

Early Glaucoma Diagnosis using Fundus Images - Review

P Gowri, Geetha R., J Suganya, K P Liniya Shylin

Assistant Professor

Department of ECE, Sri Sairam College of Engineering

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ABSTRACT - Glaucoma is a next sizable reason for seen deficiency due to dynamic lack of retinal cells called RDC (Retinal Ganglion Cell) whenever left untreated prompts perpetual visual impairment. Early reputation and remedy of glaucoma will save you further lack of RGC and in the long run keep imaginative and prescient. Systems like OCT (Optical Coherence Tomography), HRT (Heidelberg Retinal Tomography) for retinal imaging and studies are more costly and tedious. Computerized strategies are required for mass screening of the patients for glaucoma in a lot less time and minimum effort. The precept intention of this paper is to audit the continuing improvements identified with have a look at in automated glaucoma discovery.

List Terms—Glaucoma, Segmentation, Optic Cup, Optic Disk

I. INTRODUCTION

Glaucoma the primary source of visible impairment regular is an asymptomatic illness that patients do no longer see until they enjoy vision misfortune. High measure of intra visible weight (IOP) is one of the sizeable peril additives of glaucoma illness. Screening is finished with the aid of optometrist looking at the retinal picture and alluded to an ophthalmologists for extra scientific evaluation. The demonstrative precision thru the optometrist is visible as imperfect and makes avoidable stress and stress sufferers and carers. Indeed, even whole glaucoma stop completed with the resource of ophthalmologists are constrained: scientific optic nerve appraisal is confined by using the use of subjectivity and new symptomatic techniques for assessment of Optic Nerve head (ONH) and Retinal Nerve Fiber Layer (RNFL) are high priced and no longer broadly handy. Improved mechanized strategies for glaucoma discovery can reduce the rate of screening programs and furthermore an increasing number of unique. Determination of glaucoma is comprehensively grouped via 3 check to be precise tonometry to gauge intraocular strain(IOP) , visual view check this is tedious and needs course to subjects, imaging tool for plate/nerve layer assessment.

II. Qualities OF GLAUCOMA

Glaucoma is described by using everyday lack of visible ability alongside excessive weight in eyes, changes the form of OHN and RNFL thickness. The ONH thickness can also moreover occur in certain parts, for example, circles, cup, neuroretinal side, veins and Para Papillary Atropy (PPA). Expansion of cup period can activate changes in the estimation of CDR and neuroretinal aspect vicinity decreases. Neuroretinal diminishing (scoring) make void the ISNT rule. Nerve fiber layer drain display up as a crimson line this is equal or near the floor vicinity of circle. Clinical guidelines, for instance, Cup to Disk percentage (CDR), Disk breadth, ISNT percentage, PPA, indenting, ONH appraisal and so on., are applied for glaucoma screening.

III. Conversation

Ayushi Agarwal in [1] applied a feasible method for glaucoma area. Versatile restrict based completely method is carried out to portion specific parameters optic plate, optic cup, neuro retinal facet. CDR (Cup to Disk Ratio) and RDR (Rim area to Disk territory share) is determined to installation glaucoma. To put off the Region of Interest (ROI) of the image reputation of optic plate is figured. Optic circle division is finished utilizing Otsu side approach in Red channel of the fundus photo. Optic cup branch uses measurable highlights like mean and fashionable deviation for green channel of ROI The proposed approach became strong and compelling, making the department technique free of photograph satisfactory and invariant to clamor. Divided optic circle and optic cup are utilized to build up neuro retinal facet and aspect plate proportion is assessed in infero fleeting districts. Cover of size equivalent to ROI of the fundus photo is made for every quadrant and each quadrant veil is duplicated independently with neuroretinal part to compute all out element in substandard and transient locales. Proportion of edge area to characteristic as much as plate area is taken as RDR. SVM classifier is applied to reserve the fundus photographs as glaucomatous or nonglaucomatous. The approach is tried on an informational index of 60 snap shots were given from Venu Eye Research Center, Delhi, and acquired precision 90%, affectability a hundred% and explicitness eighty%.

A method depending on the ground component making use of SVM classifier for glaucoma order framework is proposed in [2]. The method applied Binary Robust Independent Elementary Features (BRIEF) based floor studies to standardize the light issues of the retinal fundus photographs and to lower the unpredictability inside the calculation. BRIEF highlights are removed from the complete fundus photograph for green channel, the extricated highlights are then spoken to as a histogram of the picture. BRIEF highlights are spoken to as twofold string to expose the presence of picture patches. Commotion image is obtained utilizing Gaussian channel and limit an incentive for spotlight extraction is predicated upon at the assessed clamor stage have been given. The have been given highlights are applied for the affiliation and the related elegance mark is processed. Effectiveness of the proposed framework is attempted using an expansion of 196 snap shots from Manchester Royal Eye Hospital UK, and region underneath curve(AUC) completed is eighty 4%. The proposed approach whenever determined to perform higher whilst contrasted with distinct detail based grouping techniques like GLCM, CLD, LBP.

A staggered side way for optic plate division is proposed through Suraya et al [3]. Preprocessing is finished in 2 degrees to extricate the veins from the green element I) Matched channel is utilized to enhance the veins by way of convolution ii) To differentiate the veins from the the rest of separated retinal photograph nearby entropy based thing method is applied. Extraction of OD from preprocessed picture is completed via manner of grouping, a histogram primarily based definitely technique is applied to find the specific amount of bunches required. Two section multi restriction Otsu method (TSMO) is modified at the way to make the brink esteems fall in a comparable variety as that of Otsu's first-rate facet. Thresholding approach is trailed by using morphological establishing to expel commotion and the portioned OD is gotten. The approval of the calculation become completed thru running it on database comprising of 50 snap shots and indicates a precision of 94%. In [4] screening technique for distinguishing glaucoma utilizing side width pointer is supplied. Because of a few fantastic instances, as an example, nearsightedness eye, truly cup-to-plate percent might not proficient for screening glaucoma. Edge width dependent on ISNT rule may be an element for characterization. The thickest side width in different districts in place of second charge is carried out to indicate as glaucoma. Sub-par and unequalled aspect width is contrasted and nasal component width and ISNT rule is confirmed. 52 normal non glaucomatous fundus photographs and 38 glaucoma fundus photos are obtained from Mettaphrarak Hospital, Nakornpathom, Thailand. Locale of enthusiasm throughout the searching territory inside the objective photo is gotten to decrease computational time. Optic cup restrict is diagnosed utilizing vessel bowing and Neuroretinal side width of each district is expected in variety bearing of optic plate. After all facet widths are envisioned, arrangement is started out. The thickest facet width is in extremely good locales in location of mediocre is the primary need for organization as glaucoma. In addition, each mediocre and vital part width can be contrasted and nasal facet width and affirm with ISNT rule. Retina with component width that not obey ISNT rule is probably identified as glaucoma. 47 out of fifty non-glaucoma instances are efficiently prominent the usage of the proposed strategy and the overall precision is ninety 5%.

Yanwu Xu et al. [5] manipulate the cup division difficulty for glaucoma location thru superpixel bunching or affiliation. Info plate is separated into superpixels using SLIC tool compartment. Superpixels are characterised and marked whether they lie on the cup or place. Circle fashioned cup limit is then evaluated. A low-role portrayal (LRR) calculation is proposed in the superpixel marking problem .The proposed LRR-based totally unaided technique performs advanced to a part of the directed strategies and to encourage examinations, ORIGA-slight dataset containing 168 glaucoma and 482 regular pics is applied. The proposed technique can likewise be embraced to semi directed or administered technique depending on LRR for glaucoma popularity.

Superpixel order and spotlight extraction for glaucoma evaluation is proposed in [6]. Gathering of nearby pixels into superpixels for optic circle division is finished through truthful direct iterative bunching calculation. Highlight extraction includes method I) differentiate stepped forward histogram in which the histogram of each superpixel is registered from each one of the 3 histogram balanced Red, Green, Blue channels simply as from the primary Hue and Saturation and 1280 dimensional issue are processed. Utilizing focus embody measurements for each superpixel 36 detail are separated. Randomized Hough exchange is applied to accumulate the particular limit of the optic plate and cup. Correlation of highlight estimations of the take a look at photo with the reference image is completed and association as strong or glaucomatous photo is completed with the useful resource of the SVM classifier. The calculation is ready with 36 reference images and attempted with 21 records images.

Conduct of the surface element as an element of darkish degree quantization to installation retinal snap shots is carried out in [7]. First request highlights of the pix mainly endorse, fluctuation, big deviation, entropy are extricated from the preprocessed photograph. Preprocessing of the picture through histogram adjustment. Second request textural highlights are then extricated utilising Gray-level co-occasion (GLCM). The method is proceeded for numerous quantisation ranges and one of a kind properly techniques from OD attention. Highlight choice gadget is achieved making use of successive skimming in advance strength of mind approach. The decided on highlights are given as contribution to the backpropagation neural gadget classifier. Execution of the calculation for one among a kind quantisation stage shows that the dim level 32 has excessive exactness. 50 images are applied for making ready BPN and 100 photos for trying out from the open database www. Optic_disc.Org. The calculation performed 96p.Csensitivity, ninety four% explicitness, 90 five% exactness.

level properties of pallor region. Glaucoma expert system detects glaucoma and categorises the severity of disease based on DDLS scale. 40 images from a local hospital, 10 fundus images from RIMONE database and 9 images from DIARETDB0 database are used and average F score for disk and cup segmentation is higher when compared to other methods.In [10] automated glaucoma diagnosis system using higher order spectra (HOS) cumulants extracted from Radon transform (RT) is proposed. The digital fundus images are preprocessed to reduce the size using image interpolation. Randon Transform for the image is applied at every 10o angle. Third order HOS cumulants are computed from these one dimensional signals. Linear discriminant analysis (LDA) is used to reduce the dimensionality of classes obtained and significant features are ranked based on Fisher Discrimination index. Performance of SVM and NB classifier are studied to select the best classifier for the automated glaucoma diagnosis. The method is tested using 272 fundus images with 100 normal, 72 mild glaucoma and 100 moderate/severe glaucoma images using ten-fold cross validation method. The proposed system has an average accuracy an average accuracy of 92.65%, sensitivity of 100% and specificity of 92% using NB classifier.

Gabor transform for extracting the features such as moments, entropy, energy, skewness, kurtosis used in [11]. 168 features are extracted and applied to Principal Component Analysis (PCA) for dimensionality reduction to 32 features. SVM and Naive Bayesian (NB) classifiers are used for the automated diagnosis of glaucoma. Tenfold validation is done to obtain high accuracy with maximum number of I mages. 510 Retinal images of normal(266), mild(72), moderate(86) and severe (86) glaucoma from KMC hospital, Manipal, India are used for classification to obtain highest accuracy of 93.1%, sensitivity of 89.75% and specificity of 96.20%.A

hardware implementation of glaucoma detection technique was implemented using TMS320C6416 D. SP board [12]. The image is converted to a header file format then loaded in to SDRAM of the DSP board. Image enhancement is performed by CLAHE block, edges were identified using canny edge detection technique. Circular Hough transform is performed on edge image to find the center of the optic disk and optic cup from the localized image. The circle (OD) is superimposed on the original image to mark the optic disk and cup. The cup to disk ratio is calculated and analysed for screening glaucoma. In [13] popular deep learning method convolutional neural network (CNN) an automatic feature learning scheme for glaucoma detection is presented. The method uses multilayer perceptron for learning the features related to glaucoma. Learning for features detectors are done by using small patches sampled from the large original image. Feature at a region is then obtained by convolving the feature detector with the image. Outputs of learned CNN is taken as context input of the fully connected layer. Softmax classifier is used for classification of glaucoma. Data augmentation and dropout techniques are used to increase the dataset size and hence to avoid over fitting. The algorithm is tested on two publically available dataset and performance is better on ORIGIA than SCES dataset.

TABLE 1. Performance Analysis of various methods

Authors	Methods	Database Used	No of images	Sn%	Sp%	Acc%
Ayushi et al.	Adaptive threshold	Venu Eye Research Center, Delhi	60	100	80	90
Suraya et al.	BRIEF Features	Manchester Royal Eye Hospital UK	196	--	--	84
Mila et al.	Multilevel threshold	DRIVE and a local hospital	50	--	--	94
Ruengkitpinyo et al	ISNT rule verification	Mettapracharak Hospital, Nakornpathom, Thailand	100	100	90.38	95
Yanwu Xu et al.	Adaptive LRR superpixel clustering	ORIGIA	650	--	--	--
Grace Shoba S J et al.	Randomized Hough Transform, Simple Linear Iterative Clustering, Centre Surround Statistics	Not Specified	47	--	--	--
Karthikeyan S et al.	Sequential Forward Floating Selection	www.optic-disc.org	150	96	94	95
Irene F et al.	Random Forest Classifier	GlaucomaRepo	90	86.95	97.8	95.04
P S Mittapalli et al	Local Binary Fitting (LBF)	RIMONE,DIARETDB0	59	--	--	--
Kevin P N et al.	RADON Transform, Linear discriminant Analysis	Kasturba Medical College, Manipal, India	272	100	92	92.65
U.R Acharya et al	Gabor Transform, Principal component Analysis	Kasturba Medical College, Manipal, India	510	89.75	96.20	93.10
Srinivasan A et al.	Hardware implementation, Hough Transform	DRIONS DB	15	--	--	97.5
Xiangyu Chene et al.	Convolutional Neural networks	SCES,ORIGIA	2326	--	--	AUC of 0.838 and 0.898

I. CONCLUSION

Glaucoma is one of the large reasons for seen impairment with excessive tempo of unreported times. To lessen this variety, mass screening program is directed. To lower the immoderate high-quality challenge handy and make it sensible robotized glaucoma evaluation is done. This paper surveys and talks about the continued upgrades in unique locating strategies. The created techniques were attempted on diverse freely available shading fundus pics dataset and their outcomes are broke down. In view of the past appears into, it tends to be visible that mix of numerous strategies along late ML tactics like CNN may be utilized to extend the exactness of glaucoma recognition.

II. REFERENCES

- [1] Ayushi Agarwal, Shardha Gulia, Somal Chaudhary, Carlos M. Travieso, Jesus B. Alonso-Hernandez " A Novel Approach to Detect Glaucoma in Retinal Fundus Images using Cup-Disk and Rim-Disk Ratio," International Work Conference on Bio-brought about Intelligence, @2015 IEEE
- [2] Suraya Mohammad, D.T.Morris "Surface Analysis for Glaucoma Classification" 2015 International Conference on BioSignal Analysis, Processing and Systems (ICBAPS)
- [3] Mila KanKanala, Sanjeev Kubakaddi "Programmed Segmentation of Optic Disk making use of Modified Multi-level Thresholding" Signal Processing and Information Technology (ISSPIT), 2014 IEEE International Symposium web page no: 000125 – 000130
- [4] W. Ruengkitpinyo, W. Kongprawechnon, T. Kondo, P. Bunnun, H. Kaneko "Glaucoma Screening making use of Rim Width ISNT Rule," 2015 International Conference of Information and Communication Technology for Embedded Systems (IC-ICTES)
- [5] Yanwu Xu , Lixin Duan , Stephen Lin , Xiangyu Chen , Damon Wing Kee Wong , Tien Yin Wong , and Jiang Liu "Optic Cup Segmentation for Glaucoma Detection Using Low-Rank Superpixel Representation," in MICCAI 2014.
- [6] S J Grace Shoba, A. Brintha Therese "Recognition of Glaucoma depending on Superpixel Generation and Feature Extraction," International Journal of Computer Applications (0975 – 8887) Volume 106 – No. Sixteen, November 2014
- [7] Sakthivel Karthikeyan , N. Rengarajan "Execution Analysis of Gray Level Co Occurrence Matrix Texture Features for Glaucoma Diagnosis," American Journal of Applied Sciences 11 (2): 248-257, 2014,ISSN: 1546-9239
- [8] Irene Fondón, Jose Francisco Valverde, Auxiliadora Sarmiento, Qaisar Abbas, Soledad Jiménez, Pedro Alemany "Programmed Optic Cup Segmentation Algorithm for Retinal Fundus Images depending on Random Forest Classifier," 978-1-4799-8569-2 ©2015 IEEE
- [9] Pardha Saradhi Mittapalli, Giri Babu Kande, "Division of optic plate and optic cup from automatic fundus photos for the appraisal of glaucoma," Biomedical Signal Processing and Control 24 (2016) 34–46
- [10] Kevin P. Noronha, U. Rajendra Acharya, K. Prabhakar Nayak, Roshan Joy Martis, Sulatha V. Bhandary, "Mechanized characterization of glaucoma ranges utilising better request cumulant highlights," Biomedical Signal Processing and Control (2014) 174–183
- [11] U. Rajendra Acharya, E.Y.K. Ng, Lim Wei Jie Eugene, Kevin P. Noronha, Lim Choo Min, K. Prabhakar Nayak, Sulatha V. Bhandary, "Choice emotionally supportive community for the glaucoma utilizing Gabor change," Biomedical Signal Processing and Control (2015) 18–26
- [12] Srinivasan Aruchamy, Partha Bhattacharjee and Goutam Sanyal, "Computerized Glaucoma Screening in Retinal Fundus Images," International Journal of Multimedia and Ubiquitous Engineering Vol.10, No.Nine (2015), pp.129-136
- [13] Xiangyu Chen, Yanwu Xu, Shuicheng Yan, Damon Wing Kee Wong, Tien Yin Wong, and Jiang Liu, "Programmed Feature Learning for Glaucoma Detection using Deep Learning"