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Optic Disc and Fovea Localization with GUI In Retinal Fundus Images

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Abstract – *Detection of Diabetic Retinopathy(DR) is extensively done using retinal fundus images. The localization of normal anatomic components like optic disc and fovea in retinal fundus images is necessary step for automatic diagnosis of it. A computer screening of DR provides an immediate detection of Diabetic Retinopathy. In this paper an automated method for localization of optic disc and fovea is proposed. Optic disc is localized using 2D convolution of image in different dimension and creating a mask by adjusting brightness of retinal fundus image. And fovea is detected by taking mean of green channel and using gauss filter. For making it automatic, Graphical User Interface (GUI) is used.*

Key Words: **Diabetic Retinopathy, Optic Disc, Fovea, Retinal Images, Fundus Images, Gaussian Filter, etc.**

1.INTRODUCTION

The human eye is an organ of visual system which provides sense of light incoming into eye. Eyes help us visualise and understand dimensions, shapes, etc. of known Universe. Retina is the core part of eye that includes sensory neurons that respond to incoming light. It convert incoming light signal into electrical signals. The ability of the person to see clearly is termed as visual acuity. If visual acuity of a person diminishes then eye disorders like diabetic retinopathy can occur.

Diabetic Retinopathy occurs due to Diabetic mellitus, which is caused by inability of body to produce or properly use insulin which leads to high sugar level. For automated analysis of retinal images localization of normal anatomy like optic disc and fovea is important step. Abnormalities associated with eye disease are not uniformly spread therefore knowledge of the localization of abnormalities in the retina is important while computerized analysis of retinal images. The Fovea and Optic Disc are the main landmark in the retinal images. In this paper we develop a technique for automatic localization of these landmark. Fig 1 shows the retinal fundus image with the optic disc , macula and fovea.

1.1 Optic Disc

The optic disc is the bright yellowish spot on the retina of eye from which the optic nerves begins and the axons of retinal ganglion cells come together. Optic disc is the point where the nervous and blood system enter the retina. In optic disc there are no rods or cones. . Around 1–1.2 million nerve fibers are carried from optic disc to brain. The optic disc is oval shaped, it has dimension of around 1.76mm horizontally and 1.92mm vertically. Optic disc is placed 2 to 4 mm beside fovea.

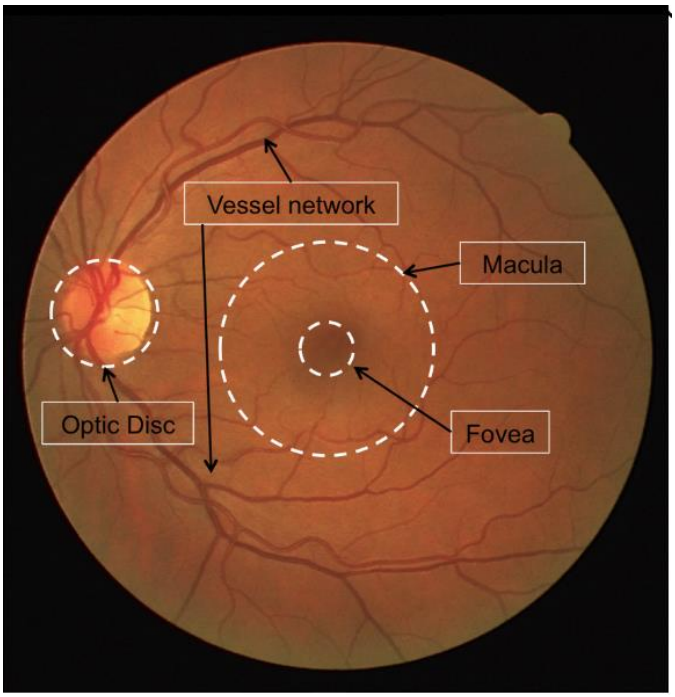

Fig: 1

1.2 Fovea

A small hole with closely bundled cone cells form Fovea. It is centrally placed inside of macula. It helps in vision by making it easier to visualise sharp and central vision, which is necessary in humans to control activities in which visual detail is very important such as reading. Macula is located at center of retina and is of diameter around 2.5 to 3mm . The center of fovea is of diameter 0.3mm. The fovea is a tiny rod-free region and there is no blood vessels. It is made up of cones as tightly packed as physically possible.

2. RELATED WORKS

Sekhar, Al-Nuaimy and Nandi present an automated localization of optic disc and Fovea. They have used the mathematical morphology for the analysis shapes in images and combined RGB(Red, Green, Blue) value of the images as it shows good variations between optic disc and background.

This methodology works only when there are no exudates in the background. Their technique included Hough transform for boundary and center. Fovea is detected by exploring the macula region by determining intensity variation [1].
Other approaches include features of retinal vasculature and its spatial relation with the OD to localise OD [2]. For the GUI other approaches which were used for hard exudate detection are used [3]. Few more methods for localisation and segmentation of OD are proposed by extracting ROI and using Hough transform [4], another method proposed kNN classifier [5].

3. METHODOLOGY

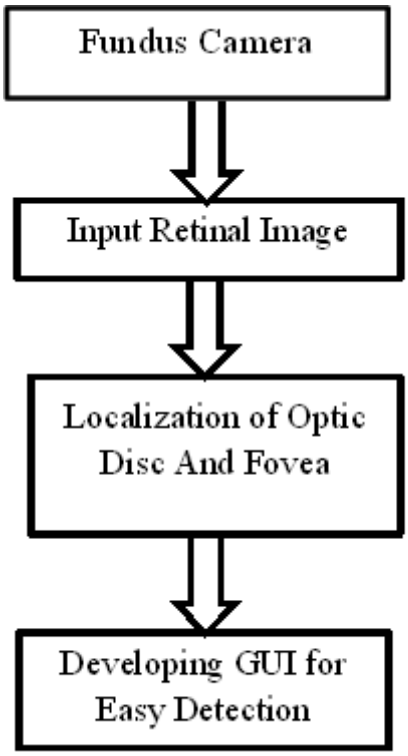

Chart -1: System Flowchart

The Flowchart in chart 1 shows the propose system workflow step by step. In IDRiD Sub-Challenge 3, the image size of fundus photographs is 4288*2848, and we reduce them to a lower resolution of 256*256 due to limited computational resource.

Fovea is one of the most fundamental structures of retina, and this is located in the center of the macula. In the fundus image, The darkest part of approximated circle is fovea. Therefore, to extract the fovea region, we have applied preprocessing such as RGB to Grey, dataset normalization, and contrast enhancement.

The GUI system we have developed contains first step as select image, from which we can select image from different different locations. After selecting image we have to preprocess the image for that we have applied RGB to grey, dataset normalization, and contrast enhancement. In preprocessing we are removing unnecessary blurring and the noise stuff of things that makes image unclear. By image preprocessing we get the clear image of retina.

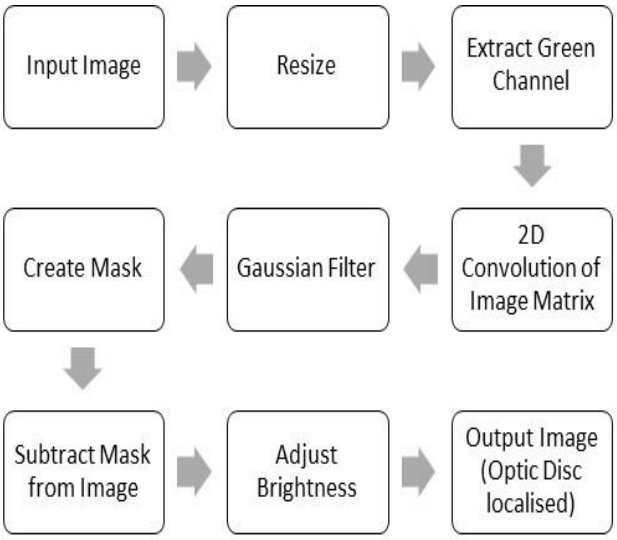

Fig:2 Optic Disc Detection Algorithm

The strel function creates a disk-shaped structuring element, where we have to specify the radius and the number of line structuring elemensts those are used to approximate the disk shape. Morphological operations using disk approximations run much faster when the structuring element uses approximations.

The imerode function erodes the binary, grayscale or packed binary image, and the eroded image is returned. The result of the function is the structuring element object or array of structuring element objects..

The edge function returns the classification edge for the object with data of uint8(im) and classification 'canny'. By this we are getting the mask. And subtract image g and p.

```
g = rgb2gray(image);
mask = sqrt((x-C).^2 + (y-R).^2) <= radius;
p=im2uint8(mask);
result = imsubtract(g, p)
```

the resultant optic disc image is in result.

For Fovea detection we are separately developed another algorithm. In which we are using green plane of the preprocessed image. And finding out the mean of green planed image for getting the vector points those are less than mean found that are required for cropping the centroid region from image. Here we are setting the sigma values as follows for applying the filter:

```
sigma_s = 40;
sigma_r = 0.15;
```

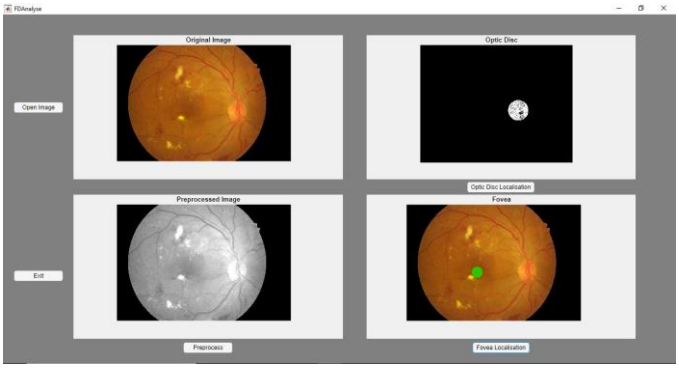

Fig -1: Screening for optic disc and fovea.

```
gg = filter(fg, sigma_s, sigma_r);
detail_amplification = 10;
detailsg = fg - gg;
enhanced_fg = fg +
detailsg*detail_amplification;
J12=im2uint8(enhanced_fg);
h = fspecial('gaussian');
J = imadjust(J12);
```

The filtered image is used to get the fovea image as we have to subtract the gg from fg. The resultant image is enhanced by `enhanced_fg = fg + detailsg*detail_amplification;`.

The Guassian filter is used here returns a Gaussian lowpass filter of size h which is rotationally symmetric with standard deviation positive sigma. The origin, which is center pixel of structuring element, identifies the pixel in the image being processed. Flat structuring elements are created by strel function.

```
afterOpening = logical(afterOpening);
fovea_image = zeros(m,n);
```

The logical function converts afterOpening image into an array of logical values. A nonzero element of after Opening is converted to logical 1 (true) and zeros are transferred to logical 0 (false). Complex values and NaNs cannot be converted to logical values and result in a conversion error.

The function getLargestComponet will return the largest connected component and this is done redundantly in a loop and stored in xout image. And from this xout image we are detecting the fovea. And here we get the fovea.

3. CONCLUSIONS

In this paper, the image captured from the fundus camera is used for localization of optic disc and fovea with the help of a graphic user interface. The localization techniques specified in this paper have success even when the exudates are present in the image. This gives us edge over previous techniques [1]. In addition, this paper presents a GUI for easy manipulation and representation of technique.

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