International Journal of Scientific Research & Engineering Trends
Volume 6, Issue 6, Nov-Dec-2020, ISSN (Online): 2395-566X

A Review of Automatic Glaucoma Detection from Fundus Imaging

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***Abstract-* Tomographical imaging is a technique through which diagnosis and monitoring can happen with an effective manner. If a disease can be diagnosed in an early stage always been a preference in the field of medical science. Glaucoma is one of the chronical disorder of optic discs in which fluid pressure increases and if it is remain untreated; the patients may lose their vision and even they may pertain total blindness. This disease cannot be cured, early recognition and precautions may protect fundus nerve against serious vision loss. It does not affect instantly, the loss of vision may occurs gradually over a long period. Glaucoma detection involves some measurements like shape and size of optic disc. Here this paper reviewed various researches and concluded that most of the researches are intended to classify the blood vessels for broken vessels detection that signifies the Glaucoma in a better way. Accuracy may degrade due to incorrect or inappropriate masking. An IRIS has some sensitive information that has not to be tampered anyhow.**

***Keywords*:-Automatic Glaucoma Detection, Fundus Imaging, Optic Disc, Optic Cup, CNN, Retinal Image, Hemorrhages**.

I. INTRODUCTION

This review describes the latest approaches in the development and application of new technologies for the detection and management of glaucoma, including imaging, visual function testing and tonometry.The widespread availability of mobile technology in developing countries improves health care, for example, allowing health care providers to remotely assess patient data using smartphones and mobile applications.

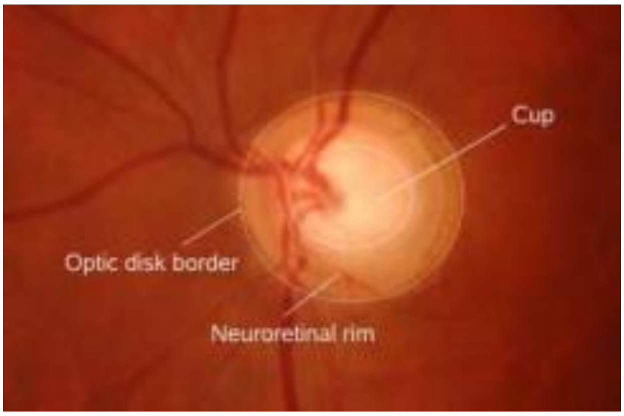

Fig 1. Glaucoma Architecture. [1]

Glaucoma is an eye disease that causes irreversible reduction in the optical field. It involves progressive damage to the optic nerve. If left untreated, the patient becomes blind. An important feature of this defect is the development of papillae excavation. In fact, the papilla or optical disc is a combination of fibers that make up the optical nerve, causing the optic nerve to disappear due to the depression found in the excavated optical disc. The "disc" report indicates the availability of glaucoma (usually around 0.3) between the excavated size and the optical disc.

II. RELATED WORKS

Swethali M. Nikam [2017] et al. proposed a system that is based on CDR (cup to disk ratio) and separation by threshold has been proposed to distinguish glaucoma from retinal images. Glaucoma can be detected by analyzing the areas above the optic cup and optic disc retina image and the size of the optic cup and disc. The system localizes these areas here using the entrance and partition by measuring horizontally and vertically. If the size is larger than 0.3, the patient may have glaucoma. But by analyzing the size of the glaucoma; the size must be accurate or the fault alarm rate will increase. Early glaucoma cannot be detected using CDR because it only analyzes the optic cup and disk [2].

Thus, the fit ellipse is used to determine the boundary between the optic cup and the optic disc. Using the cup-to-disc CDR ratio, we found that glaucoma or normal to a specific eye. This system is easy to use and we use the Matlab GUI, so it is user friendly. Matlab GUI provides numerical values for cup, disk diameter and CDR ratio along with graphical representation of the eye [2]. Namita Sengar [2017] et al. proposed a system which is based on optic disc detection and hemorrhages segmentation. Bleeding releases a portion of the blood from the ruptured vessels inside the retina image. But by determining whether the blood vessels are broken; that may not be sure if this is glaucoma. Normal eyes often have red blood vessels that look like broken vessels and are considered non-glaucoma retina [3].

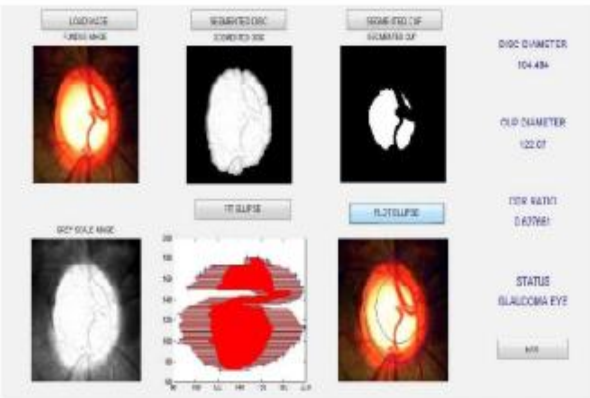

Fig 2. Graphical User Interface for Glaucoma Detection.[2]

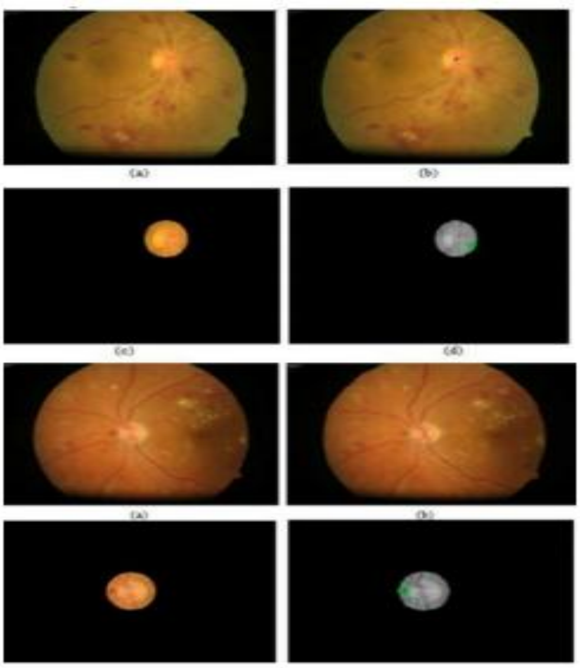

Fig 3. a) Original fundus image b) Optic disc localized image c) Segmented Region of interest d) Detected hemorrhage. [3]

Mrs. Pavitra G [2018] et al. proposed a system that is based on cup-to-disk ratio estimation and pixel brightness conversion, geometric conversion, and pre-processing of the desired area, such as a limited area of the processed image. The histogram equation is also part of it. The standard ratio from cup to disc is 0.3, which is considered if the ratio is larger than specified; this is glaucoma. This ratio is easily affected by the reflection of light and blood. Shwetha C. Shetty [2018] et al. represents a system based on clustering and optic cup measurements. K-media clustering is used to separate the optic cup area from the fundus image. During the boundary detection phase, the morphological operation takes place after the automatic optic cup and edge detection. Clustering of similar cells from the retina image also affects blood vessels, reducing accuracy or optimal detection rate [5].

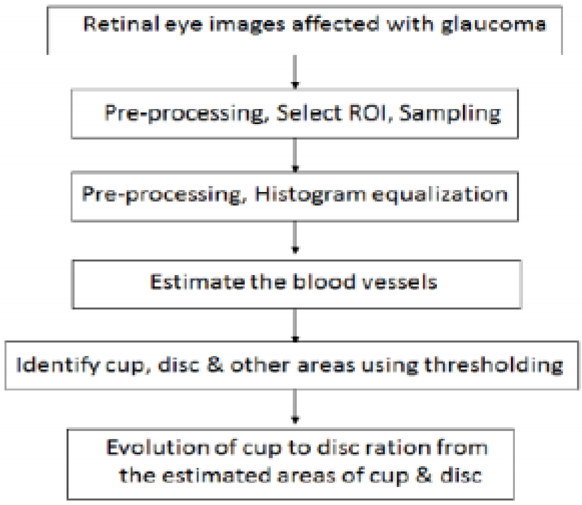

Fig 4. Block Diagram

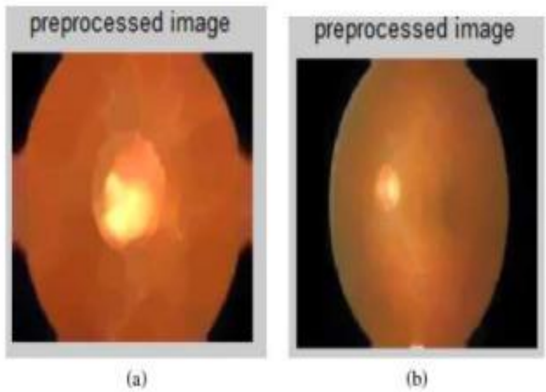

Fig 5. Pre-processed image (a) Glaucoma affected eye (b) healthy eye. [5]

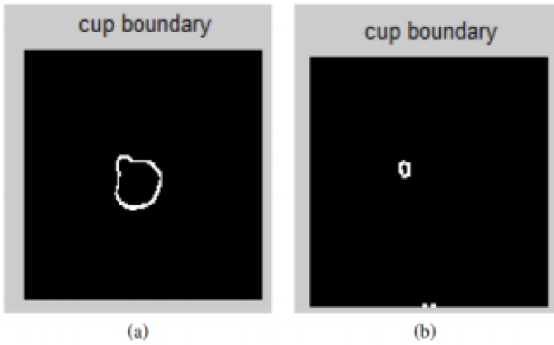

Fig6. Optic cup edge detection followed by morphological operations (a) Glaucoma affected eye (b) healthy eye. [5]

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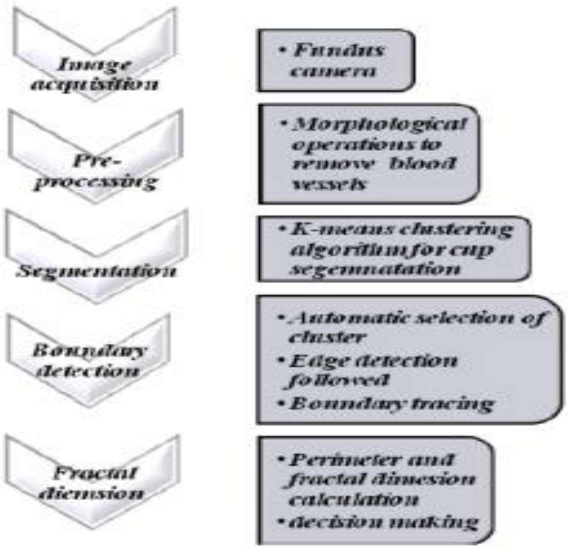

Fig. 7. Block Diagram [5]

Juan Carrillo [2019] et al. represents a system that use partitioning and access to hide unwanted background and divide the area of interest (ROI). It converts blood vessels and any area above the retina image into a grayscale image. If elimination or masking is done using the segmentation method, it can cause the loss of certain parts of the glaucoma and the sensitive information can be removed or removed from the image, which can degrade the optimal detection rate. Here the system achieves 88.5% accuracy, which may be slightly higher [6].

Liu Li [2019] et al. served a system that is based on the convolutional neural network (CNN). The CNN model includes subnets of attention assessment, symptomatic area localization, and glaucoma classification. To diagnose patterns of glaucoma, the system here must be trained with different models of glaucoma-affected retinal images. The system does not successfully classify glaucoma if the optical disc and cup differ from the trained model [7].

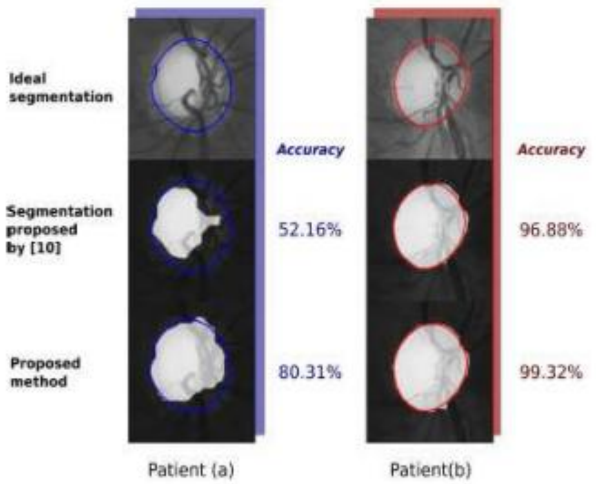

Fig 8. Disc Segmentation Results. [6]

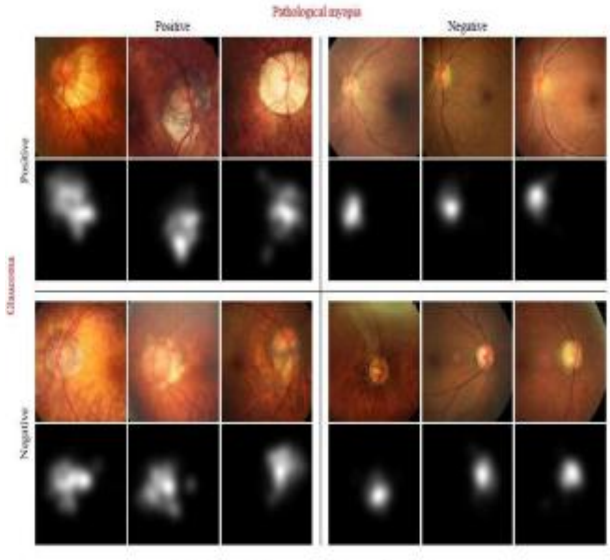

Fig 9. Glaucoma Detection. [7]

Ali Serener [2019] et al. specifies the CNN based system and uses the histogram equation to preprocess the data. Resnet 50 and Googlenet are both in-depth learning methods for training systems with different conditions to detect glaucoma. Samples are limited, and complex blood vessels may not transmit the required accuracy and optimal detection rate. The performance of both models takes into account accuracy, precision, specificity and ROC curve range. Results show that Google has surpassed Resnet-50 for early, advanced and total glaucoma detection [8].

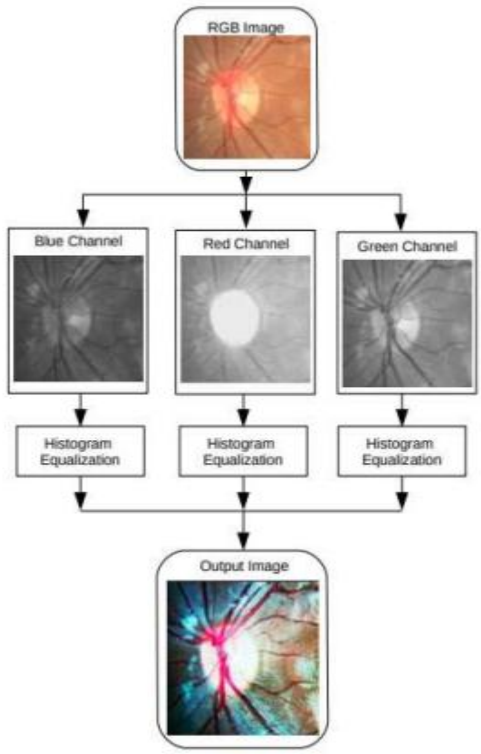

Fig 10. Preprocessing for glaucoma detection. [8]

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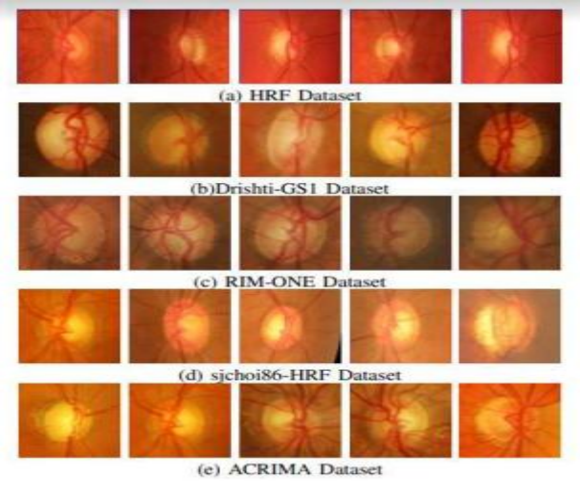

Fig 11. Sample fundus images from the five datasets. [9]

Sertan Serte [2019] et al. proposed a system which is based on the Deep Neural Network. Fundus created a simple in depth study model to identify glaucoma in images. The model works on three in-depth learning structures: Resnet, Google Net and Resnet 152. The training and testing of this model is performed using five different datasets, four of which are used in training and testing. It requires a lot of data to work better than other methods. Training is very expensive due to the complex data models. It uses a convincing algorithm. In-depth study requires expensive GPUs and hundreds of machines. Unlike previous works, the training here is conducted together in four different datasets and tested in one. Although the datasets are different from each other, the prototype of the five datasets tested and the three different structures display 80% of the time, comparable or better than the previous work [9].

III. PROBLEM IDENTIFICATION

Juan Carrillo et al. proposed a system that uses background subtraction using segmentation and thresholding for extracting the region of interest and classifies blood vessels. Segmenting only using thresholding and obtaining decision on the basis of that; is not a good approach because it may also erode the region of interest that affects the accuracy directly. The accuracy is often less that is recorded as 88.5 % that may enhanced in future.

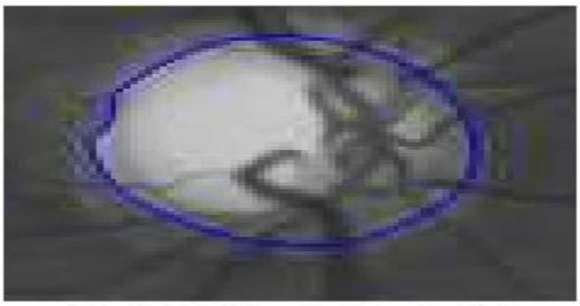

Fig 12. Retinal Boundary Extraction. [6]

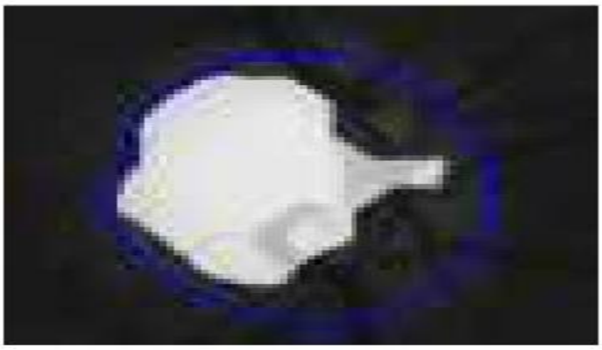

Fig 13. Erosion by Segmentation. [6]

IV. RESULT COMPARISON

Authors	Modality	Accuracy
NamitaSengar [3]	Gabor Filter & Segmentation by Thresholding	93.57%
Shwetha C.Shetty[5]	Fractal Analysis	92.00%
Juan Carrillo [6]	Background Subtraction using Segmentation by Thresholding	88.50%
Liu Li [7]	CNN	92.40%
Sertan Serte [9]	DNN	87.00%

V. CONCLUSION & FUTURE SCOPE

Automatic glaucoma detection provides the best solution to the difficulties and shortcomings of the current manual approach to detecting glaucoma with the naked human eye, which is time consuming and requires more effort and human resources with expert level knowledge and experience. There has been a lot of research done so far on the classification of glaucoma, but masking is a big issue that somehow directly destroys accuracy. An excellent system can be implemented with a HOG transformer and support vector machine to detect glaucoma with a high degree of accuracy. The system is not just about dividing the spot and blood vessels; this increases image intensity and effectively dissociates visual glaucoma and allows repetitions to lead to greater accuracy than ever before.

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