Distinguishing Normal and Abnormal Eye Images Based on Pixel Intensity Level

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ABSTRACT

In developing countries, blindness is to be one of the major public health problems. The major causes of blindness are Cataract and corneal diseases. Corneal diseases are among the major causes of vision loss and blindness in the world today. In India, it is estimated that there are approximately 6.8 million people who have vision loss due to corneal diseases. About 10.6 million people will suffer from unilateral corneal blindness in India by 2020. The National Programme for Control of Blindness (NPCB) estimates, there are currently 120,000 corneal blind persons in the country. It is estimated that there is addition of 25,000-30,000 corneal blindness cases every year in the country. The burden of corneal disease in our country is reflected by the fact that 90% of the global cases occurring due to ocular trauma and corneal ulceration which is leading to corneal blindness. This paper proposes a method for detection of eye diseases using image processing. Eight sets of normal and affected eye images are taken for analysis. Normal and abnormal eye images are obtained and the image is enhanced using histogram equalization. The region of interest is identified and mean pixel intensity value is calculated and compared with a threshold value to identify the image as normal or abnormal eye. The results obtained show that the accuracy of the proposed method is 75% with two false positives and one false negative.

Keywords –**Abnormal Eye, Blindness, Corneal Disease, Mean Pixel Intensity Value, Normal Eye**

I. INTRODUCTION

Eyes are the organs of the visual system. They provide us with the ability to see and process visual detail. They do so by detecting light and converting it into electro chemical impulses. The optical system of the eye consists of the pupil through which light enters the eye and is focused on the retina by the adjustable lens. The retina converts light into electrical signals and transmits these to the brain via the optic nerves. More and more people are suffering from some forms of eye disease and the numbers have been rising over the years. Most of the patients affected by eye disease are not aware of it as the diseases progress slowly. So, if the doctors are able to detect the disease earlier then there will be higher chances of preventing visual loss in the patients. Today we have reached a stage where eye diseases can be diagnosed by capturing optical images and processing them in a computer. Feature extraction from the obtained images help in finding out abnormalities. In this paper, we propose a method to detect the eye diseases in an early stage by using image processing.

Vijayalaxmi.etal[1],developed a Non-Intrusive Driver's Drowsiness detection system based on eye blink rate for preventing accidents on road. Rommel Anacan.etal[2],introduced an Eye-GUIDE, which is an assistive communication tool designed for the paralyzed or physically impaired people, who were unable to move parts of their bodies especially those whose communications are limited only to eye movements. Zeynep Orman.etal[3], presented a study over the existing literature on face and eye detection and gaze estimation. Md. Alamgir Hossai.etal[4], proposed a covariance approach for finding the phase of the disease for the treatment consultative module. Hari Singh.etal [5], presented a review on various techniques used for eye tracking, number of principles used in measuring eye movements, including measurements of electric and photoelectric signals, tracking a number of visual features in the image of the eye. Ishmeet Kaur.etal[6], presented different approaches adopted for segmenting theretinal vessels along with the future directions.Amit Asish Bhadra.etal[7], proposed method to diagnose the mentioned eye diseases is based on the effective computation approach using wireless communication network.

II. METHODOLOGY

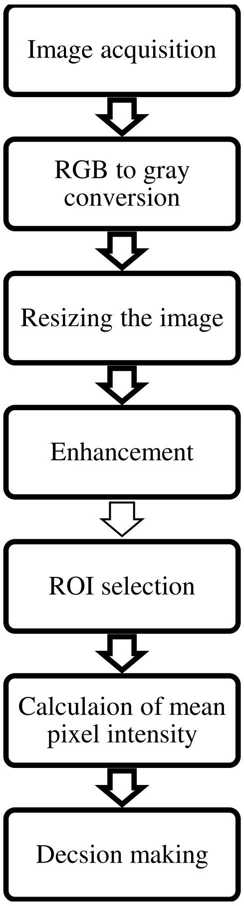

Figure 1: Block Diagram

Fig 1 shows the block diagram of the proposed method. Eight sets of normal and affected eye images are taken for analysis. The images are converted from RGB to gray. The region of interest (ROI) is then selected. The ROI here is the sclera present on the left and right side of the pupil.The selected ROI is filtered and enhanced using histogram equalization. The enhanced ROI are taken and the mean pixel intensity values of both normal and affected eye images are calculated. The difference in the mean pixel intensity value is taken as ΔMean. The threshold value is calculated by averaging the ΔMean of normal and abnormal eye images. The calculated mean pixel intensity values of the normal and affected eye images have been compared to the threshold value toidentify the normal and affected eye.

Decision rule: The average of the ΔMean is taken as the threshold value. If the ΔMean value is lesser than the threshold value, then the eye is identified as a normal eye and if the ΔMean value is greater than the threshold then the eye is identified as an abnormal eye.

The formulae used are as follows:

ΔMean = Mean Pixel intensity (right side of pupil) - Mean Pixel intensity (left side of pupil) ——————(1)

$$\text{Threshold Value} = \frac{\sum \Delta Mean}{16} \qquad (2)$$

III. RESULTS

Figure 2: Normal Eye Images

Figure 3.1: Eye burning itching and discharge

Figure 3.2: Uveitis

Figure 3.3: Watery eyes


Figure 3.4: Cataract


Figure 3.5: Glaucoma


Figure 3.6: Hordeolum and stye


Figure 3.7: Eye Infection

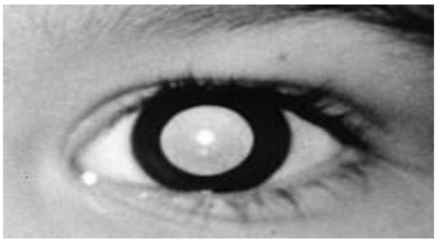
Figure 3.8: Amblyopia

Figure 3: Abnormal Eye Images

Table 1: Mean pixel intensity for normal eyes

S. No	Images	Mean Pixel Intensity value of right ROI-Mean Pixel Intensity value of eye ROI	│ΔMean│ (Mean of Right ROI-mean of left ROI)
1	Normal 1	183.7327-226.6302	42.8975
2	Normal 2	146.8440-219.0070	72.163
3	Normal 3	220.8875-225.9299	5.0424
4	Normal 4	155.8980-241.9307	86.0327
5	Normal 5	195.2701-244.1816	48.9115
6	Normal 6	132.1302-169.9050	37.7748
7	Normal 7	118.4111-131.5647	13.1536
8	Normal 8	156.2777-233.5234	77.2457

Table 2: Mean Pixel intensity for abnormal eye

S. No	Images	Mean Pixel Intensity value of right ROI-Mean Pixel Intensity value of eye ROI	│ΔMean│ (Mean of Right ROI-mean of left ROI)
1	Eye burning itching and discharge	65.4379-213.0192	147.5813
2	Uveitis	137.7967-207.1572	69.3605
3	Watery eyes	125.4095-209.2986	83.8891
4	Cataract	243.6034-211.7138	31.8896
5	Glaucoma	118.3874-210.9957	92.6083
6	Hordeolum and stye	110.4214-228.5242	118.1028
7	Eye Infection	81.2126-159.0433	77.8307
8	amblyopia	163.7461-249.0616	85.3155

$\sum\Delta$Mean=42.8975+72.163+5.0424+86.0327+48.9115+37.7748+13.1536+77.2457+147.5813+69.3605+83.8891+31.8896+92.6083+118.1028+77.8307+85.3155

$\sum\Delta$Mean=1089.799

Threshold Value = $\frac{1089.799}{16}$ = 68.1124

Table 3: Accuracy estimation of the proposed method

S. No	No. of normal eye images tested	No. of abnormal eye images tested	No. of false positives (in case of normal eye images	No. of false negatives (in case of abnormal eye images)	Accuracy (%)
1	8	8	3	1	75%

Fig 2 shows the set of normal eye images. Fig 3 shows the set of abnormal eye images. Table 1 shows the mean pixel intensity value of right ROI and left ROI of normal eye images taken. Table 2 shows the mean pixel intensity value of right ROI and left ROI of abnormal eye images taken. Table 3 shows the accuracy calculation of the proposed method.

IV. DISCUSSION

Eight set of normal and affected eye images are taken for analysis. A region of interest is identified in each sample and it is enhancement using histogram equalization. Mean pixel intensity values are calculated is set as the threshold. The calculated pixel intensities are compared with the threshold value to identify the normal and abnormal eye.
The calculated threshold value is compared with each ΔMean value. The decision rule states that if ΔMean value is above the threshold value is identified as abnormal eye and if the ΔMean value is below the threshold value its identified as normal eye.
From Table1 it is observed that out of the eight normal eye images five images have ΔMean values lesser than the threshold and three images have ΔMean value greater than the threshold. Five images are correctly identified as normal eye and three images are wrongly identified as abnormal eyes.
From Table 2 it is observed that out of the eight abnormal eye images seven images have ΔMean value greater than the threshold and one image has ΔMean value lesser than the threshold. Seven images are correctly identified as abnormal eye images and one abnormal eye image is identified as a normal image.
In this process, all the abnormal eyes except one is identified correctly but three of the normal eyes are also identified as abnormal thus giving us a false positive. The proposed method identifies abnormal eyes with an accuracy of 87.5%.

V. CONCLUSION

The proposed method has been tested on 16 images, 8 normal and 8 abnormal eyes. This method has an accuracy of 87.5% for detecting abnormal eyes. The results obtained show that the accuracy of the proposed method is more for identifying abnormal eye images. The accuracy of the proposed method has been calculated only for the 16 images used in this work, to obtain the exact accuracy this method must be tested on a large set of images. Future work must be aimed at probing into image processing techniques with suitable empirical relations to improve the accuracy of analysis.

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