IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

GLAUCOMA DETECTION USING DEEP LEARNING: A REVIEW

Tejas Dube[1], Tanvi Takawale[2],Piyush Devgirikar[3],Abhishek Saste[4],Vilas Gaikwad[5]

[1,2,3,4,5]Department of Information and Technology, Trinity College of Engineering and Research, Pune, Maharashtra, India.

Abstract: Glaucoma is a chronic and progressive eye disease characterized by optic nerve damage and gradual loss of vision. Early detection and timely intervention are critical to preventing irreversible vision impairment. In recent years, advancements in machine learning, particularly Convolutional Neural Networks (CNNs), have shown promise in automated glaucoma detection through the analysis of retinal images. This study proposes a robust glaucoma detection framework that integrates image enhancement techniques like Retinex, state-of-the-art CNN architectures, and statistical methodologies such as Design of Experiments (DOE). The Retinex enhancement process is employed to improve the quality and contrast of fundus images, enhancing the subsequent CNN-based feature extraction. CNNs, designed to identify distinctive patterns and features indicative of glaucoma, are optimized using DOE to achieve enhanced detection performance. The proposed framework exhibits a high degree of accuracy, sensitivity, and specificity, making it a potential candidate for effective glaucoma screening and diagnosis. The integration of image enhancement, deep learning, and statistical optimization in this framework underscores the significant potential for advancements in glaucoma detection, aiding ophthalmologists in early diagnosis and appropriate patient management

Index Terms **- CNN, Glaucoma, Retinex.**

Introduction

Glaucoma, a prevalent and chronic eye disorder, is a leading cause of irreversible blindness worldwide, affecting millions of individuals across diverse demographics and age groups. Characterized by progressive degeneration of the optic nerve and associated visual field loss, glaucoma often remains asymptomatic in its early stages, making early detection and intervention critical for preserving vision and enhancing the quality of life for affected individuals. The traditional diagnosis of glaucoma heavily relies on comprehensive clinical evaluations, including intraocular pressure (IOP) measurements, assessment of the optic nerve head, and visual field examinations. However, these methods are subjective, time-consuming, and may detect glaucoma only in the later stages of the disease when irreversible damage has already occurred.

Advancements in medical imaging technologies, particularly the utilization of fundus photography and optical coherence tomography (OCT), have revolutionized the landscape of glaucoma detection. Fundus photography, providing high-resolution images of the retina, has emerged as a valuable diagnostic tool for the early identification of glaucoma-related abnormalities. Furthermore, recent breakthroughs in artificial intelligence (AI) and machine learning have paved the way for automated and efficient glaucoma detection systems. Convolutional Neural Networks (CNNs), a class of deep learning models, have demonstrated exceptional capabilities in image analysis and pattern recognition, making them a potent tool for automated glaucoma detection.

This paper introduces a comprehensive review and analysis of glaucoma detection methodologies, with a primary focus on leveraging machine learning techniques, particularly CNNs, to achieve accurate and efficient automated glaucoma detection using fundus images. We explore the challenges associated with glaucoma diagnosis, the potential of CNNs in discerning glaucoma-related features from fundus images, and the integration of advanced techniques to enhance the reliability and performance of automated glaucoma detection systems. By synthesizing the current state of research and advancements in the field, we aim to provide valuable insights into the evolving landscape of glaucoma detection, contributing to improved screening, early diagnosis, and management of this sight-threatening disease.

Literature Survey

In this study, a CNN semi-supervised learning system for glaucoma detection in fundus pictures was described. The current methodology showed promising performance when compared to existing approaches by applying the self-learning strategy to expand the training samples using the unlabeled data and fine-tuning a pre-trained CNN to construct a glaucoma-specific classifier. As part of their ongoing study, the scientists are working to improve the framework's generalisation so that it can identify additional eye disorders.[1]

We provided a 3DCNN-based, totally automated glaucoma diagnosing approach. Because OD segmentation and/or data augmentation phases were not included in the suggested technique, it varies from previously described procedures. The 100% accuracy we were able to attain served as a strong indication of the results' promise, which reached levels compared to the finest research currently accessible in the associated literature. Compared to conventional designs, our volumetric analysis technique produced more favourable results; these results open up new research avenues. Last but not least, we think that our approach has value and contributes meaningfully to the medical community and, subsequently, to the computer community, particularly in the interpretation of medical pictures.[2]

In this research, we present a unique Disc-aware Ensemble Network (DENet), which incorporates four deep streams on various layers and modules, for automated glaucoma screening. The inclusion of several levels and modules is advantageous for incorporating hierarchical representations, and the disc-aware constraint ensures that the optic disc region's contextual information is included for glaucoma screening. Our technique outperforms state-of-the-art glaucoma screening algorithms, according to trials on two glaucoma datasets (SCES and recently gathered SINDI datasets).[3]

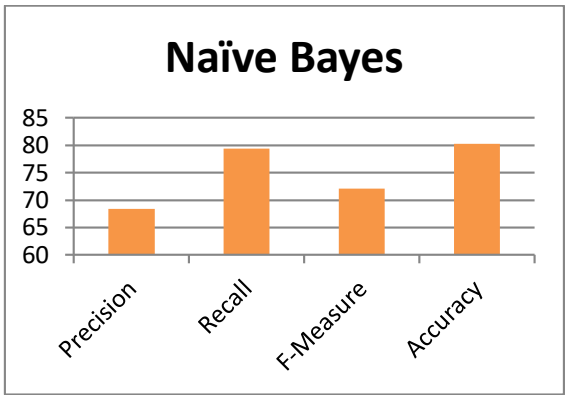
In summary, this work proposed a novel AI-based method for glaucoma identification that integrates temporal (dynamic vascular) and spatial (static structural) characteristics. Our suggested strategy showed good performance in differentiating glaucoma from healthy compared with models that just used spatial information as their input while tackling the video classification issue of glaucoma.[4]

In this study, a glaucoma detection model for fundus pictures is proposed. It makes use of graph-based saliency and convolutional neural network ensembles. We start by identifying the optic disc on the fundus pictures using graph-based saliency. Then, using four distinct ways, we combine the output of an ensemble of three potent CNN architectures to identify glaucoma. The results reveal that our model performs better than a comparable study from the literature that makes use of the same dataset. The results further demonstrate that they are on par with or superior to those reported by current glaucoma detection studies.[5]

This study offers an automated primary glaucoma screening based on quantitative analysis of fundus pictures to help ophthalmologists identify glaucoma illness more quickly and affordably. Two primary processing phases make up the suggested technique. Five different deep semantic algorithms are employed to experiment with OD segmentation, and the characteristics recovered from the clipped OD region are then utilised to train a classifier to predict the existence of glaucoma in the test pictures.[6]

Existing System And Result

The integration of Retinex enhancement, CNN, and DOE aims to enhance the accuracy and robustness of glaucoma detection from fundus images. The Retinex process improves image quality, CNN extracts relevant features, and DOE optimizes the model for better performance. However, for detailed and up-to-date information on this specific framework, I recommend referring to the latest research papers, articles, or journals in the field of ophthalmology and computer vision.



	Existing System
Precision	65.44
Recall	78.65
F-Measure	71.11
Accuracy	78.29

Proposed System

Capture detailed retinal images using specialized cameras, often through a non-invasive process. Enhance the quality of the images by reducing noise, adjusting contrast, and normalizing lighting conditions. Extract relevant features from the retinal images, such as optic nerve head parameters, cup-to-disc ratio, and blood vessel characteristics. Utilize trained machine learning models to classify the retinal images into healthy or glaucomatous categories based on the extracted features.

System Architecture

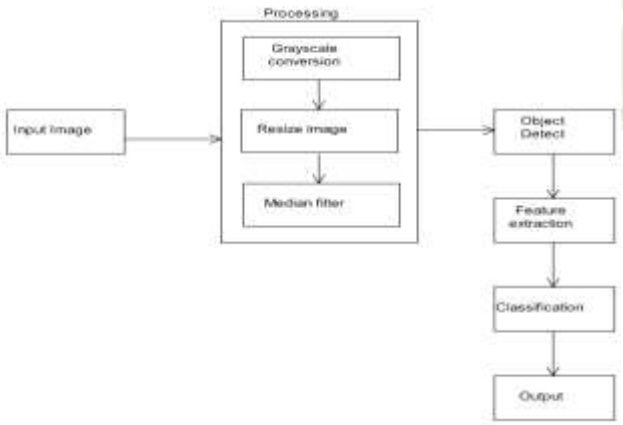


Figure 1 .System Architecture

Conclusion

Glaucoma detection using machine learning, particularly deep learning approaches like Convolutional Neural Networks (CNNs), has shown promising results in automating the diagnosis of glaucoma, a common eye disease that can lead to vision loss if left untreated. Machine learning, especially CNN-based approaches, holds great promise in glaucoma detection. These techniques have the potential to enhance the efficiency and accuracy of early diagnosis, contributing to better management and treatment of glaucoma and ultimately preserving vision for affected individuals. However, continued research, robust validation on diverse datasets, and collaboration with healthcare professionals are essential for the successful translation of these advancements into clinical practice.

References

1) Manal Al Ghamdi, Mingqi Li, Mohamed Abdel-Mottaleb, Mohamed AbouShousha,"SEMI-Supervised transfer learning for convolutional neural networks for glaucoma detection", 978-1-5386-4658-8/18/$31.00 ©2019 IEEE.
2) Yong Yu,Xiaosheng Si, Changhua Hu,Jianxun Zhang,"A Review of Recurrent Neural Networks:LSTM Cells and Network Architectures", Neural Computation 31, 1235–1270 (2019) © 2019.
3) NonatoRodrigues de Sales Carvalho, Maria da Conceição Leal Carvalho Rodrigues,Antonio Oseas de CarvalhoFilho, Mano Joseph Mathew,"Automatic method for glaucoma diagnosis using a three-dimensionalconvoluted neural network".0925-2312/ 2021 Elsevier B.V. All rights reserved.
4) Huazhu Fu, Jun Cheng, Yanwu Xu, Changqing Zhang, Damon Wing Kee Wong, Jiang Liu, and Xiaochun Cao, "Disc-aware Ensemble Network for GlaucomaScreening from Fundus Image",0278-0062 (c) 2018 IEEE.
5) SoheilaGheisari, Sahar Shariflou, JackPhu, Paul J. Kennedy, Ashish Agar, Michael Kalloniatis& S. MojtabaGolzan,"A combined convolutionaland recurrent neural networkfor enhanced glaucoma detection", 2021 11:1945.
6) SertanSerte Ali Serener," Graph-based saliency and ensembles of convolutional neuralnetworks for glaucoma detection", © 2020 The Authors. IET Image Processing published by John Wiley & Sons Ltd.
7) SynaSreng, NoppadolManeerat, Kazuhiko Hamamoto and KhinYadanarWin"Deep Learning for Optic Disc Segmentation andGlaucoma Diagnosis on Retinal Images", article 2020.
8) F. Yin, J. Liu, S. H. Ong, Y. Sun, D. W. K. Wong, N. M. Tan, C. Cheung, M. Baskaran, T. Aung, and T. Y. Wong, "Model-based optic nerve head segmentation on retinal fundus images," in Proc. EMBC, 2011, pp. 2626–2629.
9) H. Fu, J. Cheng, Y. Zu, D. Wong, J. Liu, and X. Cao, "Joint Optic Disc and Cup Segmentation Based on Multi-label Deep Network and Polar Transformation," IEEE Trans. Med. Imag., 2018.
10) X. Chen, U. Xu, S. Yan, D. Wing, T. Wong, and J. Liu, "Automatic Feature Learning for Glaucoma Detection Based on Deep Learning," in Proc. MICCAI, 2015.
11) U. R. Acharya, E. Ng, W. Eugene, Lim, K. Noronha, L. Min, K. Nayak, and S. Bhandary, "Decision support system for the glaucoma using Gabor transformation," Biomedical Signal Processing and Control, vol. 15, pp. 18–26, 2015.