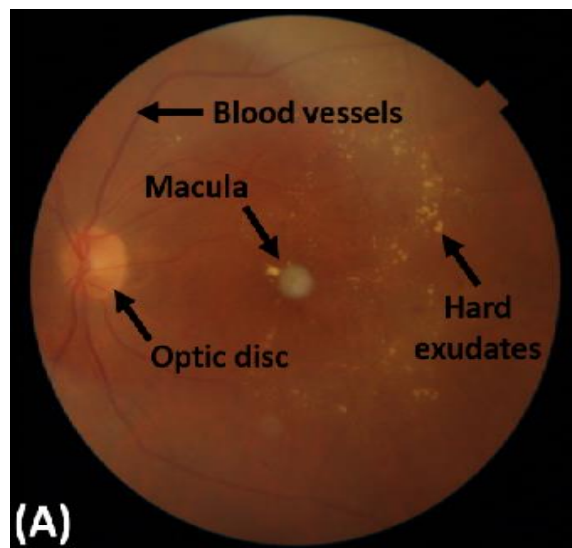<u>**Assignment # 2**</u>
<u>**(Problem Based Learning)**</u>
<u>**(CLO4 -> PLO5)**</u>
<u>**Digital Image Processing**</u>
<u>**Retinal Image Segmentation and Objects Analysis**</u>
<u>**Submission Deadline: 28 April 2024**</u>

Note: Students should score 40% in OBE specific questions to ensure their accumulated scores towards respective PLOs are above 40%

Spatial enhancement using transformation and image filtering is one the most widely preprocessing tool in image processing based applications. Image filtering further is being used to compliment segmentation and feature extraction process.

In this assignment, the aim is to give you a hands on experience of using these operations for a real-life problem. Fundus images are digital images of human retinal which are used to diagnose different retinal diseases. The main landmarks on fundus images are optic disc, vessels and fovea (macula) as shown in following image

Your aim in this assignment is to use your knowledge about spatial enhancement and segmentation to extract optic disc from given images. You are given a set of 50 fundus images containing original colored fundus images along with their respective blood vessel map (as shown in figure below) and original optic disc location in form of (row, col).
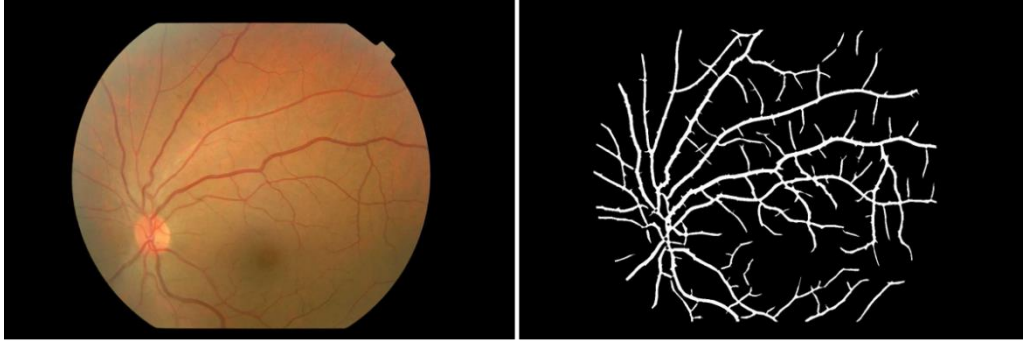
You need to extract optic disc from all these 50 images and find out error in each image and overall average error. The images for this assignment can be accessed using following link

https://drive.google.com/drive/folders/1DxmL9I2772qTCYwlbMk1KpKPtJb85o-H?usp=sharing

Deliverables are

1. **Algorithm for extraction of bright regions from input fundus images**: As you can see that optic disc is a bright region in comparison to its background so first step should be looking for such bright regions.
2. **Algorithm to identify optic disc location:** Now in case of normal images there should be only 1 bright region that is optic disc. But in abnormal case there are other bright lesions (exudates, as shown in first figure) so it would extract optic disc along with other false regions due to these bright lesions. Now you have to device a method to find out true optic disc and get coordinates for that. Blood vessels map can help here as vessels are originated from optic disc. Also, mark the location as shown in figure below
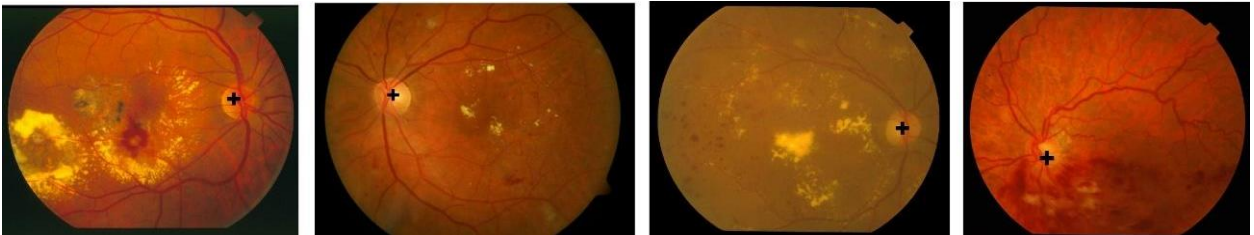
3. **Error Calculation:** Now as you have extracted optic disc along with its coordinates (row and col), so we can find out error between actual Optic disc location and location which you have extracted. For this, use Euclidean distance that is

$$\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

Here true location of optic disc is represented as (x_1, y_1) and the one which you have extracted is represented as (x_2, y_2). Calculate this error for each image and add in your report in a tabular manner.

Submission: You need to submit a report (word or pdf) against this assignment containing

1. Explain you working by clearly. Make a flow diagram for better explanation.
2. Copy complete editable code in a word file
3. Add all 50 images along with their intermediate and final outputs and error in a tabular form