EVALUATION OF OPTIC DISC FROM THE RETINA USING VARIOUS TRANSFORMS AND STUDY OF BLOOD VESSEL SEGMENTATION METHODS FOR DIABETIC RETINOPATHY

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***Abstract* - As the time passes by, there is a huge increase in the amount of people who are being affected by the disease called Diabetic Retinopathy. The reason behind this is due to increase in blood sugar level which damage the blood vessels in Retina.There are some early manifestations of this disease which includes Floaters, Dark area of visions, Distorted vision. In order to detect the Optic Disc here we have used different methods to identify & separate the optic disc from Retina.The transform which we have used here are Krisch Transform, Discrete Wavelet Transform, Bottom Hat Transform. So, first of all we will do the Separation & Segmentation of bright objects and after that the windowing process will takes place. After applying the respective transforms in the datasets i.e. DRIVE Dataset which is publicly available we will find the Spectral density, Standard Deviation and Energy for each Window to separate the Optic disc.**

Keywords – Diabetic Retinopathy; Optic Disc; Krisch Tansform; Discrete Wavelet Transform (DWT);Bottom Hat Transform ; Windowing; Spectral Density; Standard Deaviation; Energy

I. INTRODUCTION

Retina is a layer which is present at the back of the eyeball comprises of the cell which are light sensitive.Optic disc and the blood vessels are the two important anatomy used for the analysis of retinal images. By knowing different facts about the Optic disc it would become easy to investigate the seriousness of some disease such as Glucoma. Any modifications in the Optic disc represents the present state & the development of the respective diseases. Manual inspection of disordered retina because of diabetes need additional time and cost. The size of the Optic disc differs from individual to individual but in terms of number of pixels; in 640X480 sized colour image it is around 40 to 60 pixels. In order to conserve time and cost a more precise and automated computerised technique must be used for the proper detection of Optic disc. As claimed by EDTRS [Early Treatment Retinopathy Study Research Group] there are four different types or Diabetic Retinopathy. They are Mild Non-Proliferative Retinopathy, Moderate Non-Proliferative Retinopathy, Severe Non-Proliferative Retinopathy, Proliferative Retinopathy. Color retinal images are used by the opthalmologists for the recoginition of

Diabetic Retinopathy. Fig.1 shows the color retinal fundus image with it's different features and hard exudates.

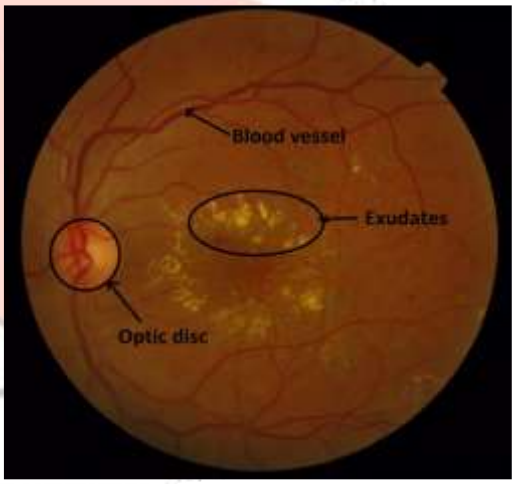

Fig.1 Main features and hard exudates in Color retinal fundus image.

In this the bright circular spot is what we called as Optic disc. Optic disc is the region from where the blood vessels arise in the Retina. Apart from this the bright lesions are known as Hard exudates and also as cotton wool spot. It looks like bright yellowish layer. It can be of any size and form, also it can be visible anywhere in the surface of retina.

This paper consists of a latest algorithms for detection and separation of Optic disc from retina. There are different steps involve in the algorithm which are given here: 1.For removing the noise and irregular supply of intensity of image there is need of preprocessing step to take place in which the processing of input image will be done. 2.Processing step can be easier if there is a conversion of

color RGB image to Gray image. 3.Separation of Bright objects from the retina image is an important step for which we are doing the image partitioning. 4.Another step is Windowing in which the input image is being divided into different parts known as windows and each window hold various images.5.Now we have to apply different transforms. The transforms which we are to going to take here are Dicrete Wavelet Transform, Krisch Transform and Bottom hat transform. 6.After applying transform we are going to find Spectral density, Standard deviation and Energy for the respective transform. 7.Window with highest Spectral density, Standard deviation and Energy will be choosen which will give the needed Optic disc. 8.If there are two windows with highest Spectral density, Standard deviation and Energy then there is need of merging them both. 9.Separation of Optic disc from the image should be done from the previoue steps.

II. LITERATURE SURVEY

Early diagnosis of Diabetic Retinopathy may reduce the possibility of blindness and vision loss .

Anup Deshmukh, Tejas Patil [1], suggested a method for the classification of the bright object from the image of the retina on the basis of the feature extraction and local mean of pixels. In order to upgrade the radiance of the image the preprocessimg is the required step. Morphological operations like closing operation will be used. For estimating the Optic disc position in the retina.

A.S.Jadhav, Pushpa B. Patil [2], focused mainly on the size of window for matching thesize of Optic disc in the retina image. Also suggested that for proper segmentation process to take place we don't require to change the threshold with respect to the variartion in the brightness.

M.Foracchia,E.Grison [3], introduced a new technique for the detection of optic disc's position. The method is dependent on the presence of a better section of the image and is also unconventional of the actual presence of the optic disc. Depending on the initial evaluation of blood vessels this method is going to work further. To detect the optic disc various techniques were suggested depends on its brightness, on its particular circular shape while comparing with the other retinal images.

Amin Dehghani, Mohammad Shahram [4], come up with a innovative technique for finding out the optic disc location in the retina. By using the histograms of a few optic disc in the presence of the pathological section and exudatesin the retina imageit becomes easy to find a correct location of optic disc.

Ana Salazar, Djibril Kaba [5], Method for the segmentaton of Optic disc and the blood vessels in the retina. By using the graph cut technique used for extracting the retina vascular tree. By calculating the histogram of every color component of retina and by averaging themwhat we get is useful as template for verifying the location and center of Optic disc in the retina.

Saiprasad Ravishankar, Arpit Jain [6] ,a latest limitations for detecting the optic disc is suggested firstly by detecting the blood vessels and tehn by using the commom factor between them to discover the imprecise optic disc position.

Aliaa Abdel-Haleim [7], for detecting the Optic disc an easy procedure isintroduced here which is 2-D vessels direction matched filters. Here some more suuested information are:
1.The presentation and efficiency of the method will be affected if we improve the working of the vessel segmentation algorithm.

2.By checking out the working of the already available different detection techniques],. by using the datasets which is easily available to get more accurate and complete results.

3.VDM (Vessel Direction Map) can completely be obtain with the help of diffrent vessel segmentation algorithms.

Gehad hussain, Nashad El-Bendary [16], Mathematical morphology is applied as pre-processing phase with K-means clustering. Morphology techniques are used to improve the digital retinal images quality and to focibly end to the background information. After that the K-means clustering is applied for segmentation of the vessels. And finally the blood vessels are extracted.

III. METHODS OF BLOOD VESSEL SEGMENTATION

There are various methods used for the process of blood vessel segmentation in Diabetic retinopathy.

1) HISTOGRAM EQUALIZATION AND AUTOMATIC THRESHOLD SELECTION

In this method of Segmentation the input given to the system will be a color fundus image of retina which is obtained from the fundus camera and after that the output which we will get will be blood vessels only. There are various steps included in this. They are :

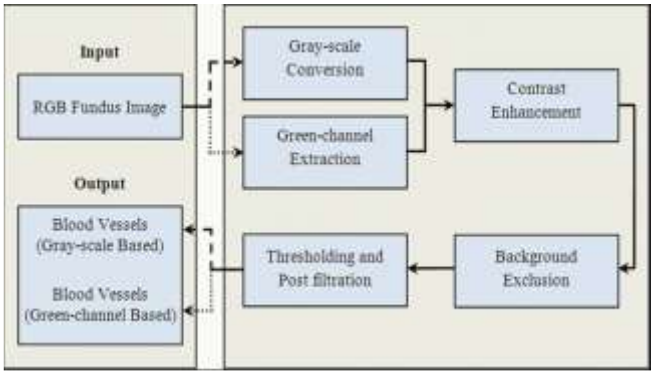

Fig.2 Block Diagram of the presented algorithm

1.Conversion of RGB to Gray

The color image which will be used as an input image should be first converted to gray scale image because of which there will be minimization in the computational time. The color image contains only the luminance detailswhich is being provided by the gray scale image by deleting the hue and saturation of it. Working of Green channel is to supply a maximum dissimilarity in between the background and foreground. After comparing the Gray and Green channel the process of segmentation will takes place with the help of Eqn (1) the conversion of color image to gray scale image can be done.

$$g = 0.2989*R + 0.5870*G + 0.1140*B \quad (1)$$

Where R,G and B resembles red, green and blue component.

2.Contrast Improvement

There is possibility of low constrast to takes place because of various reasons like poor lighting condition, small vital range of sensor. Because of this it becomes necessary to increase the contrast level of the image in order to give a good transform presentation. In order to improve the contrast a large variety of skills are used to cover a wide range of image. For enhancing the contrast of image different techniques used like Histogram equalization, Adaptive histogram equalization (AHE), unsharp mask. In this respective method CLAHE (Contrast-Limited Adaptive Histogram Equalization) used for enhancement process.

3.Background Prohibition

In Background prohibition process there is elimination of the background with continouous variations in radiance from an image after the objects in the foreground will be analyzed easily. By subtracting the original image intensity from the average filtered image the process of background prohibition can be performed. Average filter is the simplest operation which is also known as Neighbourhood average method.

4.Thresholding and Post-filtration

The main aim of this part is to generate a binary image having value either 1 for blood vessel and 0 for background. There is no thresholding techniques to find to a perfect threshold value which will give us a perfect result. In this proposed algorithm, we use technique called Isodata technique which will give a automatic threshold in order to produce a binary image. After thresholding process there is some unwanted noise present in the image because of which post-filtration needs to be done to get the proper image.

2) MULTILAYERED THRESHOLDING

1.Inverted Green Channel

As the input is in the RGB color format which contains no blue band and is having saturated red band but the better representation of the retina fundus image is presented by the green channel.

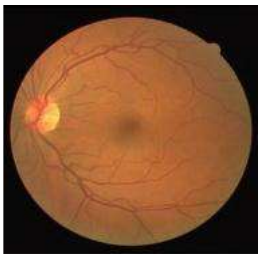

Fig.3 Input image

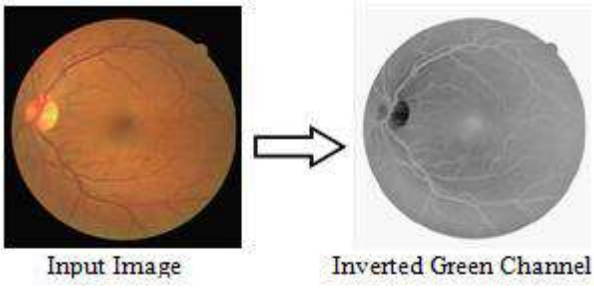

Fig.4 Inverted Green channel

The inverted green channel method is used because the blood vessels in the retina looks lighter than the background and this helps in the process of segmentation and for improving the quality of vessel.

2.Enhancement of Vessel

For thin and invisible vessels the visibility of the vascular pattern is not good which creates problem for the vessel segmentation. So improvement of vessel is necessary. There are various transforms for enhancing the vessels like Curvelet transform, Matched Filters and Gabor filter but for respective method we have used the Curvelet transform for thin vessels enhancement.

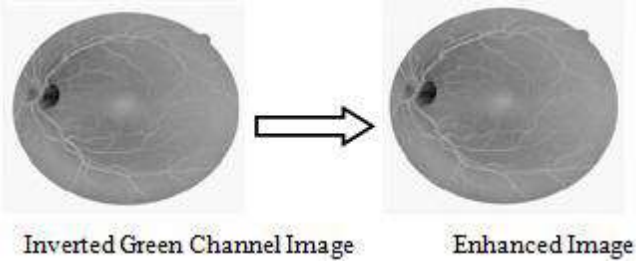

Fig.5 Enhanced Vessel

3. Image Histogram

In digital iamge the graphical reprentation of the tonal distribution can be seen in Image Histogram. After observing the Histogram of a particular image the user will be able to detemine the entire tonal distribution at a quick look.

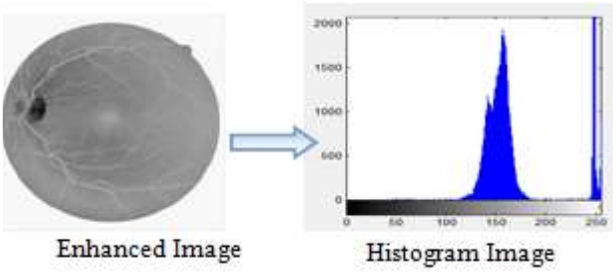

Fig.6 Histogram Image

4. Thinning Operation

It is a morphological operation used to remove pixel present in foreground from the respective binary image. The operation can be like opening or erosion. With the reduction of all the lines to a single pixel thickness the proposed method play a major role in improving the edge detectors output. Thinning operator will take 2 pieces of data. One piece as the input image which can either be binary or Gray scale image and other piece wil be the structuring element. When thinning is applied to binary images it will provide another binary image.

5.Segmentation

After all the above steps the segmenation which is the final step needs to be done. Manual blood vessel Segmentationhas been practised by the opthalmologists but it takes much time and a lot error can occur as change in the size of blood vessel takes place which may be much more complicated or can be in large quantity.

3) MATHEMATICAL MORPHOLOGY

This segmentation method is divided into 2 phase; one is the mathematical morphology and secondly the classification phase.

1.Mathematical Morphology

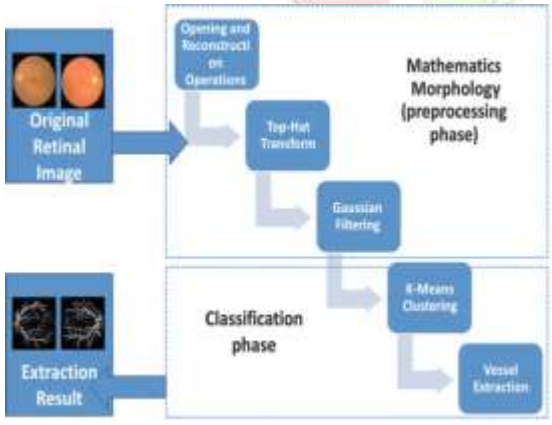

Fig.7 Architecture of respective segmentation method

For the purpose of removing noise and smoothing the process of mathematical morphology is used. Selection of a proper structuring element is necessary in order to get productive result. Here we choose the linearstructuring element based on the features of vessels. Even if the vessel and structuring element are in parallel direction there will be no change in the vessel. If we execute the Morphological opening operation with a linear structuring element which is longerthan the vessel's width then some part of the vessel will be detached.

2.Classification phase

The vessel from the image needs to be extracted in order to improve the retinal vessels. For determing the exact location of blood vessel is not a clear part because of the physics behind its image generation process. So for the segmentation process to takes place there is need of a powerful tool. In this method K-means clustering is being used in order to reduce variance within group with the help of portioning method for grouping object.

IV. CONCLUSION

In this paper we determine various methods for the Segmentation of blood vessels in Diabetic Retinopathy such as Histogram equalization and Automatic Threshold Selection, Multilayered thresholding, Mathematical morphology. Also with the help of various transforms the detection of optic disc can be done. In retina it is important to distinguish between the exudates and Optic disc. The pre-processing of the image should takes place in a proper way in order to decrease the possibility of incorrect output. The dataset which we have used here is DRIVE dataset.

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