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Detection of the State of Fundus Image Using Morphological Process

M Vasanthalakshmi[*1],Tirupathi V VGurunadha Sarma[*2], Shaik Mehamood[*3],Vadlapudi Naga Sai Vardhan[*4], Shaik Baji[*5]

Assistant Professor, Department of Electronics and Communication Engineering, Vasireddy Venkatadri Institute of Technology, Nambur, Guntur, Andhra Pradesh, India[*1]

Student, Department of Electronics and Communication Engineering, Vasireddy Venkatadri Institute of Technology, Nambur, Guntur, Andhra Pradesh, India[*2,3,4,5]

ABSTRACT: The human eye is the organ that enables us to see things. The eye plays a key role to interpret the shapes, colors, and dimensions of various objects. So, the retina plays a vast role in human vision system. Identification of abnormalities is a test for the ophthalmologists and detection of the diseases in an early stage can avoid lasting vision misfortune.In this paper, we proposed a way for segmentation of the disc present inretinalimages which is efficient and also with a better accuracy than the existing methodologies. The main objective is to detect the image is normal or abnormal. The whole process is mainly divided into three categories. In the first stage, we perform preprocessing operation. In second stage we perform segmentation operation, for this we use morphological and thresholding algorithms to segment the blood vessel region from the image. The final stage involves post processing. A CDR value is estimated to recognize the input mage is normal or abnormal which helps in early detection of diseases like glaucoma and diabetic retinopathy. The results show that the proposed method performs better in terms of accuracy andalso provides user friendly interaction by communicating the status of an eye through text message.

KEYWORDS: retinal images, morphological, thresholding, CDR

I. INTRODUCTION

In our daily life, we see unique objects, colors and nature. All this is possible through our eyes only. So, our eye plays a key role in a day-to-day life. But many people are suffering from different eye problems which leads to vision loss problems and blindness. But detection of these diseases in an early stage leads to minimize the problem. So, detection of the abnormalities in an eye is best way to decrease the problem. normally we extract blood vessels from retinal images for detection of abnormalities. Retinal fundus images with high resolution could help ophthalmologists to diagnosediseases automatically by extracting blood vessels, the optic disc, and macula. OD detection helps to easily identify vascular structures. Width measurement also helps in finding the any change happen in width of a blood vessels which eventually helps in early diagnosing of many diseases like glaucoma, diabetes, and hypertension etc. Optic disc is the brightest feature in a fundus image and has an elliptical shape. It appears in bright orange-pink with apale center.Thepresence of orange-pink appearance indicates the healthy neuro-retinal tissue. Due to pathological reasons, the orange-pink color gradually disappeared and looked pale. The loss of optic fibers due to glaucoma progression is associated with a corresponding change in the optic disc. So, this is the cup to disc ratio (CDR), defined as the relation between the OD and cup area. Optic disc appearance is therefore, critical in glaucoma diagnosis, and retinal images are mandatory for a correct disease assessment. Image-based glaucoma diagnosis mainly uses CDR analysis. Currently, this calculation is based on manually selected areas in the retinal fundus image. The skilled human grader must carefully draw the region with image editor software tools, and afterwards, the ratio of the areas is calculated. So, the Manual observation of a retinal blood vessel takes a long period of time.Hence,computer based automatic segmentation can provide fast and easy segmentation of blood vessels in retinal images without any bias.Now a days many methodologies have been proposed for detection of blood vessel in retinal images for the early detection of many diseases and which results in prevention of vision loss. But the main issue is accuracy and also their computational speed. So, our proposed method comes with better accuracy and takes less time for computation result.

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II. METHODOLOGY

This paper works using morphological process in extraction of blood vessels in retinal images. In first stage we perform some preprocessing operations such that we can implement image resize, R-G-B channel separation and Grayscale conversion. In segmentation we perform morphological and thresholding operations to segment the image. In post processing we estimate the CDR value based on that we predict the input image is normal or abnormal.

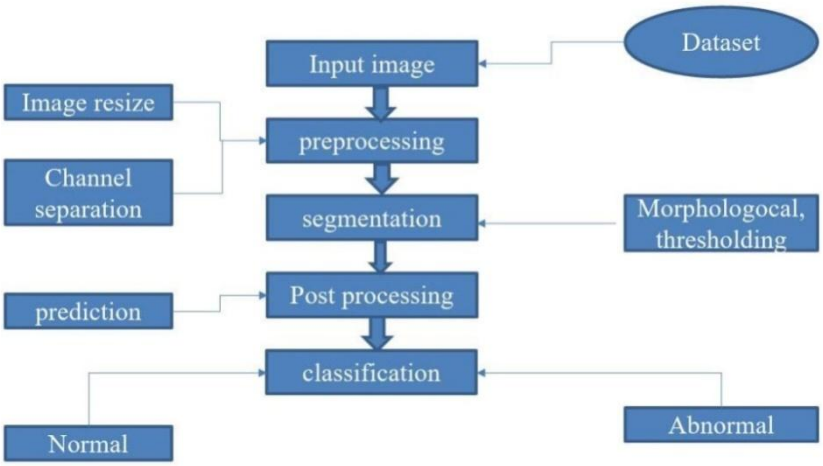

Fig 1. Block Diagram of proposed architecture

2.1)Preprocessing Stage

Some images captured by the camera and input to our algorithm have different sizes, so we need to set a basicsize for all images. In general, RGB images consists of three channels (red, green and blue) This can be accomplished by dividingthe retinal image into three channels and using only one of them (the green channel), the blue channel is characterized by low contrast and does not have much information about blood vessels. The vessels are visible in the red channel but this channel contains high noise or it is simply saturated, since most of the features emit signal in the red channel. While the green channel will have less noise than the red or blue channel, and also gives best result in the contrast of blood vessels (darker blood vessels or bright background). Therefore, the green channel of the image is used in the further analysis of retinal images. The Grey-scale image provides luminance information from the retinal images after eliminating the hue and saturation. The conversion of color image to gray-scale image is carried out by forming a weighted sum of the RGB components as given below.

$$gray = 0.2989 * R + 0.5870 * G + 0.1140 * B$$

where R, G, and B represents the red, green and blue components respectively.

2.2) Segmentation Stage:

Blood Vessel segmentation of retinal pictures performs a crucial function withinside the prognosis of eye diseases. Here firstly, a multidimensional feature vector is built with the green channel intensity and the vessel enhanced intensity through the morphological operation. The operations such as dilation and erosion are present in the morphological operations. Dilation concept is about adding the pixels and theconcept of erosion is removing the pixels on the object boundaries. Vessel structure is removed by inpainting process. The boundary of the OD can be determined by binary thresholding operations.

2.3) Post Processing Stage:

At this stage, the Receiver operating characteristic (ROC), performance analysis and CDR value are truth conducted by the ophthalmologists. ROC is used to measure the value of FP, FN, TP and TN of the segmented. ROC analysis is based on the values of TP and TN, produced by classifying each pixel as positive and negative values from the segmented input image.Based on CDR value we predict the input image is normal or abnormal. We find the area of cup

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and disc then the ratio of the areas of cup to disc provides the value of CDR. If CDR is less than 1 then it is normal image otherwise it is referred as abnormal image

III. SYSTEM REQUIREMENT

1. Operating System: windows
2. Processor: Intel Pentium
3. RAM: 4GB

IV. SOFTWARE USED

Python is an object-oriented programming language and provides rapid application development. It was released during 1991-1992 by Guido van Rossum.Python needs a unique readable syntax, which makes the language easy to learn and easy to understand. It supports modules and packages that allowcode reuse and program modularity. You will be pleasantly surprised how easy it is to focus on the problem-solution rather than the syntax and structure of the language you re programming in.Python can be used for Data visualization, game development, web development, programming applications.Python follows an organized structure. This, combined with its versatility and simple syntax, makes it an excellent programming language for all type of projects.

Some of the important features of python are given below

1. simple and easy to learn
2. free and open source,
3. High-level language
4. portable and
5. Extensible

V. PERFORMNACE METRICS

True Positive (TP): region segmented as Disk or Cup that also proved to be Disk or Cup

True Negative (TN): region segmented as not Disk or Cup that also proved to be not Disk or Cup

False Positive (FP): region segmented as Disk or Cup that also proved to be not Disk or Cup

False Negative (FN): region segmented as not Disk or Cup that also proved to be Disk or Cup

Table 1. Confusion matrix

Parameter	Actual value (Positive)	Actual Value (Negative)
Predicted value (Positive)	True Positive	False Positive
Predicted value (Negative)	False Negative	True Negative

Specificity: TP /(TP+TN)

Sensitivity=TN / (TN + FP)

Accuracy=(TP+TN)/(TP+TN+FP+FN)

CDR= (area of cup)/(area of diameter)

VI. RESULTS AND DISCUSSION

The procedure described above is applied on the 100 images. The results were found satisfactory. The CDR value is calculated from the segmented image of a fundus image. Based on that CDR value, the input fundus image isclassified as normal or abnormal. The images which have a CDR value less than one are classified as normal images. The images with CDR value greater than one are classified as abnormal images. The accuracy is improved, sensitivity and specificity parameters are calculated. A performance estimation chart of accuracy, specificity and sensitivity is also provided.

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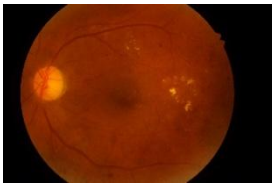
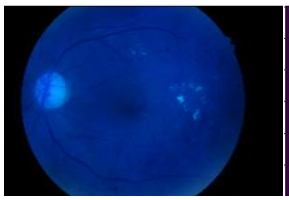
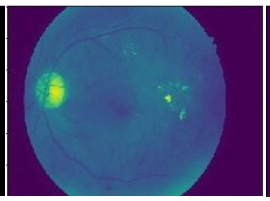
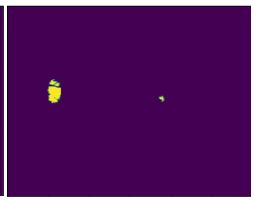

Fig 2: Original image Fig 3: Resized image Fig 4: Gray image Fig 5: Segmented image

Table 2. Comparison of different performance metrics

1	Accuracy	97
2	Sensitivity	96
3	Specificity	98

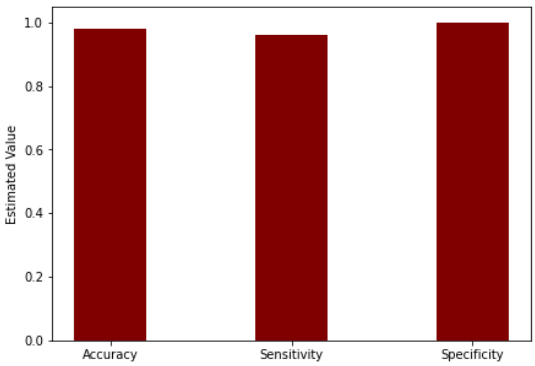

Figure 6: Performance Estimation

VII. CONCLUSION

In this paper CDR value is determined for both the abnormal and normal fundus images. We have found satisfactory results in both normal and abnormal cases.we communicate the status of a fundus image is normal or abnormal through a text message to the respective patient.However, this is possible only when the respective affected person phone number is registered with us.So, the early detection of a disease in a fundus image results in treating the abnormalities in a better way.

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