TEST Engineering & Management

January-February 2020
ISSN: 0193-4120 Page No. 15014 - 15018

Glaucoma Detection through image Processing

SathyaRamasamy[1*], BalamuruganPonnunaicker[2], Senthil Kumar Jeyaraj[3], AbinithiGurusamy[4] and ArchanaAlagesan[5]
[1] Sri Krishna Adithya College of Arts and Science, Coimbatore, India.
[2] Government Arts College, Coimbatore, India.
[3, 4 &5] Sri Krishna Arts and Science College, Coimbatore, India.
*Corresponding author rsathyaramasamy@gmail.com

Article Info
Volume 82
Page Number: 15014 - 15018
Publication Issue:
January-February 2020

Abstract:

Glaucoma is literally defined as a disease which commonly affects human eyes and it is also known as the second highest cause of blindness, worldwide. In order to avoid blindness, the condition needs to be treated at an early stage. Glaucoma is always associated with an increased intra-ocular pressure (IOP) in eye and it slowly leads to problems and totally collapses the vision of the patient. Ocular-hypertension is connected with the persons in whom IOP increases steadily and will not cause any damages to the optic nerves. Glaucoma shall classify as a. open-angle, b. close-angle, c. congenital, and d. normal tension based on its position of infection. The tension generated during glaucoma affects vision and damages optic nerve, ultimately ends up with vision loss. The automated analysis of retina images seems to one among the significant screening tool during the diagnosis process. This technique assists in detection of various disease and risks associated with eyes. Early diagnosis of this disease must be carried out in order to prevent the patients from permanent blindness. Screening of glaucoma is performed with its digital images of retina during the past few decades. There are few techniques are readily available to detect abnormality in the retina in reference to glaucoma. The significant processing techniques shall classed as image registration, fusion, segmentation, feature extraction, enhancement, morphology, pattern matching, image classification, analysis, and statistical measurements. The objective of this paper is to propose a technique which relates image processing and classification tools for reliable detection of glaucoma, compare and measure various parameters in fundus images obtained from the patients of glaucoma and those without the condition.

Keywords:*IOP, Image segmentation, Image extraction, pattern making, etc.*

Article History
Article Received*: 18 May 2019*
Revised*: 14 July 2019*
Accepted*: 22 December 2019*
Publication*: 28 February 2020*

INTRODUCTION

Glaucoma is the name for a variety of conditions that have reformist ocular pathology and which lead to sight loss. Our eyes have intraocular weight. Intraocular weight (IOP) keeps on increasing to a specific dimension, harms the optical nerve system. This causes diminished fringe vision and in long-term visual impairment. Manual examination of eye pictures is tedious and results vary depending on the specialist. Therefore, a mechanized method is required. The examination of retina pictures is a critical screening instrument. This system distinguishes different types of eye conditions. Glaucoma shall classed in to two as per convenience as open edge or unending glaucoma and shut point or intense glaucoma, these two will increase intraocular

January-February 2020
ISSN: 0193-4120 Page No. 15014 - 15018

weight. The early stages of glaucoma typically don't have any visual symptoms or side effects. As the malady advances, it leads to vision loss and the patients often experience the ill effects of limited focus.Angle-open glaucoma is an ophthalmic pathology which in turn affects the nerves and it shall identify through the loss of retinal ganglion cells. The hatchet seed of optic nerve system and its affect on the field of vision has to be studied extensively. High intra-visual weight is one of the real risks of glaucoma disease. The aim of medication is to decrease the IOP to avoid auxiliary harm. There are a few types of glaucoma: the most frequent types is open-point and close-edge one. Any of this two will result in a high intra-visual weight. There are no indications for open-edge glaucoma as grows steadily, while close-point glaucoma is excruciating and needs prompt treatment. In light of this investigation, we can figure out which system is best in each situation.

ROLE OF IMAGE PROCESSING IN GLAUCOMA DETECTION

This segment connects with numerous studies in relevance with detection of glaucoma with an aid of image processing techniques.

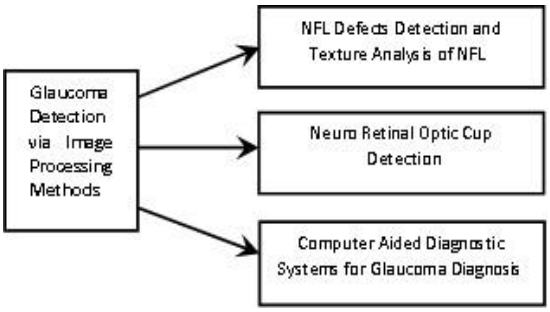


Figure 1: The detection of glaucoma using image processing methods. The Detection of NFL Defects and Texture Analysis of NFL.

Discovery of deformities in the nerve fiber layer and its surface examination, glaucoma can be effectively analyzed. Its valuation is a noteworthy advance for watching and taking care of glaucoma. OCT is broadly utilized for the valuation of a retina's systems, such as glaucoma and external stratum obsessive issues. Clinicians ordinarily measure NFL in light of the fact that the NFL dimensions are a huge indicator of the advancement of this disease; additionally, the state of the NFL is vital for the treatment and analysis of the disease. Yoshinori et al. proposed a procedure for discovery of RNFL from retinal fundus pictures. NFLD laid its milestone for diagnosis of glaucoma. The CAD framework is included on the grounds that the limited time available for ophthalmologists to identify changes in which in turn leads to various illnesses, such as diabetes, hypertension, etc. In assistance to CAD, the accurate results shall achieved in lesser time. The flow chart is illustrated in Figure 2.

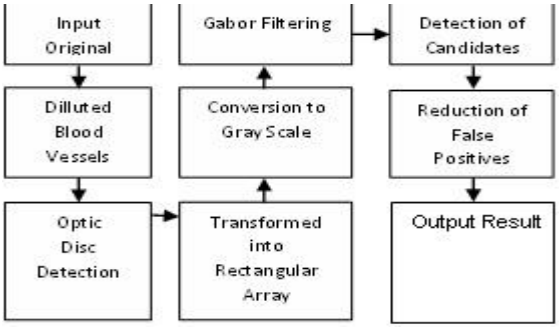
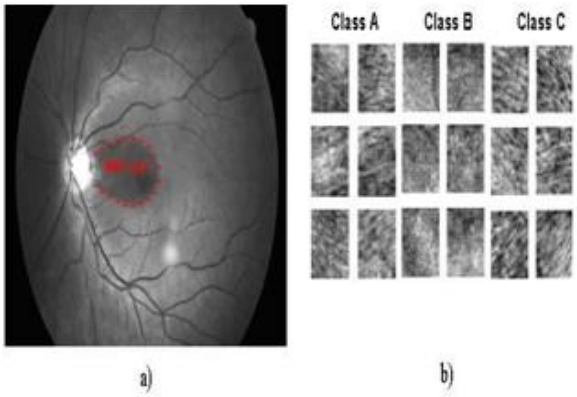


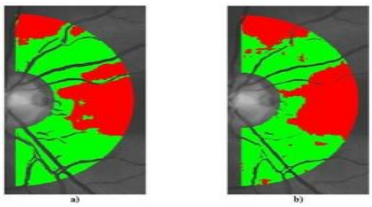
Figure 2: Illustration of the proposed methodology.

Step I: Blood vessels were diluted from the retrived image in assistance with morphological filtering and also with optic disc. This can detect through snakes and they shall transform into an rectangular array. Finally, NFLD regions showed transformed image's long vertical dark areas. As mentioned in Figure 2, the transformed image is converted into grey scale and the Gabor filtering process is applied. In the enhanced image, potential arenas of NFLD are identified and impressions of false results were reduced using a simple rule-based technique. Finally, the transformed image can converted back into an original image for analytical research.



January-February 2020
ISSN: 0193-4120 Page No. 15014 - 15018

Figure 3: a) Fundus image with RNFL loss; b) Image regions with 97×97 pixels divided into three classes that represent RNFL tissues.The testing on LBP was carried out with classes A1, B1, and C1, while the GMRF detection was performed with classes A2, B2, and C2. Both techniques were tested and validated further in order to differentiate the healthy and infected tissues in patients. This information readily available serves as an automated tool for RNFL loss detector, further it also helps in testing real images through the sequence of steps. First, it is essential to choose the right ROI. Then blood vessel segmentation shall achieve in order to ensure RNFL texture analysis in an effective way.



a) Figure 4: RNFL Image results LBP Method; b) GRMF Method: red indicates negative for RNFL and green indicates positive.

Surface investigation of RNFL is one of the methods used for the early detection of glaucoma. Jan Odstrcilik et al. presented a technique for RNFL examination. This technique utilizes GMRF and Least Square Error (LSE) approaches to detect RNFL. In terms of sound and glaucomatous RNFL tissues, display parameters, such as the Bayesian principle, are utilized. They should be analyzed for order mistakes and then connected to detect RNFL in the shaded areas. Finally, the outcome of the grouping process should be contrasted to provide OCT estimations.

AUTOMATED GLAUCOMA DETECTION – A Review

Neelapala Anil Kumar et al. [1] devised a technique with enhanced detection of glaucoma in an automated way using Angel Open Distance 500 calculations. This method employ the three step method, shall described further. In first step, three features of the ultrasound image features such as contrast, resolution and its clarity are significantly enhanced for effective anterior chamber segmentation. The second steps, several regions of ultra sound image are classified in order to eliminate the unwanted image. The anterior chamber region is cropped and the reference axis located. Finally, step three focuses on the exact determination of the anterior chamber angle to find out whether the eye is affected by glaucoma. This algorithm is able to correctly diagnose glaucoma in 97% of cases.Pachiyappan et al. [2] proposed the technique to diagnosis glaucoma using the fundus images and optical coherence tomography (OCT). The diseased and non diseased were classified based on the nerve fiber layer and its thickness, of about 105 µm. About 97.75% accuracy for optical disk detection can arrived through this technique.Kumar et al. [3] arrived in an algorithm for easy detection of glaucoma. The segmentation and extraction from an available image shall complete with the active contours, simultaneously the determination of initial point was also arrived. Then the region of interest is cropped. Finally, the anterior chamber is calculated. If the open angle is found to be greater than threshold angle, the condition of eye is normal.Aquino et al. [4] presented new optic disc (OD) detection technique, to fasten up the automated diagnosis of glaucoma. The article expresses their new template-based approach for differentiating the OD from available digital retinal images. This approach employs morphological and edge detection techniques, in association with Circular Hough Transform, which aids to arrive at circular OD boundary approximation. A pixel available within OD provides the initial information. Thus, this technique uses segmentation, as well as analysis, to detect glaucoma automatically in reference with the depth, shape and color of OD.Cheng et al. [5] proposed a technique in order to detect glaucoma based on RetCam. RetCam is an imaging modality which captures the iridocorneal angle of the image. The manual grading and analysis is the consuming process. In his study, an intelligent system was developed for effective analysis of iridocorneal angle

January-February 2020
ISSN: 0193-4120 Page No. 15014 - 15018

images, which automatically differentiates open and closed angle glaucoma.

Mary et al. [6] proposed a technique to detect glaucoma and the optic disc segmentation via pyramidal decomposition is carried out on retinal images, for an effective and performance than other algorithms and it is noteworthy.Kavitha et al. [7] inculcated the super-pixel classification based on disc and cup segmentation technique for glaucoma screening. If the ratio value exceeds 0.6, the patient should be recommended to undergo further analysis.

I. IMAGE PROCESSING TECHNIQUES

Various image processing technique were used in early diagnosis of numerous eye related diseases. They are such as enhancement, registration, fusion, segmentation, feature extraction, pattern matching, classification, morphology, statistical measurements, and analysis.Enhancement: Image enhancement tends to either brighten or contrast the image based on its requirement. Filtering and histogram equalization are other associated tools in enhancement process. Preprocessing step will also enhances various features of the image.Registration: Image registration is one among the significant technique to detect the change through retinal image diagnosis. The images are aligned geometrically in order to achieve a better analysis and more accurate measurements.Fusion: Image fusion shall define as a process of synchronizing the information acquired from various imaging devices. Its goal is to integrate contemporary, multisensor, multi-temporal, or multi-view information into a single image that contains all the information.Feature Extraction: This is the process of identifying and extracting the region of interest from the image.Segmentation: Segmentation algorithms are the key areas that are oriented rather than the pixel oriented. The objective of image segmentation assists to achieve and extract distinct features of image, which can either merged or split in order to analyze and interpret the object of interest, inclusive of clustering, "thresholding", and so on.Morphology: Morphology is the science; it exclusively deals with the physical appearance and orientation. Mathematical morphology is a collection of non-linear processes, which can be applied to an image to remove details smaller than a certain reference shape.Classification: Classification is an important technique that estimates the statistical parameter according to the pixels' gray level intensities.

II. CONCLUSION

In this survey paper, we have examined numerous works on robotized glaucoma recognition. Glaucoma is one of the fundamental elements that contribute to visual impairment around the world. Along these lines, we have to build up some reasonable mechanized method for the exact location of various phases of glaucoma. These systems will be of incredible help for ophthalmologists in under developed nations. There has been little research undertaken in this field. In the future, we will have to become increasingly proactive in searching for reasonable mechanized strategies for the identification of glaucoma, the advantages are passed away to least fortunate individuals. When glaucoma is accurately analyzed, exact medication can recommended or they can go through a medical procedure in order protect their eyesight.

III. REFERENCES

1. Neelapala Anil Kumar and P.A. NageswaraRao, Prof P.MallikarjunaRao, Smt. M. SatyaAnuradha: "Automatic detection of glaucoma in eye by angle opens distance 500 calculation by using GUI", International Journal of Science and Advanced Technology (ISSN 2221-8386) Volume 1 No 6 August2011.
2. ArulmozhivarmanPachiyappan, Undurti N Das, Tatavarti VSP Murthy and RaoTatavarti: "Automated diagnosis of diabetic retinopathy and glaucoma using

January-February 2020
ISSN: 0193-4120 Page No. 15014 - 15018

fundus and OCT images" Lipids in Health and Disease 2012.

3. N.Anil Kumar, M. SatyaAnuradha, Prakash.SSVD.Vepa, Ravuri Daniel: "Active Contours Techniques for Automatic Detection of Glaucoma", International Journal of Recent Technology and Engineering (IJRTE) Volume-1, Issue-4, October2012.
4. Arturo Aquino, Manuel Emilio Gegúndez-Arias, and Diego Marín: "Detecting the Optic Disc Boundary in Digital Fundus Images Using Morphological Edge Detection and Feature Extraction Techniques", IEEE TRANSACTIONS ON MEDICAL IMAGING 2010
5. Jun Cheng, Jiang Liu, BengHai Lee, "Closed Angle Glaucoma Detection in RetCam Images", IEEE Proceedings of the 32nd Annual International Conference, Sep 2004, pp 4096-4099
6. M. Caroline Viola Stella Mary, B. JainudhinSudarMarri: "Automatic Optic Nerve Head Segmentation for Glaucomatous Detection using Hough Transform and Pyramidal Decomposition", International Conference on Recent Trends in Computational Methods, Communication and Controls (ICON3C 2012) Proceedings published in International Journal of Computer Applications(IJCA)
7. K. Kavitha, IIM.Malathi. "Optic Disc and Optic Cup Segmentation for Glaucoma Classification", International Journal of Advanced Research in Computer Science & Technology (IJARCST 2014) Vol. 2 Issue Special 1 Jan-March 2014.