

A Review on Detection of Glaucoma from Retinal Fundus Images Using Digital Image Processing

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Abstract: Glaucoma is a disease in which the optic nerve of the eye gets destroyed. As a result, it causes vision loss or blindness. However, with earlier diagnosis and treatment, eyes can be protected against severe vision loss. Most vision loss cases due to Glaucoma are preventable if the disease treatment is started in early stages. Most of times peripheral vision can be damaged earlier than an individual's central vision by Glaucoma because it does not show any sign and symptoms. The existing procedures to detect Glaucoma are time consuming and uncertain at the clinic. We propose a low-cost Glaucoma detection system which is a computer-based technology and therefore, it uses algorithms to instantaneously detect and classify healthy and Glaucoma eye. It does this by analyzing region of interest (ROI) of images through implementation of various image extraction features like GLCM matrix; Wavelet based Texture features like Multi scale Linear Binary pattern. For Classification of healthy and Glaucoma eye we propose Supervised Machine Learning approach.

Index Terms: Glaucoma, GLCM matrix , Wavelet, Supervised Machine

INTRODUCTION

Glaucoma often causes permanent blindness slowly without symptoms and warnings. It is a primary cause of vision loss worldwide. It is the group of the disease that contaminates the optic nerve and the optic nerve cells which results in loss of vision. In healthy eyes, there is normal balance between the fluids, one that is produced in the eye, and the second that leaves the eye through eye's drainage system. This balance of fluids keeps Inter Ocular Pressure (IOP) within the eye constant but in glaucoma, the balance of fluids produced within the eye is not maintained properly which in turn causes an increase in IOP, resulting in the damage of optic nerve. Due to increase in IOP, the cup size begins to increase which consequently increases the Cup to Disc Ratio. As For normal disc the CDR is considered to be less than 0.5 but in case of glaucoma, it is greater than 0.5. As the cup size increases it also affects the Neuro retinal Rim (NRR). NRR is the region located between the edge of the disc and the physiological cup. In the presence of glaucoma, area ratio covered by NRR in superior and inferior region becomes thin as compared to area covered by NRR in nasal and temporal region.

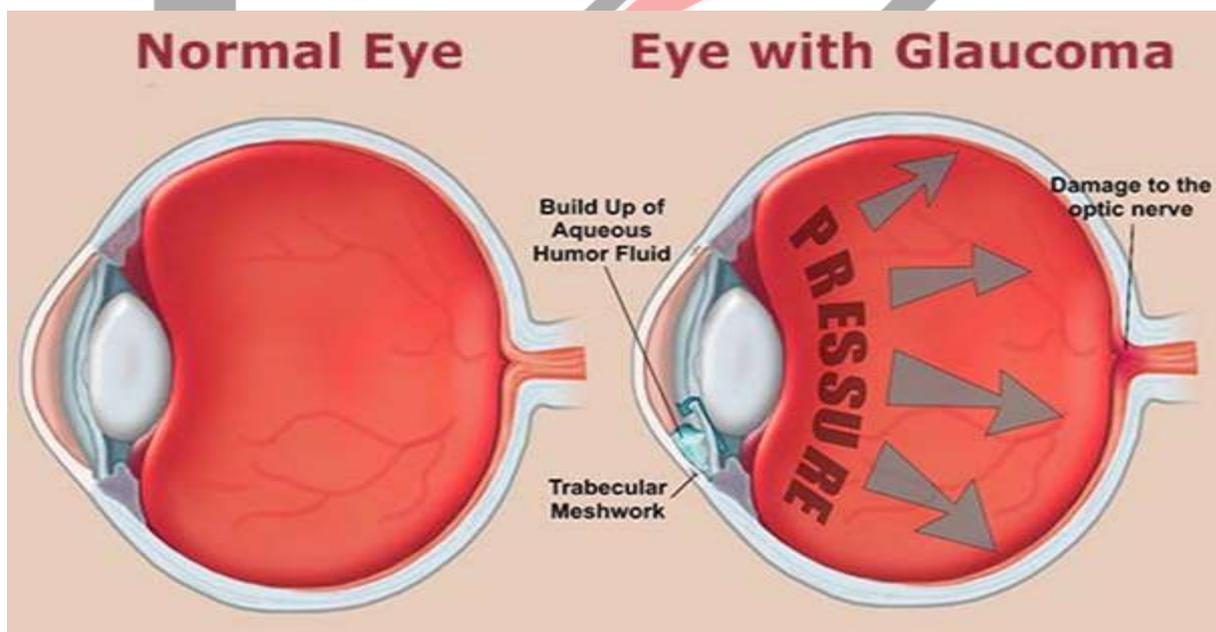


Figure 1.2 Healthy and Glaucoma Eye

As detection of Glaucoma at later stage may lead to permanent loss of vision and person become blind for all his remaining lifetime. Figure 1.2 shows the healthy and Glaucoma eye structure. In Glaucoma optic nerve gets damaged as shown in seen in above figure than normal healthy eye. So early detect Glaucoma can prevents vision loss. To detect Glaucoma in early stage expert persons are

required and these persons are not easily available in rural areas like developing countries like India. There is also possibility of human mistakes while manually operating devices which measures eye images. So need to develop automated system which will detect Glaucoma with more accuracy.

LITERATURE REVIEW

In glaucoma, this balance of fluids is not maintained properly inside the eye. Several studies and researches have been done in the last few years for the detection and classification of glaucoma. Following are the some researches and studies to detect glaucoma. Bhendra Singh Kirar, Dheeraj Kumar Agrawal[1] proposed hybrid and concatenation approach to increase the accuracy for measuring features of images. DWT decomposes images into approximate and detail coefficients and EWT decomposes images into its sub band images. The concatenation approach employs the combination of all features obtained using DWT and EWT and their combination. Extracted features from each of DWT, EWT, DWTEWT and EWTDWT are concatenated. Concatenated features are normalised, ranked and fed to singular value decomposition to find robust features. Fourteen robust features are used by support vector machine classifier.

Deepthi K Prasad, L.Vibha [2] proposed system concentrates on both Cup-to Disk Ratio (CDR) and different features to improve the accuracy of glaucoma. Morphological Hough Transform Algorithm (MHTA) is designed for optic disc segmentation. Intensity based elliptic curve method is used for separation of optic cup effectively. Further feature extraction and CDR value can be estimated. Finally, classification is performed with combination of Naive Bayes Classifier and K Nearest Neighbour (KNN). The proposed system is evaluated by using High Resolution Fundus (HRF) database.

E.Deepika, Dr.S.Maheswari [3] proposed an effective algorithm for the detection of glaucoma has been proposed. It consists of two main process, CDR detection and blood vessel segmentation. The entire process to detect abnormalities is split into several sections are arranged as follows: four preprocessing methods namely median filter, wiener filter, green channel extraction and CLAHE. Active contour model and morphological operation based candidate extraction is presented. This multiple number of preprocessing and candidate extraction creates diversity among the members. Then the abnormalities are classified as normal, mild, severe depending on their severity using ANFIS and SVM. The experimental results of the proposed methods and the comparative results are compared to detect Glaucoma. Then sensitivity, specificity and accuracy of two classifiers are compared to attest an efficient diagnosis system for screening the Glaucoma disorder.

Namita Sengar, Malay Kishore Dutta et.al.[5] proposed the optic disc and hemorrhages are segmented in a particular region automatically by using adaptive thresholding and some geometrical features. In existing methods, the majority of work is based on diagnosis of glaucoma, but rarely on suspected glaucoma. So, the proposed method can helpful to diagnose the cases of suspected glaucoma. The proposed algorithm achieves accuracy of 93.57% on digital fundus images for detection of suspected glaucoma. Here detection of suspected glaucoma can be mainly divided into two sections: Segmentation of region of interest (ROI) and detection of suspected glaucoma using hemorrhages detection is obtained. The proposed methodology for detection of hemorrhages has following steps as follows.

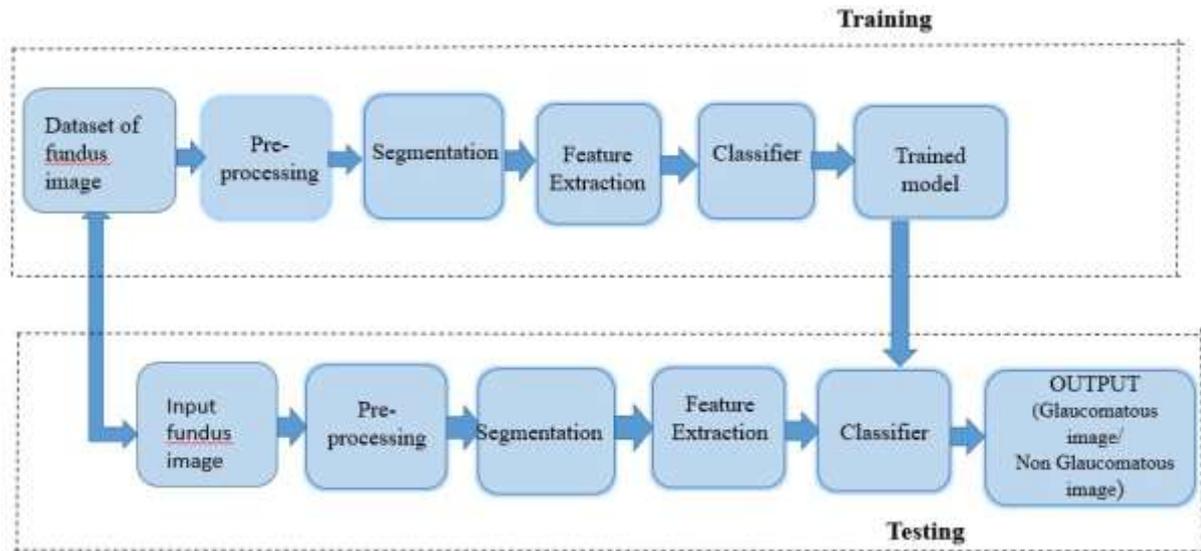
Kavya N, Dr. Padmaja K V[6] proposed The method in which region of interest is extracted from the fundus image by using Hough Transformation. It is an automated way of segmentation used to obtain the accurate results and it replaces the manual segmentation. The k-mean clustering also used for segmentation which is another approach. From the segmented ONH, the different features like Gray Level Cooccurrence Matrix (GLCM) and Markov Random Field (MRF) are extracted. As the structural changes taken place in ONH, the texture and the intensity values also changes. The features are used to classify the images as normal and glaucoma. The algorithm speed increases by applying the technique on region of interest instead of using complete image directly.

Mrs.Pavithra G, Anushree G.et.al.[7] proposed some novel calculations for programmed recognition of eyes influenced with glaucoma utilizing picture preparing separating and change strategies and actualize the same on equipment utilizing DSP Texas Instruments (TI) DM3730 construct framework in light of chip (SOC) minimal effort, low power single board PC framework or utilizing LabVIEW based NI interfacing framework. The product that will be created by us could be implanted on the equipment to test the sound and undesirable fundus pictures for the recognition of glaucoma. Programmed glaucoma screening utilizing a TMS320C6416DSK DSP board is the equipment that could be considered for execution purposes. The calculations that could be created can be actualized on retinal pictures in Verilog HDL utilizing Xilinx ISE, MATLAB and MODELSIM. TI based unit or NI based pack (any one) is the equipment apparatus that is considered for execution purposes.

Atheesan S., Yashothara S.[10] proposed method which has the added advantage if being affordable. Here glaucoma is identified through cup (optical disc's inner circle) to disc (outer circle) ratio (CDR) calculation and by the orientation of the blood vessels. In this system firstly, cup and disc are extracted using average and maximum grey level pixels respectively with the use of histogram. Then contours are found, which in turn are used to draw the best fitting circle, thus finding the radius of cup and disc. After calculating CDR, The abnormal image can be recognized if CDR exceeds the threshold value. Otherwise it is a normal image. The system extracts the blood vessels and through their orientation glaucoma is identified.

PROPOSED WORK

As we know detection of glaucoma in early stage will avoid vision loss. We propose a low-cost Glaucoma detection system which is a computer-based technology and therefore, it uses algorithms to instantaneously detect and classify healthy and Glaucoma eye. We will use machine learning algorithm like Random Forest Algorithm for higher accuracy.



In training or learning system, in image acquisition step the input image is selected from the database from fundus images of MIAG images database. In Pre-processing stage digital image of glaucoma and healthy images are pre-processed. The color fundus images are resized to 256×256 to make images of the same resolution. Image resizing increases the processing speed. Feature extraction is the process of obtaining higher-level information of an image such as color, shape, and texture. Texture is a key component of human visual perception. For classification we use machine learning field of computer science that uses statistic techniques to give computer systems the ability to learn (e.g., progressively improved performance on a specific task) with data, without being explicitly programmed. Here Random forest algorithm can use both for classification and the regression kind of problems. Here sample database is prepared which will be used further in testing phase.

Similar to training system in testing phase we are using the same Pre processing, segmentation and feature extraction and classification of fundus images. Here using Random forest algorithm we will classify that input fundus image given is of glaucoma or normal healthy eye. Then accuracy, sensitivity and errors these parameters are calculated with better efficiency.

CONCLUSION

Glaucoma is a disease in which the optic nerve of the eye gets destroyed. As a result, it causes vision loss or blindness. Most vision loss cases due to Glaucoma are preventable if the disease treatment is started in early stages. In this paper, we propose a low-cost Glaucoma detection system which is a computer-based technology and therefore, it uses algorithms to instantaneously detect and classify healthy and Glaucoma eye. For classification of healthy and Glaucoma eye we proposed supervised Machine Learning approach like random forest which will detect glaucoma at early stage with higher efficiency.

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