How to Cite:
Bhattacharya, S., & Rathore, Y. K. (2022). A review on restoration of vision in glaucoma through image processing using machine learning techniques. *International Journal of Health Sciences*, *6*(S2), 8218–8225. https://doi.org/10.53730/ijhs.v6nS2.7085

A review on restoration of vision in glaucoma through image processing using machine learning techniques

Sandhya Bhattacharya
M. Tech. (Scholar), Department of Computer Science & Engineering, Shri Shankaracharya Institute of Professional Management and Technology, Raipur, Chhattisgarh, India
Correspondence author email: sandhya.bhattacharya@ssipmt.com

Yogesh Kumar Rathore
Assistant Professor, Department of Computer Science & Engineering, Shri Shankaracharya Institute of Professional Management and Technology, Raipur, Chhattisgarh, India
Email: y.rathore@ssipmt.com

***Abstract*---**Glaucoma is the silent vision thief. Early detection of glaucoma is almost impossible and there is currently no solution for glaucoma in its later stages. This study focused on a variety of automated glaucoma detection techniques. An extensive literature review was performed on preprocessing, feature extraction, feature selection, machine learning (ML) methods, and the dataset used for testing and training. Automated glaucoma prediction is essential, but unfortunately, only a small amount of work has been done in this area and only a minimal level of accuracy has been achieved. However, automatic glaucoma detection has advanced to the point where most machine learning techniques can accurately detect 85% of glaucoma patients. Optical coherence tomography (OCT) can be used to predict the outcome of surgery-induced glaucoma.

***Keywords*---**image processing, machine learning, glaucoma, review.

Introduction

Glaucoma is a pathological condition of optic nerve damage and is the second leading cause of vision loss. It is known as the silent thief of sight. The discovery of the glaucoma disease dates back to the 17th century. Its important role as a cause of blindness has been known since the 19th century. Initial comprehension of its pathogenesis and treatment belong to the 20th century. Its prevention will

hopefully be the work of the 21st century. The word glaucoma came from ancient Greek, meaning clouded or blue-green hue, most likely describing a person with a swollen cornea or who was rapidly developing a cataract, both of which may be caused by chronic (long-term) elevated pressure inside the eye [1]. Diagnosis of glaucoma can be done automatically based upon a variety of clinical findings by different eye-care professionals. It is not a single disease, but rather a group of diseases with some common characteristics.

Two main types of glaucoma are Open-angle glaucoma and Angle-Closure glaucoma. Open-angle glaucoma is the most common form of glaucoma, accounting for at least 90% of all glaucoma cases. Both types of glaucoma is caused because of increased eye pressure. Open-angle glaucoma has a wide-angle between IRIS and cornea, whereas angle-Closure glaucoma has a narrow-angle between IRIS and cornea.

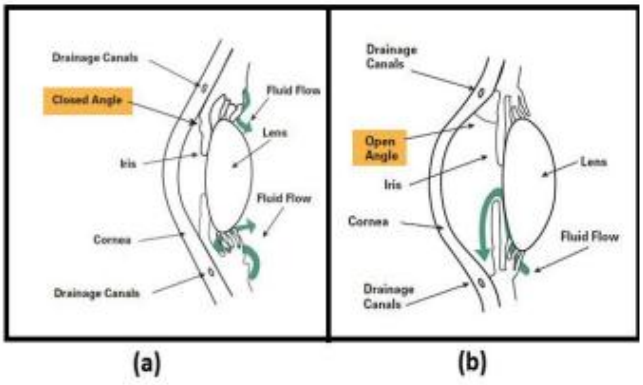

Figure 1.1: Types of Glaucoma

The analysis of glaucoma is based on the capabilities of the retina optic disc. Glaucoma reasons blindness, so early detection protects sufferers from temporary or everlasting blindness [2]. Consequently, the analysis of glaucoma is a totally tough process in the area of imaging and evaluation. Many research tasks had been provided in present works the usage of a variety of facts mining strategies to diagnose glaucoma. however, the accuracy of the analysis of glaucoma using traditional strategies isn't enough. in addition, the time required to come across the presence of glaucoma in implant images is huge. Therefore, a brand new approach is wanted to diagnose active glaucoma [3]. Our eyes are certain as our blood is known as intraocular stress. while this intraocular strain (IOP) reaches a certain stage, it damages the optic nerve. This will result in lower peripheral vision and probable blindness. Guide evaluation of eye photographs is time-consuming, and the accuracy of size parameters varies among specialists [4]. consequently, the default procedure is needed. automatic retina retrieval trying out will become an essential diagnostic tool nowadays. This method identifies chance categories and eye sicknesses. There are forms of glaucoma, one with open glaucoma or alternating glaucoma and the alternative with facet or intense glaucoma, both of which reply to growth in intraocular strain. Inside the early degrees of glaucoma, sufferers often haven't any signs and symptoms or signs and symptoms [5]. As the disorder progresses, there are causes of decreased

imagination and prescient and the affected person may additionally have a terrible impact on confined concentration (just myopia). Therefore, early detection of this disorder is the premise for additional improvement [6]. This condition occurs because of a boom in intraocular stress. Early detection of this disorder is vital to save you permanent blindness. Glaucoma assessments based totally on digital retina pictures had been achieved in recent years. There are a few checks available to differentiate retina disorder in glaucoma [13]. Essential techniques for photo processing are image registration, photo compilation, image segmentation, function rendering, picture enhancement, picture shaping, picture compression, sampling, photo segmentation, statistical evaluation, and measurement [14].

The generic automated glaucoma detection process is illustrated in Figure 1.2.

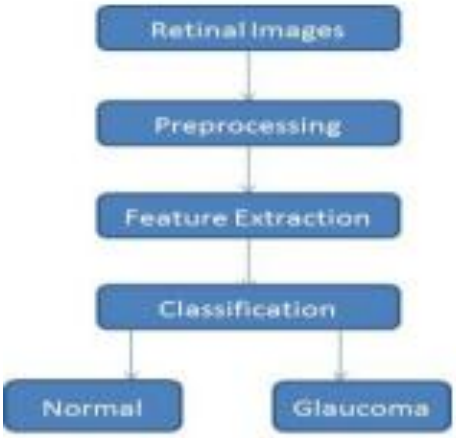

Figure 1.2: Generic Process for Automated Glaucoma Detection

In glaucoma detection first of all image of the retina is taken using digital image capturing devices. Then preprocessing is required for equalization of irregularities with images. Feature extraction involves simplifying the number of resources required to describe a large data set accurately [7, 8]. A feature is significant data that can be used for classification. Classification refers to the analysis of the properties of an image. Depending upon the analysis, the dataset is further referred into different classes i.e. normal or glaucoma affected.

Literature Review

Sno.	Authors	Title	Study
1.	Viren Jain et al. (2007)	Supervised Learning of Image Restoration with Convolutional Networks [10]	Studied low-level image processing, convolutional networks are skilled using gradient getting to know to clear up the problem of improving noisy or degraded photos. In this dataset, Markov random

			discipline (MRF), conditional random subject (CRF) and anisotropic scattering algorithms behave like simple thresholding, but attain higher overall performance with report community convolution consists of greater than 34,000 tunable parameters. The results went accurate with increasing accuracy.
2.	Imran Qureshi et al. (2015)	Glaucoma Detection in Retinal Images Using Image Processing Techniques: A Survey [4]	Studied modern CAD systems and photograph processing techniques are systematically studied and in comparison, in phrases of category accuracy, method, sensitivity and specificity. The comparison effects display that the accuracy of these CAD structures and photograph processing are higher.
3.	NatarajVijapur et al. (2020)	Efficient Machine Learning Techniques to Detect Glaucoma using Structure and Texture based Features [7]	Studied the grey level Coherence Matrix-primarily based detail extraction method and the waveform-basedmethod are used to extract those structural-based functions and textures. A combination of architectural-primarily based and tailor-primarily based techniques and machine studying techniques improves machine performance. Improved computer-assisted Glaucoma popularity system
4.	J. Josphin Mary et al. (2020)	Prediction of Glaucoma Disease using Deep Learning Techniques [5]	CNN, offer sequential illustration of pictures to differentiate among glaucoma and NG traits in diagnostic choices. The proposed DL structure consists of six learning

			techniques: four Convolutionary strata and completely integrated layers. strategies for discontinuation and statistics escalation were used to enhance the treatment of glaucoma. sizeable verification of ORIGA and SCES statistics is carried out. The findings suggest that the underlying curve characteristic of the receiver (AUC) is considerably better than the nation of the art system in diagnosing glaucoma of which zero,831 and zero,887 are databases.
5.	Daniel M. S. Barros et al. (2020)	Machine Learning Applied to Retinal Image Processing for Glaucoma Detection: Review and Perspective [3]	Machine learning and deep neural network is used.The principle differences between the structures are the range of pics required for processing and the high cost of calculation required for the use of in-depth analyzing techniques.. Statistics augmentation and transfer techniques had been used as an alternative to enhancing and minimizing community education.
6.	Amsa Shabbir et al. (2021)	Detection of Glaucoma using Retinal Fundus Images: A Comprehensive Review [1]	Computerized detection of glaucoma thru an aggregate of picture processing, artificial intelligence and computer imaginative and prescient can help prevent and stumble on the ailment in this overview article
7.	Sharanya S et al. (2021)	Glaucoma Detection Using Machine Learning [9]	The optic cup-to disc measurement compares the width of the optical cup part of the optic disc with the overall width of the

			optic disc. manual checking out of optic disk and optic cup consumes time. therefore, the glaucoma detection algorithm is being developed. however, expansion of the optic cup itself isn't a signal of glaucoma because optic cupping can also arise without glaucoma due to genetic element.
8.	P.M. Siva Raja et al. (2021)	Deep Learning Algorithms and Glaucoma Detection: A Review [8]	Convolutional Neural Networks (CNN) schemes to demonstrate the effect of appropriate functions together with data set size, structure and use of switch getting to know in comparison to the systems previously described with high accuracy.

Proposed Methodology

Image processing

Digital image processing is the use of a digital computer to process digital images through an algorithm. As a subcategory or field of digital signal processing, digital image processing has many advantages over analog image processing. It allows a much wider range of algorithms to be applied to the input data and can avoid problems such as the build-up of noise and distortion during processing [10]. Since images are defined over two dimensions (perhaps more) digital image processing may be modeled in the form of multidimensional systems. The generation and development of digital image processing are mainly affected by three factors: first, the development of computers; second, the development of mathematics (especially the creation and improvement of discrete mathematics theory); third, the demand for a wide range of applications in environment, agriculture, military, industry, and medical science has increased [11, 12].

Machine learning

Machine learning (ML) is the study of computer algorithms that can improve automatically through experience and by the use of data. It is seen as a part of artificial intelligence. Machine learning algorithms build a model based on sample data, known as training data, in order to make predictions or decisions without being explicitly programmed to do so. Machine learning algorithms are used in a wide variety of applications, such as in medicine, email filtering, speech

recognition, and computer vision, where it is difficult or unfeasible to develop conventional algorithms to perform the needed tasks [9].

A subset of machine learning is closely related to computational statistics, which focuses on making predictions using computers; but not all machine learning is statistical learning. The study of mathematical optimization delivers methods, theory, and application domains to the field of machine learning. Data mining is a related field of study, focusing on exploratory data analysis through unsupervised learning. Some implementations of machine learning use data and neural networks in a way that mimics the working of a biological brain. In its application across business problems, machine learning is also referred to as predictive analytics.

Conclusion

This evaluation attempts to deal with special sorts of software of deep getting to know techniques in the diagnosis of glaucoma. Glaucoma is one of the essential contributors to the visual acuity around the attention. it's far important to develop unique automatic strategies for the correct detection of numerous degrees of glaucoma. these packages could be a tremendous help in less developed countries where there may be a scarcity of optometrists. it is very clear in research that during-depth learning applications in retina pictures are very useful and effective. Reduces the need for guide coding as practice methods are ordinarily pushed by way of statistics Deep learning is a facts-driven technique which is why a massive amount of defined scientific records is wanted to create a strong version. Glaucoma quietly steals the eyes and reasons irreversible damage to the eyes without being detected in its early degrees. There are not any substantive signs of glaucoma till it becomes an incurable disorder and to date there's no treatment for the disorder within the later stages. Little paintings has been performed to come across glaucoma in the first vicinity. But the automated detection of glaucoma the usage of machine gaining knowledge of strategies in current stages has confirmed to be an powerful technique with an eighty five% achievement rate.

References

1. Amsa Shabbir, Aqsa Rasheed, Huma Shehraz, Aliya Saleem, Bushra Zafar, Muhammad Sajid, NoumanAli , Saadat Hanif Dar and Tehmina Shehryar, “Detection of Glaucoma using Retinal Fundus Images: A Comprehensive Review”, Mathematical Biosciences and Engineering Volume 18, Issue 3.
2. Anirban Mitra, Priya Shankar Banerjee, Sudipta Roy, “The region of interest localization for glaucoma analysis from retinal fundus image using deep learning,” 2018.
3. Daniele M. S. Barros, Julio C. C. Moura, Cefas R. Freire, Alexandre C. Taleb , Ricardo A. M. Valentim and Philippi S. G. Morais, “Machine Learning Applied to Retinal Image Processing for Glaucoma Detection: Review and Perspective”, BioMedical Engineering OnLine, (2020) 19:20 https://doi.org/10.1186/s12938-020-00767.

4. Imran Qureshi, “Glaucoma Detection in Retinal Images Using Image Processing Techniques: A Survey”, International Journal of Advanced Networking and Applications Volume: 07 Issue: 02, 2015.
5. J. Josphin Mary, R. Charanya, V. Shanthi, G. Sridevi, “Prediction of Glaucoma Disease using Deep Learning Techniques”, European Journal of Molecular & Clinical Medicine ISSN 2515-8260 Volume 07, Issue 09, 2020.
6. Javier Civit-Masot , Manuel J. Dominguez-Morales, Saturnino Vicente-Diazand AntonCivit, “Dual Machine-Learning System to Aid Glaucoma Diagnosis Using Disc and Cup Feature Extraction”, Special Section on Emerging Deep Learning Theories and Methods for Biomedical Engineering, Volume 8, 2020.
7. NatarajVijapur, R. Srinivasa Rao Kunte, “Efficient Machine Learning Techniques to Detect Glaucoma using Structure and Texture based Features”, International Journal of Recent Technology and Engineering (IJRTE) ISSN: 2277-3878, Volume-9 Issue-2, July 2020.
8. P.M. Siva Raja, S. L. Jothilakshmi, “Deep Learning Algorithms and Glaucoma Detection: A Review”, International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056 Volume: 08 Issue: 02 | Feb 2021.
9. Sharanya S, “Glaucoma Detection Using Machine Learning”, International Journal of Science and Research (IJSR), Volume 10 Issue 4, April 2021.
10. Viren Jain, Joseph F. Murray, Fabian Roth, Srinivas Turaga, Valentin Zhigulin, Kevin L. Briggman, Moritz N. Helmstaedter3, Winfried Denk3, and H. Sebastian Seung, “Supervised Learning of Image Restoration with Convolutional Networks”, 978-1-4244-1631-8/07/$25.00 ©2007 IEEE.
11. Abdullah Sarhan, Jon Rokne, and Reda Alhajj, "Glaucoma detection using image processing techniques: A literature review", Computerized Medical Imaging and Graphics, Elsevier, volume 78, 2019.
12. Afshan Latif, Aqsa Rasheed, Umer Sajid, and Jameel Ahmed, et. al.,"Content-based image retrieval and feature extraction: a comprehensive review", Mathematical Problems in Engineering, volume 2019, 2019, Hindawi.
13. Saleha Masood, and Muhammad Sharif, Mudassar Raza, and Mussarat Yasmin, et. al.,"Glaucoma disease: A survey", Current Medical Imaging, volume 11, Issue 4, pp 272-283,2015, Bentham Science Publishers.
14. Akram Tehmina Khalil, Khalid Muhammad Usman and Dar, Samina, et. al., "A study to identify limitations of existing automated systems to detect glaucoma at initial and curable stage", volume 31, Issue 3, pp 1155--1173, 2021, Wiley Online Library.