A Novel Approach to Detect Glaucoma in Retinal Fundus Images using Cup-Disk and Rim-Disk Ratio

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Abstract— Glaucoma is a continual disorder which if now not detected in early stages can lead to permanent blindness. The scientific approaches utilized by ophthalmologists like HRT and OCT is high priced and time ingesting. As a result, there is a need to strengthen automated computer aided system which is able to become aware of glaucoma effectively and in much less time. Optic disk and optic cup are prime aspects which help in diagnosing glaucoma. For that reason, proper segmentation of optic disk and optic cup performs an major position in detecting the sickness. On this paper an adaptive threshold based approach which is impartial of photo great and invariant to noise is used to phase optic disk, optic cup, Neuroretinal rim and cup to disk ratio is calculated to screen glaucoma. Another ocular parameter, rim to disk ratio is also considered which in mixture with CDR gives extra reliability in picking glaucoma and makes the procedure extra robust. Extra an SVM classifier has been used to categorize the pixel as glaucomatic or non glaucomatic. The experimental outcome acquired is compared with the ophthalmologist and is discovered to have excessive accuracy of 90%. Also additionally, the proposed system is rapid, having low computational fee.

**Key words:** Cup to Disk Ratio (CDR), Rim to Disk Ratio (RDR), Glaucoma Detection

I. INTRODUCTION

Glaucoma is the ocular disease which ends up in everlasting blindness peculiarly in aged people. Because the sickness is irreversible it’s important to realize it in its early phases. The clinical methods utilized by ophthalmologists similar to Heidelberg retinal tomography (HRT) and Ocular coherence tomography (OCT) to screen glaucoma are time ingesting and requires special talent and equipments. Therefore there's a need for laptop based automatic methods which make screening of glaucoma simpler and rapid. A digital fundus photo is used for screening of glaucoma as it consumes less time, have better accuracy and requires no skilled force. As in comparison with different tricky instruments, digital fundus, digital camera is more economical and is mainly utilized in basic eye examination.

Probably the most customary method [1] through which glaucoma can also be detected is by means of discovering cup-disk ratio. Detection of optic disk [2] is major in establishing computerized diagnosis programs and its segmentation is a imperative and a central step. One system [3] where optic disk is localised automatically is principal aspect analysis (PCA) and its form is detected via active shape model (ASM). Gaussian Vessel Detector and Tangent know-how transform [4] are used for detecting optic disk centre. Digital image processing systems similar to morphological operations and thresholding [5] are traditionally used in automated detection of optic disk, blood vessels and computation of the points to realize glaucoma. Additionally there has been some work achieved in automated segmentation [6] of optic disk and optic cup from fundus images. Glaucoma produces version in shape, color and depth of optic disk which helps in its identification [3]. Wavelet established energy points [7] are applied inside fundus portraits for efficient glaucomatous classification. Aspects comparable to cup-disk ratio and ISNT ratio [8] are used for detection of glaucoma. Digital fundus images are analysed in two phases [9] one among which is vessel detection and inpainting. The 2nd phase contains of CDR calculation Picture inpainting and active contour mannequin has been used for detection of optic disk and optic cup. As the cup size increases, it also influences Neuroretinal rim (NRR). NRR is the vicinity located between the threshold of optic disk and optic cup. In case of glaucoma, area ratio protected by means of NRR in inferotemporal areas is much less as in comparison with the discipline covered by way of NRR in common eye [10].Despite the fact that some picture processing techniques had been proposed, there may be nonetheless a requirement for extra expert, more reliable and no more intricate process that is unbiased of image great to screen glaucoma.

II. IMPORTANT FEATURES OF RETINAL FUNDUS IMAGE

Fundus is a Latin time period, automatically relating to a element of organ reverse from its opening. Fundus photo of an eye fixed is the graphic of the interior floor of the eye which entails retinal blood vessels, macula, fovea, optic disk and optic cup as proven in Fig. 1. For the reason that glaucoma influences optic disk and optic cup through altering cup to disk ratio and rim to disk ratio for this reason right segmentation of both the features is major for glaucoma detection.

![Fig.1: The coloured RGB fundus image](image-url)
III. METHODOLOGY

In this paper, RGB fundus image is used as an input. In order to detect glaucoma, the most important region of interest is optic disk. Thus, instead of processing on the whole retinal image, region only optic disk is extracted. This ROI is a small image which helps in faster processing and large automated screening of glaucoma. The flowchart of proposed method is described in Fig 2. Each block is explained separately in this section.

B. Optic Disk Segmentation

The extracted ROI photograph contains three channels, red, green and blue as proven to discover optic disk, red channel is used in this channel, optic disk seems to be the brightest and blood vessels are also suppressed in this channel. Accordingly it is less difficult and accurate to phase optic disk in pink channel of enter fundus image. Otsu thres holding process is used to section the optic disk which makes the segmentation unbiased of photo first-class.

C. Neuroretinal Rim

Neuroretinal rim is the region located between the edge of optic disk and optic cup. After segmenting of optic disk Fig (a) and optic cup (b), NRR is obtained by subtracting optic cup from optic disk. NRR is shown in Fig (c).

Algorithm for evaluating Rim-disk ratio:
1) Mask of measurement of ROI snapshot is created for each and every quadrant of fundus photograph as proven in.
2) Each quadrant masks is improved in my opinion with Neuroretinal.
3) Whole discipline of rim is calculated in inferior and temporal regions.
4) Ratio of rim field in infero-temporal neighborhood to the total disk discipline is taken as RDR.

D. Classification

Classification of images as glaucomatous or healthy is done on the basis of two parameters; Cup to disk ratio and rim to disk ratio.

E. Cup to Disk Ratio

The primary parameter that we use to notice glaucoma is CDR i.e. Cup-disc ratio. CDR is outlined as ratio of whole segmented cup area to total segmented disk field. CDR = Optic Cup subject/Optic Cup subject (5) Cup field and disk discipline are accomplished by summing of all the white
pixels in segmented cup and disk. This calculated CDR is used for screening of Glaucoma. If CDR is higher than 0.3 (globally authorized price), the fundus photo below experiment is said to be glaucomatous else it is healthy.

F. Rim to Disk Ratio

The CDR in itself just isn't some of the high-quality predictors of whether or not the eye is glaucomatous. Many a times a character has been identified inappropriately as a result of colossal optic cup in presence of gigantic optic disk and has healthful rim tissues. Hence Neuroretinal rim tissue performs a critical function in glaucoma detection. Rim to disk ratio is evaluated utilising the algorithm stated above. It's defined as RDR= Rim discipline in infero-temporal region/ Disk subject (6) After examining a database of 50 pix, worth of zero.Four is determined as threshold for classifying pictures as glaucomatous or not. If RDR is not up to equal to zero.Four, fundus snapshot is considered to be glaucomatous else it's glaucoma free. Each these parameters are calculated to train the SVM classifier for detecting glaucoma to be able to develop the reliability and robustness of the approach.

IV. EXPERIMENTAL RESULTS

After extracting the points from fundus portraits such as optic disk, optic cup and Neuroretinal rim, ocular parameters such as CDR and RDR are evaluated for a database of around 60 portraits to categorise them as glaucomatous or healthy. These samples are accrued and labelled via medical professionals of Venu Eye research Centre, New Delhi. The pics had been received utilizing an excessive decision fundus digital camera suitable to seize the retinal surface of the eye.

For classifying the fundus photographs as glaucomatous or healthful, rbf kernel of SVM was used. An accuracy of ninety% with one hundred% sensitivity and eighty% specificity was once received for the SVM classifier with forty coaching and 20 trying out samples. The 40 coaching samples consisted of 20 glaucomatous photographs and 20 common photos.

V. CONCLUSION

An effective technique to discover glaucoma is proposed on this paper. So as to classify the input fundus snapshot as glaucomatous or healthful, two exclusive ocular parameters, cup to disk ratio and rim to disk ratio are regarded. Adaptive picture threshold system is used to segment optic disk and optic cup which makes the proposed system independent of image exceptional and invariant to noise. The thresholding method makes the procedure robust and amazing, as it depends upon the neighborhood features equivalent to imply and typical deviation extracted from the picture. Neuroretinal rim is obtained from segmented optic disk and optic cup which is used to evaluate Rim-disk ratio in infero-temporal regions which helps in screening glaucoma. SVM classifier is used to categorise the fundus photos as glaucomatous or healthy. When confirmed on a significant information set of 60 fundus images, the proposed approach gives promising results over ninety% accuracy, one hundred% sensitivity and eighty% specificity.

Future work could contain extracting more parameters in fundus photo which displays glaucoma signs corresponding to disk hemorrhage, focal notching, peripapillary atrophy, ISNT ratio, and many others. Study of those motives requires deep processing of fundus image. Extending these parameters to the proposed work could make the method extra automated and safe, giving better accuracy.

REFERENCES

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