A REVIEW ON THE IMPORTANCE OF RNFL SEGMENTATION IN OCT IMAGES FOR GLAUCOMA DETECTION

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***Abstract* - Glaucoma is a condition defined as loss of retinal ganglion cell axons, which can lead to perpetual vision loss, if not diagnosed and treated at the right time. Over years, OCT is described to be the best diagnostic approach to glaucoma detection. This paper aims at describing various approaches and techniques of glaucoma detection, from OCT images and to conclude in accordance a review overall about the importance of Retinal Nerve Fiber Layer(RNFL) segmentation, a modern and appropriate method for the accurate confirmation of glaucoma in the results of OCT images.**

***Key words* -** *Glaucoma, OCT, RNFL.*

I.INTRODUCTION

Glaucoma is a condition which damages the optic nerve of the eye, which is the leading cause of blindness in the world. It is a condition characterized when the normal fluid pressure inside the eye increases.(1). It is also described as the progressive structural loss of Retinal Ganglion Cells(RGC). Glaucoma usually results in vision loss and irreversible blindness. Early detection can be a useful management method. Since glaucoma has no noticeable symptoms in its early stages, damage caused by it is irreversible and that it can lead to permanent vision loss if not treated appropriately on time, the detection and treatment is much important. The thickness of the RNFL, shape, macular holes and blood vessels are the morphological features that account for retinal diagnosis(5). Since the main cause of glaucoma is Retinal Nerve Fiber loss, due to increased Intra Ocular Pressure(IOP), decreasing the RNFL thickness, the estimation of RNFL plays a major role in analysis.OCT is a modality involving distinct models, namely and mostly used and described, Time Domain Optical Coherence Tomography(TD-OCT) and Spectral Domain Optical Coherence Tomography(SD-OCT). The speciality of iteration in Optical Coherence Tomography has advantages in assessing the earlier detection of glaucoma over traditional method. The recent commercially available iteration of the OCT technology, spectral domain (SD)-OCT, has theoretical advantages in glaucoma assessment over the earlier generation of time domain (TD)-OCT due to increased axial resolution and faster scanning speed that lead to lower susceptibility to eye movement artefacts(6).

II.LITERATURE REVIEW

(1)This paper has a novel approach for segmenting retinal nerve fiber layer in retinal OCT image . At first, pre-processing was done by median filter for removing the speckle noise present in image.So,it helps in effective preprocessing of an image.

(2) This concept discusses about the diagnosis and confirmation of glaucoma which was earlier based on the examination of Optic Nerve Head(ONH), and Retinal Nerve Fiber Layer(RNFL), but the clear evaluation of glaucomatous structural damage is possible with the Optical Coherence Tomography(OCT)

(3) This work explains about clearly about several different parameters that can be used to evaluate glaucoma such as IOP,VCR,NRRT, Central Cornea Thickness(CCT),ISNT, TSR, etc..Study of these parameters helps for the evaluation of the images effectively.

(4) This project explains about the modalities to detection preferred are Fundoscopy, Visual Field Test and Optical Coherence Tomography which are non invasive. Based on the principle of low coherence interferometry, OCT measures the intensity of backscattered InfraRed light One of .the most important uses of OCT eye imaging is the Retinal diseases detection.

(5) The aim of the paper is to determine the thickness of the RNFL, shape, macular holes and blood vessels are the morphological features that account for retinal diagnosis. Since the main cause of glaucoma is Retinal Nerve Fiber loss, due to increased Intra Ocular Pressure(IOP), decreasing the RNFL thickness, the estimation of RNFL plays a major role in analysis. It was then followed by image enhancement, using image adjustment for increasing the brightness of image, which was then followed by

RNFL boundary detection using Statistical region merging algorithm to extract RNF layers in the image and finally, RNFL was extracted by developed algorithm. The developed approach was demonstrated to achieve accurate retinal nerve fiber layer segmentation on retinal OCT images under low image contrast. The authors Elaine To, Dennis Lam, FRCOphth and Christopher Kai-shun Leung, found that advances of spectral-domain OCT technology for RNFL imaging have enhanced the visualization of RNFL damage and improved the detection of RNFL progression in glaucoma. High diagnostic sensitivity and specificity for glaucoma detection were demonstrated with the Cirrus HD-OCT RNFL thickness deviation map

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(7)The proposed approach shows higher potential for estimation of retinal layer thickness. Their results of the proposed approach proved that, RNFL extraction is concurrent with the ophthalmologist's opinion.In short, an automated segmentation algorithm based on the shortest path was proposed by the authors Mahdi Salarian, Rashid Ansari, Justin Wanek, and Mahnaz Shahidi. These authors found that ILM-NFL boundary is more important for clinical diagnosis and investigation, and focused on finding this layer by locating the proper ROI and correcting this boundary by identifying any instability. The authors applied pre-processing steps, removed the first white region, zooming and focusing on the fovea, showing discontinuities, and evaluated and analyzed results. They applied this method to all B-Scan images of 16 people even in low quality images, as well as, with pathological eyes. The result were accurate based on person who was expert in finding different layers manually.

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(8)The summarized work is that with trend analysis of average RNFL thicknesses, event analysis of the RNFL thickness change maps and the RNFL thickness profiles, the diffuse and focal changes of the RNFL can be followed, and the rate of RNFL progression can be measured. They concluded that, RNFL imaging with spectral-domain OCT can provide important diagnostic information in the management of glaucoma.The authors Jinming Duan, Christopher Tench, Irene Gottlob, Frank Proudlock, Li Bai presented a new automated retinal layer segmentation method based on the geodesic distance for both 2D and 3D OCT images.

(9)The method integrated horizontal and vertical gradient information which accounted for intensity changes in both the directions. Therefore , the exponential weight function in the approach enhanced the foveal depression regions and weak retinal layer boundaries. As a result of which, the proposed method was able to segment complex retinal structures of large curvatures and irregularities caused by pathologies. Extensive numerical results, validated, demonstrated the effective results of proposed method for segmenting both normal and pathological OCT images. The proposed method acquired higher segmentation accuracy. It is concluded that, in eyes with early glaucoma, RNFL thickness was decreased significantly in 8 of the 12 peri papillary sectors, and macular volume was decreased significantly in six of the nine macular sectors, compared with normal eyes. In the advanced glaucoma eyes, RNFL and macular volume were decreased throughout, except in RNFL thickness in the papillomacular region, and in retinal thickness in the foveal region. The Area Under the Receiver-Operating characteristic Curve (AUROC) of the average RNFL was larger than the macular volume.

(10)Hence, they concluded that both peri-papillary RNFL thickness and macular volume were decreased even in the early stage of glaucoma. Average RNFL thickness had greater diagnostic power than macular volume.The authors Bingqing Wang, Amit S. Paranjape, Biwei Yin, Shuang Liu, Mia K. Markey, Thomas E. Milner and H. Grady Rylander, proposed a two-step RNFL segmentation method for clustered ring scan images acquired with a Swept Source Polarization-Sensitive Optical CoherenceTomography (SS-PSOCT) system. The RNFL segmentation utilized both intensity and polarimetric information for finding optimized RNFL boundary detection to estimate birefringence. RNFL anterior and posterior boundaries were first detected from the intensity image. RNFL birefringence was estimated from intensity-based RNFL segmentation with a multiple-state Levenberg-Marquardt nonlinear fitting algorithm. Optimized RNFL segmentation was achieved by minimizing the Levenberg-Marquardt uncertainty of RNFL birefringence while locally adjusting the posterior RNFL boundary. The proposed RNFL segmentation approach provided an optimized RNFL segmentation. Clinical results from a healthy volunteer suggest that the proposed segmentation method estimated phase retardation in the RNFL.

(11)The paper explains about the intra- retinal layer segmentation in OCT images. Here, the individual layers were identified and segmented by the use of two step kernel based optimization scheme. This proposed method, is used to process and segment the OCT images with low contrast, speckle noise and irregular shape structural features.

III.CONCLUSION

Glaucoma is a condition characterized and concluded based most importantly on results from retinal morphology. The Retinal Nerve Fiber Layer(RNFL) thickness plays a major role in the confirmatory results of glaucomatous condition. Hence, the

importance of RNFL thickness based on different OCT modalities were studied and concluded. In the above study, research works of different authors were studied.

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