to the averaging blur operation; it applies a bilateral image to a filter.

Our post-processing model

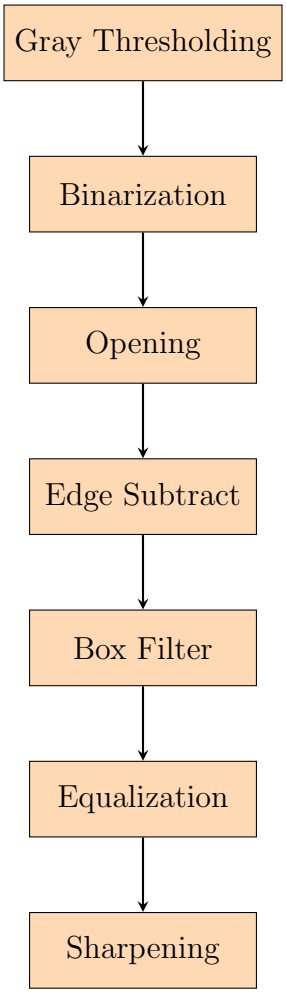

Figure 6: Post processing

6 Output images

Our sample output images are given step by step:

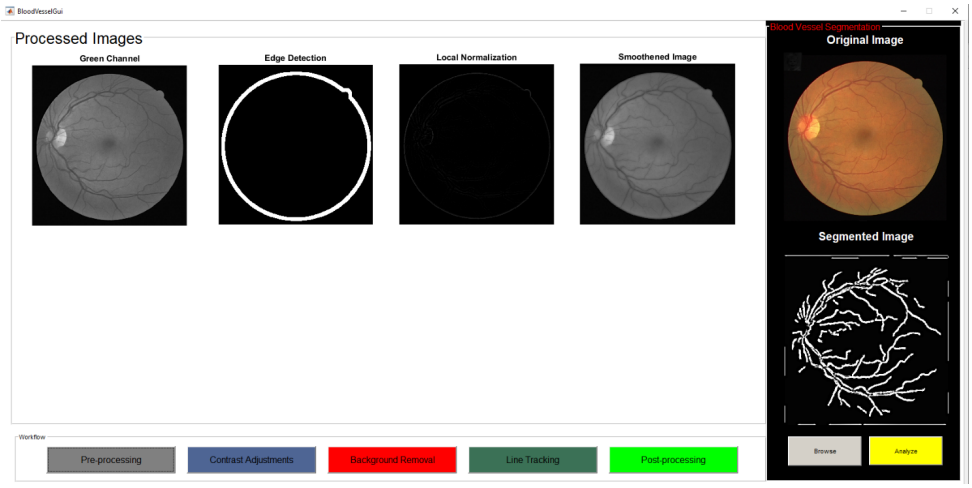

Figure 7: Pre-processing step

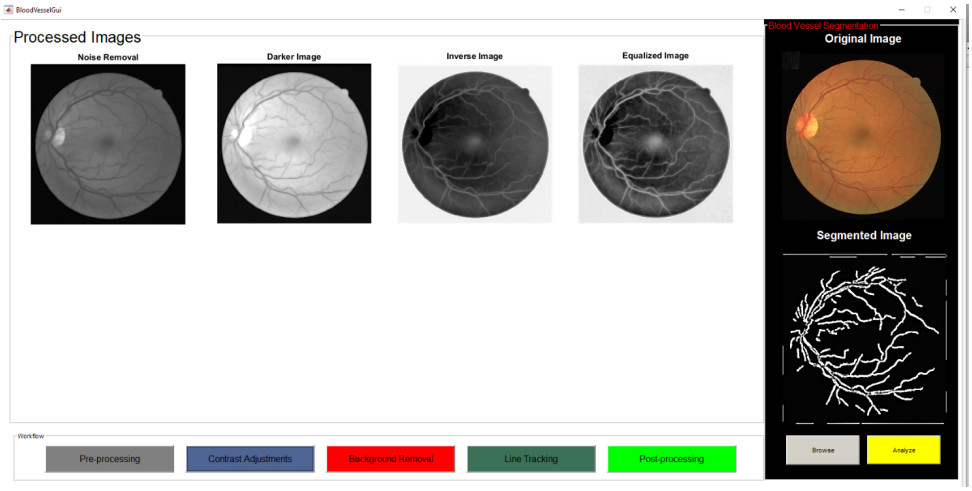

Figure 8: Contrast Adjustment

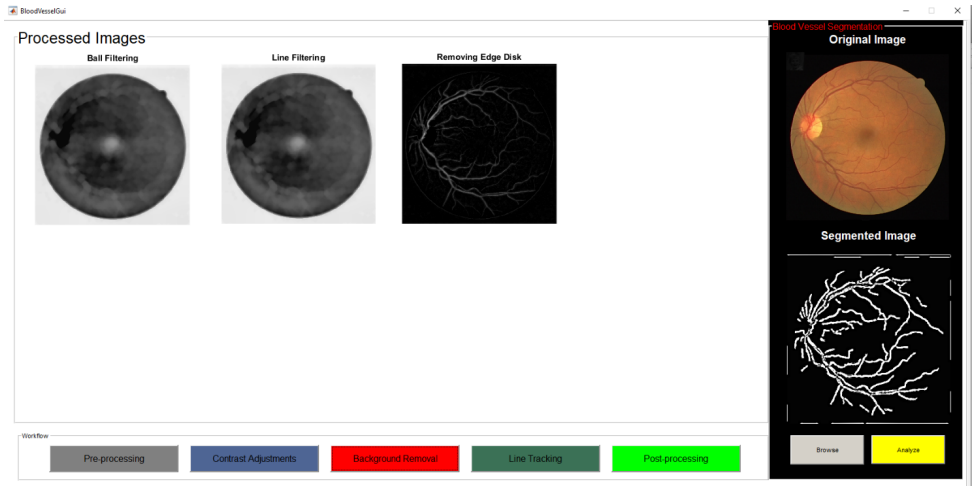

Figure 9: Remove Background

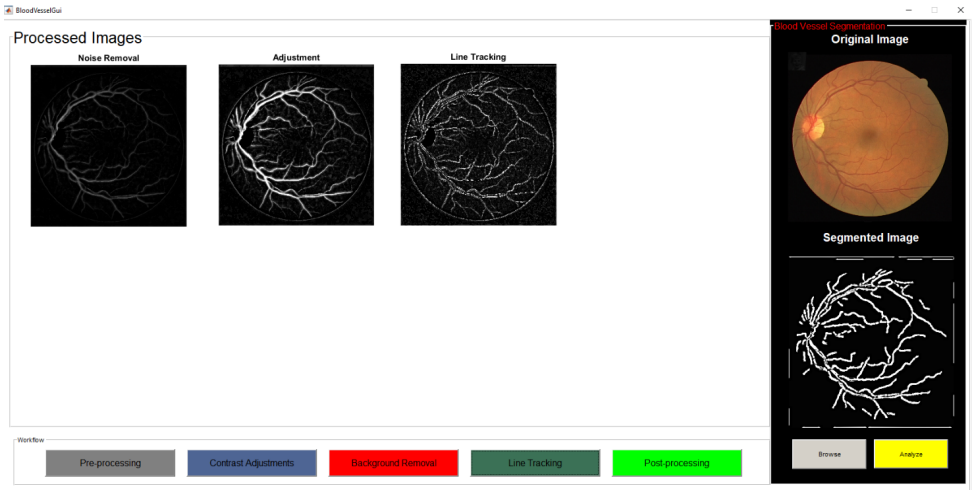

Figure 10: Line Tracking

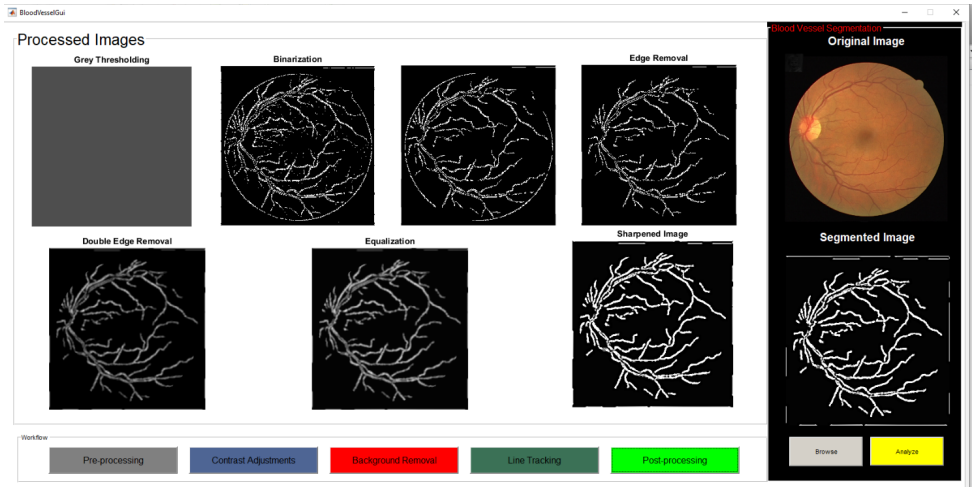

Figure 11: Post processing

7 References

[**1**] Marios Vlachos, Evangelos Dermatas, "Multi-scale retinal vessel segmentation using line tracking", Computerized Medical Imaging and Graphics.

[**2**] https://www.isi.uu.nl/Research/Databases/DRIVE/

[**3**] https://en.wikipedia.org/wiki/Line_detection

[**4**] https://ieeexplore.ieee.org/document/7531957

[**5**] https://ieeexplore.ieee.org/document/7531758