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Glaucoma Detection using Pixel Counting

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ABSTRACT:

In biomedical engineering field, detecting glaucoma is really a challenging task due to lot of error. It also consumes too much time due to complex processing in many algorithms. In this research work, we propose a simple method of glaucoma detection using image processing. In addition with simplicity, the extra advantage of the method is that it is not time-consuming. We know that in the image of a glaucoma effected eye, white part is less compared with normal eye. Hence in this research work, initially color images of retina (both normal and glaucoma effected) are collected. The images are converted into the grayscale images followed by binary images using proper thresholding value. In the next stage, total number of white pixels are counted. At the final stage, a comparative study is done with the percentage value of white pixel number in the both types of images. It has been observed that the number of the white pixel in the normal eyes is more compared with glaucoma effected eyes.

Keywords: Glaucoma, pixel, thresholding, binarization

Introduction:

Image processing is widely used in many application to analyze many parameters in both medical and remote sensing area. For last few decades, researchers proposed a lot of techniques regarding this. Few researchers used deep learning in addition with image processing in medical image processing application to enhance the performance of the entire process. [1-3] Texture parameters are analyzed to extract more information from medical images which is required for detailed analysis. [4] Texture analysis is also used in some other medical applications including MRI images. [5, 6] Various image enhancement techniques are used for the last few years to as a part of pre- processing of many applications. [7 – 11] In these communications, researcher explained different methodologies to improve the quality of the output images by removing noise and unnecessary elements. Image compression is one of the important application in medical image processing. As medical images consume a large amount of data so it is necessary to compress them. Researchers proposed various algorithms in this area. [12-15] Due to various advantages of optics, optical methods like sinusoidal amplitude and phase grating, alpha blending, polarization are also used nowadays in medical image processing field. [16-20] Sinusoidal amplitude and phase gratings are used to generate multiple spectrum and only one is to be considered for the next process. Entire work is done in the optical frequency domain. Alpha blending is used for watermarking or hiding some valuable information of the image.

In the above mentioned algorithms, we discussed the different applications of digital image processing and optical techniques in medical image processing filed. In this communication, we used a simple image processing algorithm to detect glaucoma by counting the specific pixels in the image. Here, color images of retina is collected for the entire work. Initially the color images are converted into the grayscale images followed by the binary images. During the conversion of binary image from the grayscale image, a suitable threshold value is selected. In the next process, number of white pixels are counted in the binary images. Compared to the total number of pixels of the entire image, the percentage of white pixels are calculated. It has been observed that the percentage of white pixels is more in the normal eye compared with glaucoma effected eye. We performed the research work in simulation software and the process provides satisfactory result.

Methodology:

Let us assume that the color image is marked by $f_1(x, y)$

It is converted into the grayscale image which is marked by $g_1(x, y)$

Selected threshold value is th

Converted binary image is marked by $b_1(x, y)$

Pixels of the grayscale image is marked by $p_1(x, y)$

If $p_1(x, y) < th$

Then the value of the pixels in the image $b_1(x, y)$ is treated as 0

Otherwise the value of the pixels in the image $b_1(x, y)$ is treated as 255

[These values are selected because 0 is considered as pure black and 255 is considered as pure white]

Let, total number of pixels in the binary image $b_1(x, y)$ is T

Total number of white pixels in the binary image $b_1(x, y)$ is T_w

The percentage of the ratio is $\frac{T}{T_w}\ x\ 100$

In the next process, the percentage values are compared with the normal eye value.

Result:

The total research work is done using MATLAB simulation software.

The images of normal retina is displayed in the figure 1 whereas the images of glaucoma effected retina is displayed in the figure 2

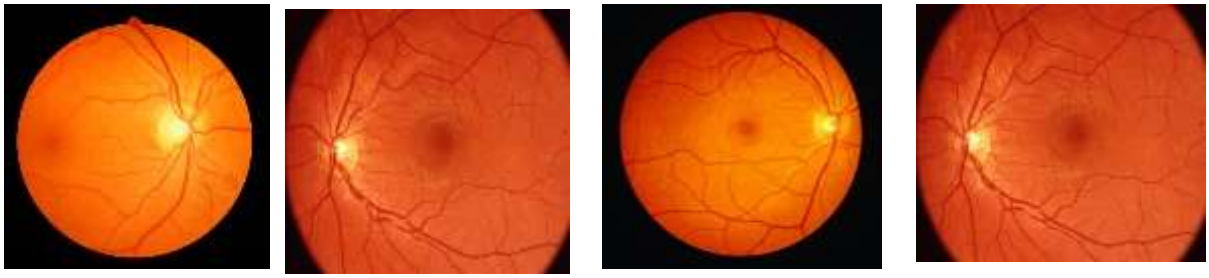

Figure 1 – Images of Normal Retina

Figure 2 – Images of Glaucoma Effected Retina

During the binarization process, we have used different values as thresold and achieved the satisfactory result when the thresold value is 190. Figure 3 displays the output of the images using thresold value 100, 130, 150, 170, 190 respectively.

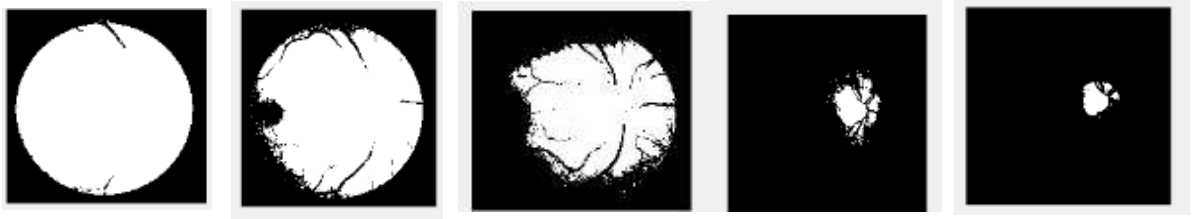

Figure 3 – Binary Images with different Thresold Values

The percentage calculation of the total number of pixels and the white number of pixels is shown in the Table 1. Though we have worked with 30 number of images, here only the result of fewimages are displayed in the table.

Table 1

Sl No.	Image	Percentage (Total Pixels/ White Pixels)	Result
1	Image 1	0.61	No Glaucoma
2	Image 2	0.39	No Glaucoma
3	Image 3	0.61	No Glaucoma
4	Image 4	0.14	No Glaucoma
5	Image 5	0.88	No Glaucoma
6	Image 6	3	Glaucoma Effected
7	Image 7	16	Glaucoma Effected
8	Image 8	11	Glaucoma Effected
9	Image 9	4.5	Glaucoma Effected
10	Image 10	8.2	Glaucoma Effected

Conclusion:

From the table 1, it is clear that the percentage of the number of white pixels in the glaucoma effected eyes is more than 2%. So using this simple process, by counting the number of white pixels ratio, we can easily determine whether an eye is glaucoma effected or not. This process is not time consuming due to less number of computation algorithms. This method is simple and it is independent of image resolution. The modified version of this method is used to calculate the ratio of the retina diameter which will be explained in the future communication.

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