International Journal of Advanced Information Science and Technology (IJAIST) ISSN: 2319:2682
Vol.3, No.9, September 2014 DOI:10.15693/ijaist/2014.v3i9.26-29

Pre-processing of Retinal Image and Image Segmentation using OTSU Histogram.

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***Abstract*: This paper discusses ongoing work on the segmentation of the optic disc in retinal images for calculation of Cup to Disc Ration (CDR). Image processing is an important step which can help detect many disorders in the eyes. Image segmentation is the process of dividing an image into regions or objects, which helps to analyse the image. This paper describes the proposed method of extracting CDR from the retinal images of the eyes obtained from Sudhalkar Eye hospital, Vadodara. The image segmentation is carried out using OTS U histogram. Morphological operation have been performed for the enhancement of the images and extract optic cup and optic disc region from the eye. Image processing has been carried out on 40 retinal images obtained from Stratus OCT. MATLAB software has been used for image processing on the retinal images.**

Keyword s: Glaucoma, image processing, OTSU histogram, segmentation, MATLAB.

I. INTRODUCTION

Glaucoma is the name for a number of conditions that damage the optic nerve, usually as a result of increased pressure within the eye that results when the naturally occurring fluid (aqueous humor) in the eye does not drain properly out of the eye. Slow drainage may occur with normal eye anatomy (open-angle glaucoma) or with structural problems in the drainage mechanism (angle-closure glaucoma). The optic nerve damage of glaucoma usually affects your peripheral vision first, leading to tunnel vision and moves progressively to involve your central vision. An efficient detection of optic disc in colour retinal image is a prerequisite to perform segmentation of normal and other pathological features. The measurement of varying optic disc to cup diameter ratio is used for detection of the glaucoma in fundus images. [14]

II. LITERATURE SURVEY

Anisotropic diffusion filter was used for noise removal. Otsu thresholding technique was used for segmentation. Cannyedge map and image in-painting for extraction of blood vessels have been applied for calcu lating CDR. CDR failed for some images due to other pathogens present. The computed CDR shows nearness as compared to that co mputed by HRT and ophthalmologist. [1]

The author Mrs. S. Vasanthi et al have used threshold to based initialization level set method and ellipse fitt ing algorith m for cup segmentation. [2]

The authors G. Jayanthi et. al have used active contour model for optic disk segmentation cup. They have applied Colour image segmentation by initializing window size, bit depth and colours for segmentation. K-means algorith m has been applied for classifying pixels in an ext racted feature space. [3]

Linear Discriminate Analysis, LDA algorith m has been used for pre -processing of the image for dimension reduction. The regions of Interest (ROI) have been than segmented using med ial axis. Morphological operation has been applied for feature extraction. The author has compared performance of various algorith ms and has found the proposed method to be best with f-score 0.9[4]

The authors Darsana S1, Rahul M Nair proposed masking method for calculat ion of ocular parameters such as Rim to Disc Ratio (RDR) and In ferior Superior Nasal Temporal (ISNT) Ratio and verification of ISNT Rule. The authors have discussed segmentation of fundus image feature into ISNT quadrants using array centroid method. Efficiency of the proposed method has not been mentioned. Also, how many samples of eyes were taken and their results have not been mentioned. [5]

The authors Eleesa Jacob1 et. al have defined super pixel classification for detection of glaucoma . Super pixel captures redundancy in the image and reduces the complexity of

Subsequent processing. They have used the simple linear iterative clustering algorithm (SLIC), for detection of super pixel as it is faster and robust in detection of boundaries, moreover it uses only one parameter, i.e. pixels. [6]

The authors have used the position of optic disc as a reference length for measuring distances in retinal images. Optic Disc is a bright region where the optic nerve and blood vessels enter the retina while the cup is a depressed area inside the Optic Disc. A quantitative understanding of the shape deformation within Optic Disc is used for evaluating the progression of glaucoma. [15]

III. METHODOLOGY

The aim is to segment the Optic disc and optic cup from the images of the eyes obtained. The following steps were applied for image pre-processing and segmentation of the image. Fundus, perimetry and OCT images of 20 patients have been classified.

The image processing is divided into 3 steps
(i) preprocessing,
(ii) image-based feature extraction
(iii) classification.

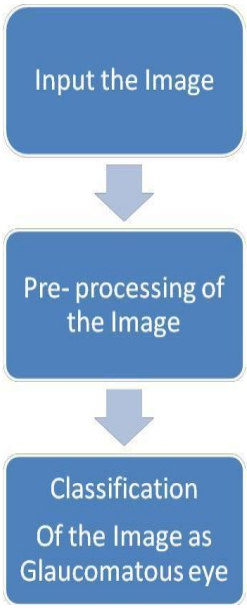

Fig 1. Pre -processing steps for retinal images

The pre-processing on the 40 retinal images was carried out, in which 20 are normal and 20 are glaucomatous eyes in the following steps:

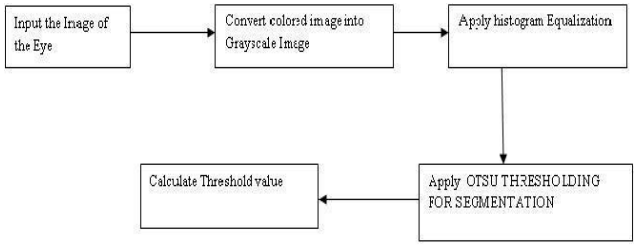

Fig 2: Steps for Image segmentation.

I) Steps for Pre-Processing of Images and Calculating Threshold value :-

The pre processing of the images is done in the following steps

1. **Original coloured images are first converted into gray scale for obtaining uniform intensity**

Colour images are often stored as three separate image matrices; one storing the amount of red (R) in each pixel, one the amount of green (G) and one the amount of blue (B). In grayscale images, we cannot differentiate the intensity of different colors, same amount of intensity is emitted in each channel. Thus, we can differentiate is the total amount of emitted light for each pixel; little light gives dark pixels and much light is perceived as bright pixels. When converting an RGB image to grayscale, we have to take the RGB values for each pixel and make as output a single value reflecting the brightness of that pixel. One such approach is to take the average of the contribution from each channel: (R+B+C)/3.

2. **After obtaining a gray scaled image, we have applied histogram equalization on each image to increase the contrast in image.**

Histogram of each pixel shows how the pixel value is distributed. Histogram Equalization is defined as equalizing the intensity distribution of an image or flattening the intensity distribution curve. Histogram equalization is used to improve the contrast of an image. Histogram based method is applied as they are very efficient compared to other segmentation method, as they require only one pass through pixels. Peaks and valleys in the histogram are used to locate clusters in the image.

3. **After applying histogram equalization on the original images the threshold value of the processed image is found .**

Applying a threshold will separate out the part of the optic disc and some other unconnected bright regions fro m the background. In this work an optimal thresholding based on

Otsu 1979 method is applied to separate brighter regions from dark background. Thresholding technique is based on clip – level or threshold value to turn a gray scale image into binary image. Several popular methods are used such as

- Maximum entropy
- OTSU
- K-means clustering.

The above steps were carried out using MATLAB2010a version.

IV. IMAGE SEGMENTATION

IMAGE PRE-PROCESSING AND SEGM ENTATION ON GLAUCOMATOUS EYES AND NORMA L EYES

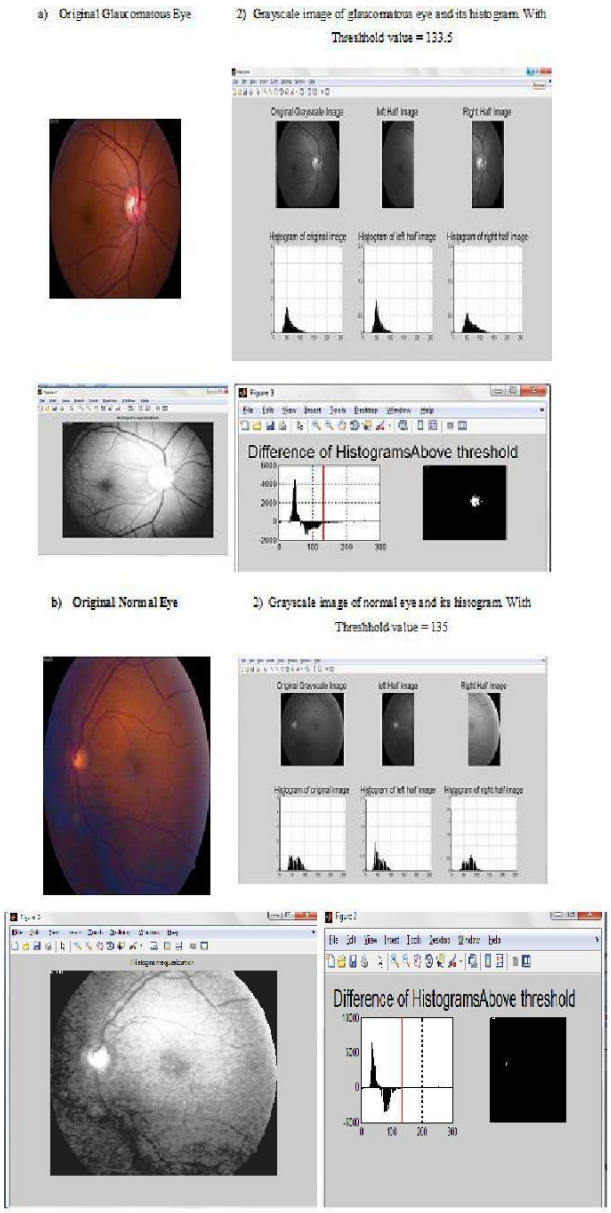

Fig .3 Comparison of Images of Glaucomatous eyes and Normal Eye.

Optimal thresholding method based on approximation of the histogram of an image using a weighted sum of two or more probability densities with normal distribution is used for initial thresholding of the retinal image. Histogram information derived from the source image is used to partition the brightest regions from background. As can be seen from the images the pixels corresponding to the optic disc and the optic cup belong to the higher intensity bars in the histogram. The diameter of the optic disc is in the range of 1.8 to 2mm. Based on the visual inference in a standard retinal image with 768×576 size with 20micron/pixel resolution, which is used to calculate the threshold value. A threshold value which segments out the pixels, corresponding to the top 1/3 of the grayscale intensity, is used to define the initial cup contour. The method to select the top 1/3 of the grayscale intensity is to find the threshold value from the normalized cu mulative histogram and then compare it with all the intensity values of the input image

V. RESULT

The histogram of normal eyes is plotted and compared with glaucomatous eyes. As seen in the figure the Otsu threshold value for normal eyes is found to be 135 and that of glaucomatous eye is 132.5.

VI. CONCLUSION

It has been found that threshold value for 20 processed normal eyes is approximately 135 ,Whereas, for 20 processed glaucomatous eyes approximately ranges between 132 to 134, depending upon the severity of glaucoma. Using Otsu threshold technique, cup contour has been segmented. And differential histogram has been plotted in which the highest pixel intensity represents the cup. The next step is to apply morphological operation for image enhancement and carrying out feature extraction for calculating CDR ratio.

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