ACADEMICIA

ISSN: 2249-7137 Vol. 11, Issue 10, October 2021 Impact Factor: SJIF 2021 = 7.492

ACADEMICIA
An International Multidisciplinary Research Journal
(Double Blind Refereed & Peer Reviewed Journal)

DOI: 10.5958/2249-7137.2021.02195.9

EVALUATION OF MACHINE LEARNING TECHNIQUES FOR GLAUCOMA RECOGNITION AND PREDICTION

Mr Pankaj Saraswat*

*SOEIT, Sanskriti University,
Mathura, Uttar Pradesh, INDIA
Email id: pankajsaraswat.cse@sanskriti.edu.in

ABSTRACT

Glaucoma is a quiet vision thief. Early detection of glaucoma is almost difficult, and there is currently no treatment for glaucoma in its latter stages. This research looked at a variety of automated glaucoma detection methods. A thorough review of the literature was performed on preprocessing, feature extraction, feature selection, Machine Learning methods, and data sets utilized for testing and training. Automated glaucoma prediction is critical, but sadly, only a small amount of work has been done in this area, and only a minimal level of accuracy has been reached. However, automated glaucoma detection has progressed to the point that most machine learning methods can correctly identify 85 percent of glaucoma patients. Glaucoma can be predicted successfully using Optical Coherence Tomography.

KEYWORDS: *Glaucoma Detection, Glaucoma Prediction, Feature Selection, Feature Extraction, Machine Learning.*

INTRODUCTION

Glaucoma is a medical disease in which the optic nerve is damaged, and it is the second most common cause of visual loss. It's called the "quiet thief of sight." The illness of glaucoma was first discovered in the 17th century. Its significance as a cause of blindness has been recognized since the nineteenth century. The first understanding of its etiology and therapy dates from the twentieth century. Its averting will, ideally, be a task for the twenty-first century. Glaucoma is derived from the ancient Greek word glaucoma, which means cloudy or blue-green tint. It was most likely used to describe someone who had a swollen cornea or was quickly developing a cataract, either of which would have been caused by chronic (long-term) increased pressure within the eye. Glaucoma may be automatically diagnosed based on a number of clinical findings by various eye-care specialists. It is a collection of illnesses with certain similar features, rather than a single disease. The ophthalmoscope was a significant innovation that made it feasible to identify glaucomatous abnormalities in the fundus. Glaucoma simplex is a condition that causes blindness due to high intraocular pressure. The development of the tonometer and the perimeter, as well as the usage of cocaine, helped to advance glaucoma diagnosis. The first successful surgical glaucoma therapy[1].

Various Machine Learning methods have been used to automate the diagnosis and prediction of glaucoma during the past few decades. Neural networks, decision trees based on ID3 methods, Vector Support Machine, Naive Bayes classifier, k- closest neighbor, Canny edge detector, active contour model, linear regression, and Fuzzy min-max neural network were used to accomplish automated glaucoma diagnosis. There has been very little work done on automated glaucoma prediction, with just two methods being used: fuzzy logic and linear regression[2].

1.1.Glaucoma detection method that is automated

Figure 1 depicts a general automated glaucoma detection method.

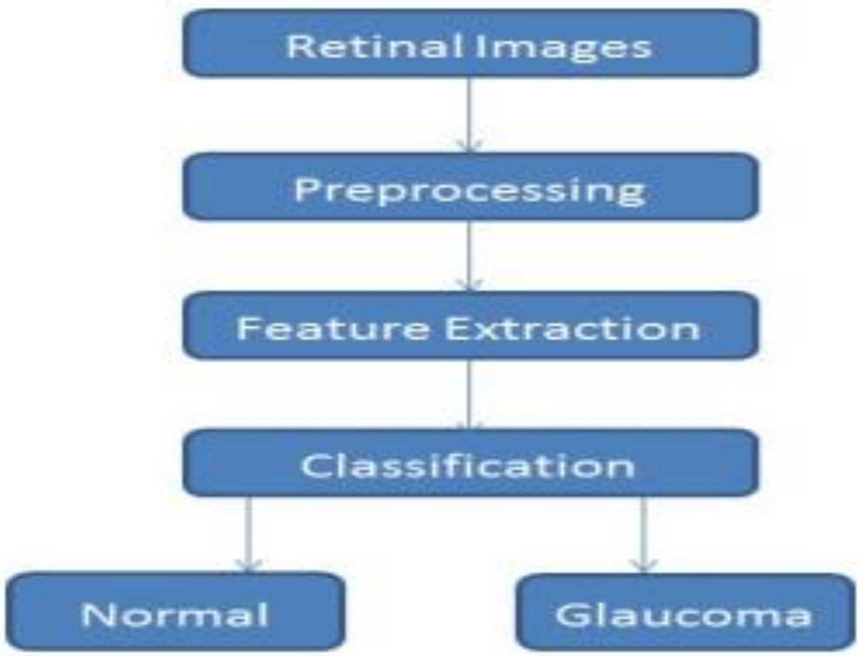

Figure 1: Illustrate the diagram shows the generic Process for Automated Glaucoma Detection

The initial step in the identification of glaucoma is to obtain a digital picture of the retina. Then, in order to equalize anomalies with pictures, preprocessing is needed. Feature extraction is the process of reducing the number of resources needed to properly describe a big data collection. A feature is a significant piece of information that may be used to classify anything[3]. The study of an image's characteristics is referred to as classification. The dataset is divided into two groups based on the results of the analysis: normal and glaucoma-affected.

1.2.Types of glaucoma

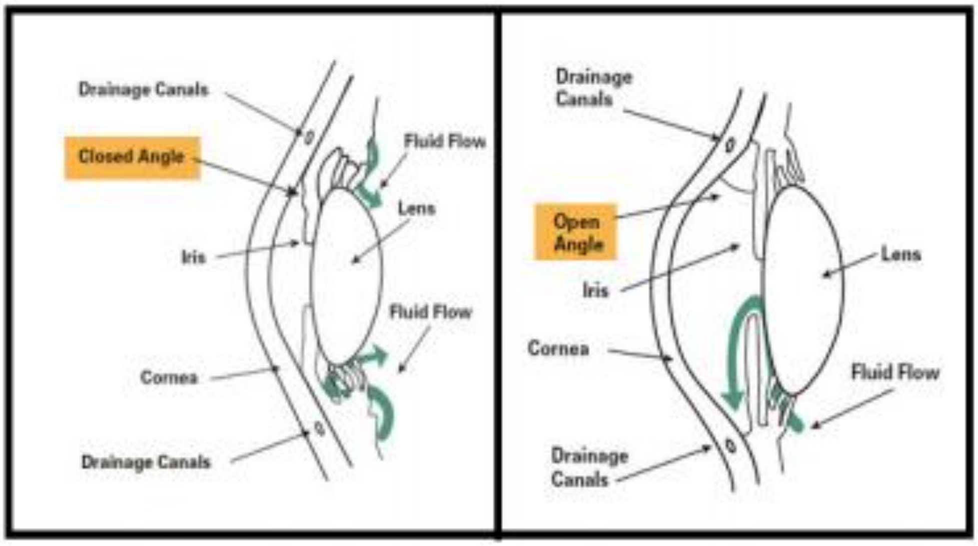

Figure 2: schematic diagram shows the types of glaucoma: (a) and (b) represents, angle-closure glaucoma and open-angle glaucoma respectively.

Transparent glaucoma and Angle-Closure glaucoma are the two most common forms of glaucoma. The much more prevalent kind of glaucoma, open-angle glaucoma, accounts for at least 90% of all glaucoma cases. Glaucoma is caused by an increase in ocular pressure in both types of glaucoma. Angle-Closure glaucoma has a small angle between the IRIS and the cornea, while open-angle glaucoma has a broad angle[4]. Angle-closure glaucoma (a) and open-angle glaucoma (b) are shown in Figure 2. Angle-Closure glaucoma develops rapidly and has noticeable symptoms, while open-angle glaucoma develops slowly and has no noticeable symptoms.

1.3.Technologies for ophthalmic imaging

The most significant factor in glaucoma detection is the ophthalmic imaging technology utilized to collect images for glaucoma detection. The more comprehensive and crisp the picture under observation, the more precise the detection and prediction will be. Fundus pictures, Confocal Scanning Laser Tomography, and Optic Coherence Tomography are among the ocular imaging technologies used to acquire images for the diagnosis and prediction of glaucoma. Fundus pictures are basic digital photographs that do not include any of the eye's interior features[5]. A laser light is used in CSLT. Confocal imaging is the technique of using a focused laser beam to scan an object part by part and collecting the reflected light via a tiny opening called a confocal pin hole. The interior features of the eye are captured via OCT, which utilizes light and generates a picture based on reflected light. Figure 3 depicts an overview of work done to identify and forecast glaucoma using various imaging methods. It can be observed that only a small amount of work has been done in glaucoma prediction, with the majority of work being done utilizing fundus images.

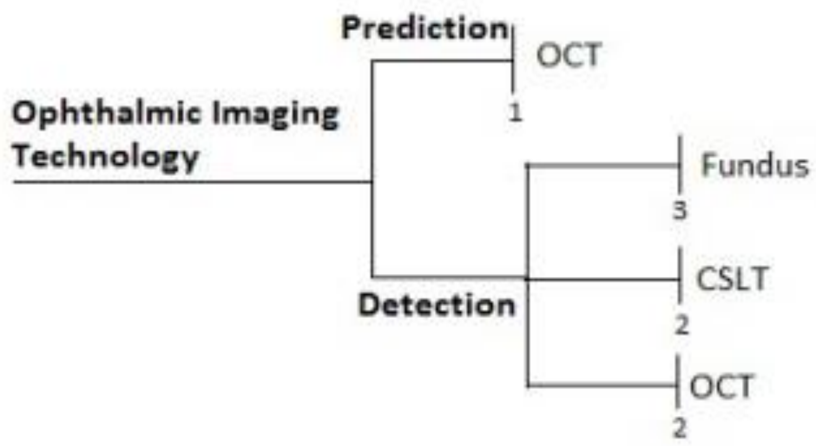

Figure 3: Overview of Ophthalmic Imaging Technologies used for detection and prediction of glaucoma

1.4.Techniques for preprocessing

For error-free glaucoma diagnosis, several preprocessing methods have been used to pictures. Figure 4 depicts several glaucoma detection preprocessing methods.

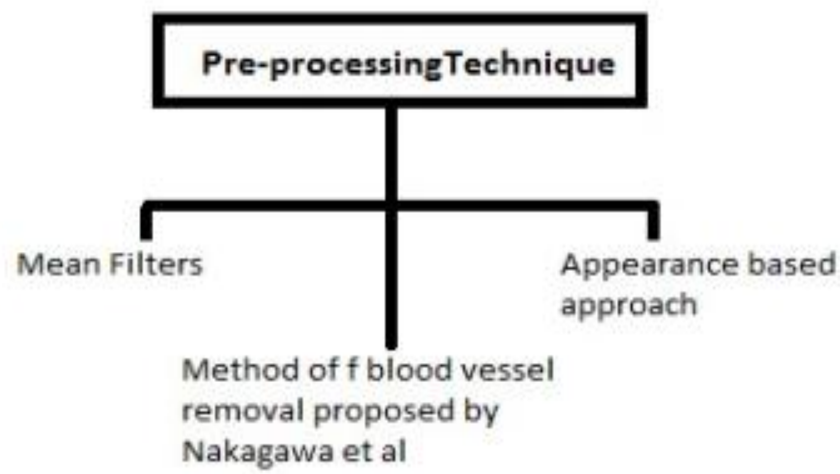

Figure 4: Illustrate the diagram shows the preprocessing Techniques used in detection of Glaucoma

Appearance based approach was implanted in to segment blood vessels and spatially in paint them to a vessel free image.

Figure 5: Illustrate the Vessel in painting on color fundus Image after preprocessing

After preprocessing, Fig. 5 displays a vessel-free picture. The methodology of blood vessel elimination suggested by Nakagawa et al. was used in preprocessing[6]. Color convention, scaling the picture, and noise reduction from the original image were all done using mean filters in the pre-processing of OCT images.

1.5.Techniques for extracting features

The most important activity is feature extraction. The accuracy of the system is mostly determined by its features. Various automated feature extractions were utilized to make the glaucoma detection procedure effective. Figure 6 depicts a few methods utilized in the glaucoma detection procedure, as well as the method approach used to identify feature Mean and Variance. Luminance and translation invariance size were included in several extractions such as Pixel Intensity Value, Textures, F Pixels Intensity, and Histogram Model[7]. Utilized the P-tile threshold technique to identify color and form. Macular Cub was used in to extract characteristics such as the macula thick sequential FMM in the painting technique module to detect features such as the cup to disc ratio, configuration, and vessel distribution information. Feature Extraction Techniques for Detection (Fig. 6).

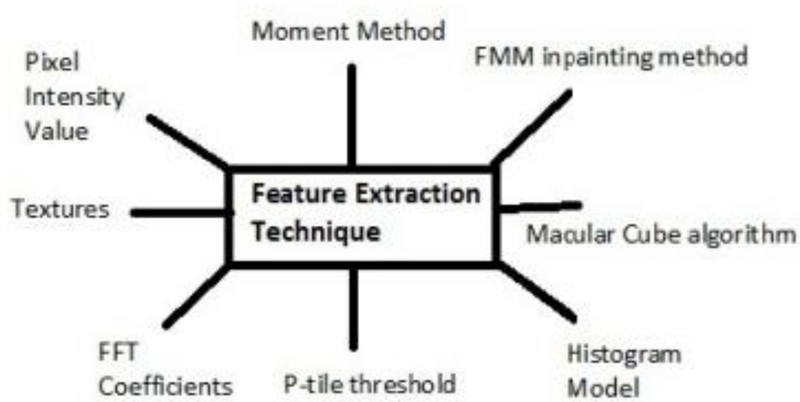

Figure 6: Feature Extraction Techniques used in detection of glaucoma

1.6.Technique for selecting features

The process of choosing a subset of relevant characteristics for use in model building is known as feature selection. Various feature selection methods utilized in glaucoma detection are shown in Figure 8. Principle Thirty of the 950 dimensions were identified using the component analysis method.

1.7.Glaucoma detection using a referential detection feature

Glaucoma is a word that refers to a collection of illnesses rather than a specific condition. Glaucoma is detected using a variety of referral detection features. Different referential detecting characteristics that have been utilized in glaucoma detection are mentioned in Fig. 7.

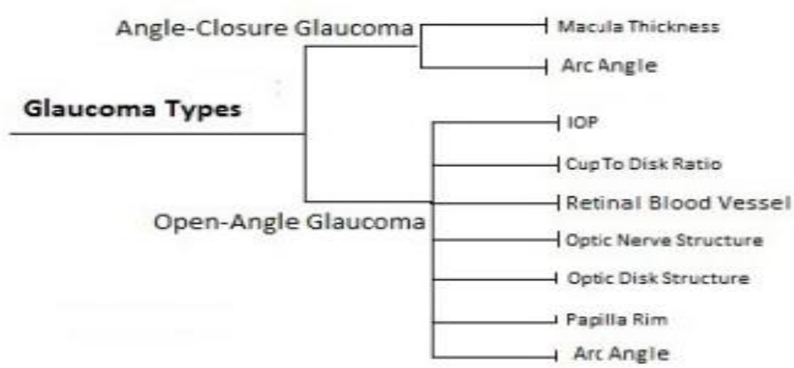

Figure 7: Indication of Recommendation Detection Feature for glaucoma

Angle-closure glaucoma was detected using Macula Thickness. Inter Ocular Pressure (IOP) was utilized as a detecting method. For the purpose of detection, the retinal blood vessel was utilized. The structure of the optic nerve was utilized. The rim of the papilla was utilized to detect activity. The arc angle was utilized to determine if the patient had open-angle or angle closure glaucoma[8].

REVIEW OF THE LITERATURE

In the framework of clinical vision research, Miguel Caixinha investigated the role of machine learning methods for diagnosis and illness monitoring. Many eye disorders that lead to blindness may be prevented or postponed if identified and treated early on. New sources of data for early illness diagnosis and patient management are now accessible because to recent advances in diagnostic equipment, imaging, and genomics. Machine learning methods first appeared in the biomedical sciences as clinical decision-support tools to enhance the sensitivity and specificity of illness diagnosis and monitoring, allowing clinicians to make more objective decisions. This paper provides an overview of machine learning methods for multimodal ocular illness diagnosis and monitoring. Machine learning algorithms are used to identify complicated patterns in a dataset automatically. When a group label is provided for each instance, these methods allow for the creation of homogenous groups or the creation of a classifier that predicts group membership of new cases. To guarantee that machine learning methods work well in a particular dataset, all potential sources of bias should be eliminated or reduced. The second part of this article will describe and explore the use of machine learning methods in ocular disease detection and monitoring[9].

Machine learning is involved with the creation and implementation of algorithms and methods that enable computers to “learn” patterns in data via repeated processes. CHRISTOPHER

BOWD researched it. Observed or unobserved processes may be used. Machine learning classifiers are not bound by statistical assumptions, making them flexible to a wide range of data. Recent applications of MLC approaches to the identification and monitoring of glaucoma using visual field and optical imaging data indicate that these methods can outperform existing methods. This paper covers MLC methods as they have been used to visual function and optical imaging in glaucoma research. It also offers some background on the classification problem in glaucoma and the construction and assessment of MLCs[10].

DISCUSSION

This article discusses some of the most common machine learning techniques used in vision science. However, in order to develop unbiased prediction models in clinical vision sciences, a number of issues must be resolved. The selection of the training sample is one of the main issues with prediction models in eye disorders. For patient diagnosis or illness prediction, predictive models should be developed. The majority of published studies only examine one eye per patient, which is chosen at random, based on the patient's right or left eye, or based on the patient's worse or better eye. New methods must be developed to build a prediction model that considers eye specific variables within each patient rather than each eye separately. Clustering-based approaches may be able to solve this issue. Because the model was trained solely for glaucoma or non-glaucoma prediction, a glaucoma detection model deployed in a patient with diabetic retinopathy may fail to recognize the patient's eyes as sick.

CONCLUSION

Glaucoma steals vision invisibly and causes irreversible loss to vision without being detected in its early stages. Glaucoma has no symptoms until it has progressed to the point where it is chronic, and there is currently no treatment for the illness in its advanced stages. Early identification of glaucoma has received little attention. However, automated glaucoma identification utilizing machine learning has shown to be an effective approach, with an 80 percent success rate. Because of its capacity to extract comprehensive and in-depth internal structures of the eye, OCT pictures may be utilized to accurately anticipate glaucoma symptoms. Existing prediction models, on the other hand, are often based on a training set consisting of one of the patient's eyes, with the selected eye being normal or sick. For example, proposed a nonparametric method in which each eye is treated as a sub-unit of a cluster, i.e. the patient. Furthermore, while employing the predictive models in the real world, the patients' eyes may be in a different state from the one that was taken into account when the models were being trained. Glaucoma patients with early detection and recovery.

REFERENCES

1. T. Khalil, S. Khalid, and A. M. Syed, "Review of Machine Learning techniques for glaucoma detection and prediction," *Proc. 2014 Sci. Inf. Conf. SAI 2014*, pp. 438–442, 2014, doi: 10.1109/SAI.2014.6918224.

2. A. A. Salam, M. U. Akram, K. Wazir, and S. M. Anwar, "Using Structural Features," *Ieee*, vol. 1, 2015.

3. R. Belgacem, I. taamallah Malek, H. Trabelsi, and I. Jabri, "A supervised machine learning algorithm SKVMs used for both classification and screening of glaucoma disease," *New*

Front. Ophthalmol., 2018, doi: 10.15761/nfo.1000211.

4. T. Köhler, R. Bock, J. Hornegger, and G. Michelson, “Computer-aided diagnostics and pattern recognition: Automated glaucoma detection,” in *Teleophthalmology in Preventive Medicine*, 2015.

5. S. Cheriguene, N. Azizi, and N. Dey, “Ensemble classifiers construction using diversity measures and random subspace algorithm combination: Application to glaucoma diagnosis,” in *Studies in Computational Intelligence*, 2016.

6. Chengqi Zhang*, Ling Guan**, and Z. Chi, “Introduction to the Special Issue on Learning in Intelligent Algorithms and Systems Design,” *J. Adv. Comput. Intell. Intell. Informatics*, 1999, doi: 10.20965/jaciii.1999.p0439.

7. M. Christopher *et al.*, “Retinal nerve fiber layer features identified by unsupervised machine learning on optical coherence tomography scans predict glaucoma progression,” *Investig. Ophthalmol. Vis. Sci.*, 2018, doi: 10.1167/iovs.17-23387.

8. T. Khalil, S. Khalid, and A. M. Syed, “Review of Machine Learning techniques for glaucoma detection and prediction,” 2014, doi: 10.1109/SAI.2014.6918224.

9. M. Caixinha and S. Nunes, “Machine Learning Techniques in Clinical Vision Sciences,” *Curr. Eye Res.*, vol. 42, no. 1, pp. 1–15, 2017, doi: 10.1080/02713683.2016.1175019.

10. C. Bowd and M. H. Goldbaum, “Machine learning classifiers in glaucoma,” *Optom. Vis. Sci.*, vol. 85, no. 6, pp. 396–405, 2008, doi: 10.1097/OPX.0b013e3181783ab6.