Smart Intelligent Computing and Communication Technology
V.D. Ambeth Kumar et al. (Eds.)

doi:10.3233/APC210098

Vision Atrophy Screening and Revelation

Kiruthiga Devi M[a], Lingamuthu K [b], Baskar M[b], Deepa B[c] and Merlin G[d]
[a]*Assistant Professor, Dept of CSE, Sri Sai Ram Engineering College*
[b]*Student, Dept of CSE, Sri Sai Ram Engineering College*
[c]*Assistant Professor, Dept of IT, Sri SaiRam Institute Of Technology*
[d]*Assistant Professor, Dept of IT, Kings Engineering College*

Abstract: Glaucoma which is known as the "thief of sight", is an irreversible eye disease It is mainly caused by increased intraocular pressure (IOP), or loss of blood supply to the optic nerve. Glaucoma detection and diagnosis is very important. By analyzing the optic disc and its surroundings, This paper introduces a method for providing automated glaucoma screening services based on a framework that proposes a retinal image synthesizer for glaucoma assessment by analyzing the optic disc and its surroundings. The Cup to Disc Ratio (CDR) is critical for the system, and it is calculated using 2-D retinal fundus images. The synthetic images produced by our system are compared quantitatively. The structural properties of synthetic and real images are analyzed, and the quality of colour is calculated by extracting the 2-D histogram. The system allows patients to receive low-cost remote diagnostics from a distance, preventing blindness and vision loss by early detection and management.

Keyword: CDR value, Fundus Image

1. Introduction

Vision loss caused by glaucoma cannot be reversed, unlike other eye disorders such as cataracts and myopia[1]. By 2021, it is expected to hit about 80 million people around the world. Many glaucoma patients are unaware of their disease. As a result, early detection is critical for early care in order to preserve vision and quality of life. Optic nerve fiber misfortune is the most common symptom, which is indicated by increased intraocular pressure (IOP) or probably a lack of blood flow to the optic nerve. Intraocular pressure (IOP) estimation, Function-based visual field examination, and Optic nerve head (ONH) evaluation are the three clinical tests used to screen for glaucoma[3]. The optic nerve head or optic disc can be visually divided into two zones in a 2D fundus image, a bright and central zone called the optic cup[2]. We then determine the CDR value in order to predict the potency of the disorder.

[1]Kiruthiga Devi M, Assistant Professor, Dept of CSE, Sri Sai Ram Engineering College, India
E-mail: kiruthiga.cse@sairam.edu.in

2. Literature Survey

An ensemble approach for optic cup detection based on spatial heuristic analysis in retinal fundus images.Optic cup location stays a difficult assignment in retinal picture examination, and is of specific significance for glaucoma assessment, where illness seriousness is regularly evaluated by the optic cup size. They used the ORIGA informational array of 650 retinal pictures to conduct experiments and found that the group technique outperforms the separate divisions[1].Local patch reconstruction framework for optic cup localization in glaucoma detection. cup confinement/division has drawn much consideration from clinical imaging analysts, since it is the essential picture segment clinically utilized for recognizing glaucoma, which is a main source of visual deficiency. Two sorts of neighbour hood patches, for example networks and super pixels are utilized to show the assortment, speculation capacity and vigour of the proposed system[2]. The existing system has been designed in such a way that the evaluation of the CDR value is completely based on 3D SCAN[10]. The patient's health is completely analyzed based on the scan report. With respect to 3D images, calculate the cup-to-disc ratio. The ILM (Inner Limiting Membrane) and RPE (Retinal Pigment Epithelium) layers, as well as the CDR value, are appropriately segmented using an efficient computer-aided technique that takes an OCT picture as reference[10]. Transitions in the inward retinal layers caused by glaucoma have been examined.

3. Proposed System

The proposed system tries to solve the problem by aggregating patients' two dimensional fundus image. The Image Synthesizer accepts the 2D Retinal Fundus Image, which was earlier collected by an non-invasive method. Images with marked CDR data are used for producing adequacy from the referred data and contrasting conditions, which are used during optic disc classification and redesign[5]. Our methodology could be used as a desktop glaucoma diagnostic tool. Ophthalmologists may help the persons irrespective of their place, pace or time.

4. System Implementation

A plan with various modules, helps to lessen complexity, looks into modifications, and finally gives in easy implementation with improvement in various components of the project. Module 1: Image Synthesizer. Module 2: CDR Evaluation. Module 3: Algorithm (Testing & Predicting).

4.1. Image Synthesizer

In this module all the data about the patient's eye is extracted from the available and regularly collected 2D-Fundus image for analysis and evaluating the CDR value[8]. We approached our nearby Eye care Hospital and collected images of 2 patients, one tested positive and other with negative.

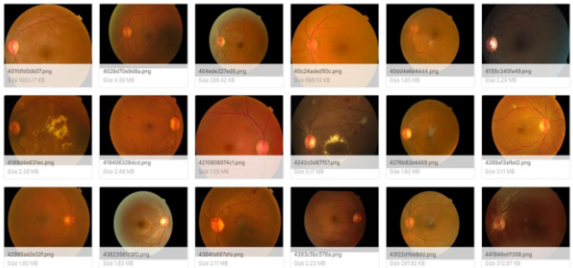

Figure 1. Set of collected 2D-rendus images

4.2. Dataset

We downloaded publicly available datasets from the internet, Example, Kaggle, data.gov.in, etc. In the image of a two dimensional fundus, there is an elliptic shaped part that is luminous than the others nearby called optic disc. Continuous intraocular pressure in OC within a glaucomatous eye might grow[1]. There is a reduction in the neuro-retinal edge that occurs in the middle of OD and OC with respect to the growth of OC. If the neuro-retinal rim becomes too thin, the vision quality will be blurred and destroyed.

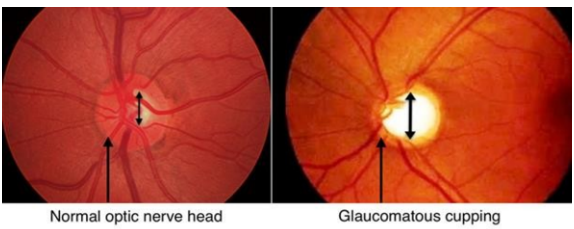

Figure 2. Optic nerve head comparison with normal and affected eye

4.3. CDR Evaluation

Finally, processing the 2D-image of the patient. We proposed an algorithm in the MATLAB software such that it concludes whether he/she tested for glaucoma disease resulted in a positive or negative note[7]. Detailed report about the patient is provided in form of pictorial representations like charts and graphs for easy understanding. Now this will give the ophthalmologist and patient an idea of the current scenario in their vision wealth.

4.4. Algorithm

Read the image. Convert it into a binary and clear the border. Fill the holes in the binary image. Create a structuring element in the shape of a disk of radius 6 and dilate it (disk image).Create another structuring element with the same shape but radius of 2 (cup image).Find the disc boundary and mark it in the image. Find the ratio between the area of the objects in the disk image and the cup image as CDR ratio. Check If CDR ratio is less than 4.5 then “No Glaucoma "If CDR ratio is between 4.5 and 6 then “No glaucoma but risk of acquiring" If the CDR ratio is greater than 6 then "Glaucoma detected".The fundus image of a patient is converted into a binary image and then it filters the binary image to locate the optical cup.

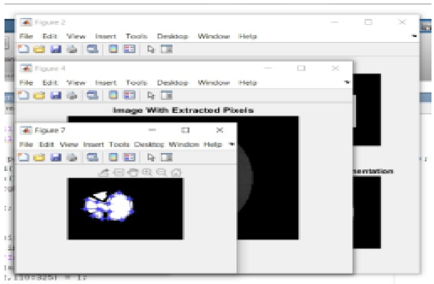

Figure 3. Image Enhancement (Cropping & Filtering)

Boundaries are marked for further enhancement, the specialty of our system is that, If our system is handled by the doctor. Then he/she can mark the location manually and specifically.

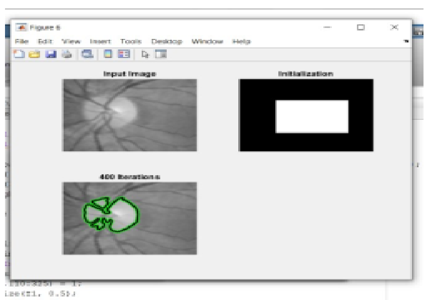

Figure 4. Area Formation

After this process gets over, Our system maintains the record of all the diagnostic results of a particular person in an excel sheet. It is then sent to the machine learning algorithm to predict the efficacy of the disorder and with which ophthalmologists can discuss the medications required for the affected person.

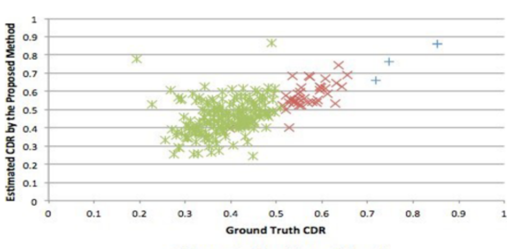

Figure 5. CDR Estimation

4.5. Prediction

Initially, images were trained and tested on the features extracted from super pixels. One is LDC (Linear Discriminant Classifier) and the other one is NN(neural networks). Both achieved Higher accuracy for classifying cup and disc in the training. Therefore, it is used in the real time experiments Accuracy is the ratio between correctly labeled to overall subjects. Precision is ratio between correctly positive labeled to overall positive labeled. Recall is ratio between positive outcome of our program to overall who have positive in reality. The results have also shown the effectiveness of the approach with 90% specificity and 94% sensitivity.

$$\text{Accuracy} = \frac{TP+TN}{TP+TN+FP+FN} \qquad \text{precision} = \frac{TP}{TP+FP}$$

$$\text{Recall} = \frac{TN}{TP+FN}$$

TP=True positive
TN=True Negative
FP=False Positive
FN=False Negative

Figure 6. Accuracy,Percision,Recall

5. Conclusion And Future Enhancement

Glaucoma is a category of eye illnesses that cause the optic nerve and cause myopia. If not, it causes a lack of side sight, which makes it impossible to get around properly. Glaucoma will also impair the central vision over time. Thus, the novelty of our idea is to provide a diagnosis in more cost-effective and with greater evaluation accuracy, the proposed non-invasive method detects glaucoma eye at an early stage. Furthermore, the results can be extended for therapeutic applications. With automation at its highest point of saturation. The future of this project is to provide an easy accessible web and mobile application. The automatic detection glaucoma is provided by this application. As a result, it introduces a better platform for physicians to enhance their skills, coordinate patient budgets, and deliver improved treatment.

References

[1] Abramoff.M.D et al., Automated segmentation of the optic disc from stereo Color photographs using physiologically plausible features, investigative ophthalmol. Vis. Sci., Vol. 48.
[2] J. Xu et al., Optic disk feature extraction via modifi deformable model technique for Glaucoma analysis, pattern recognit., Vol. 40 pp.2063– 2076, 2007.
[3] Ms. Pooja Chaudhari Prof. Girish A.. Student at SSGB COET Professor at SSGBCOET, Review of different Image Processing Methods to Detect Glaucoma, IJARECE Volume 5, Issue 6, June 2016
[4] Mrunalini Manchalwar, Krishna Detection of Cataract and Conjunctivitis Disease Using Histogram of Oriented Gradient, International Journal of Engineering and Technology (IJET) Vol 9 No 3 Jun-Jul 2017
[5] Mixture model-based approach for optic cup segmentation, Tan NM,Liu J,Wong DK,Yin F,Lim JH,Wong TY Journal of 2019.
[6] Chen.X, Y. Xu, S. Yan, D. W. K. Wong, T. Y. Wong, andJ. Liu, Automatic feature learning for glaucoma detection based on deep learning, in Medical Image Computing and Computer Assisted Intervention—MICCAI. Cham, Switzerland: Springer, 2015,pp. 669–677.
[7] Carmona.E.J and Rincón.M, J. García-Feijoó, and J. M. Martínez-de-la-Casa, Identification of the optic nerve head with genetic algorithms, Artif. Intell. Med., vol. 43, no. 3, pp. 243–259, 2008
[8] Argo, C., Sadiq, M.A., Hassan, M., et al, Assessment of change in retinal layers at the Macula in glaucoma patients and correlation to visual fieldI ndex, Investigate Ophthalmology and Visual Science, ARVO Annual Meeting, Seattle, USA, 2016, vol. 57, p. 369