IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

ISO 3297:2007 Certified ⁜ Impact Factor 8.102 ⁜ Peer-reviewed / Refereed journal ⁜ Vol. 12, Issue 5, May 2023

DOI: 10.17148/IJARCCE.2023.12589

GLAUCOMA DETECTION IN RETINAL IMAGE

P. Roopa Ranjani[1], M·Jahnavi[2], K.Mahimasri[3], S.Sneha[4]

Asstistant Professor, Department of Electronics and Communication Engineering, G. Narayanamma Institute of Technology and Science (For women), Hyderabad, India[1]

[2]Student, Department of Electronics and Communication Engineering, G. Narayanamma Institute of Technology and Science (For women), Hyderabad, India[2-4]

Abstract: The main objective of this proposed system is to detect Glaucoma in the retinal image. Glaucoma is an eye condition that can't be healed once it happens. In case the corrective therapy does not continue, it causes a permanent visual disability so it cannot be ignored. Treatment will be helpful when the disease is identified at an early stage. Most of the research describes different techniques widely incorporated in the detection of Glaucoma disease.

In this proposed system, the detection of Glaucoma is identified through Image Pre-processing and SVM algorithm. Pre-processing operators like Segmentation, Enhancement, Binarization, and Thresholding are used to extract the optic cup and optic disc from the retinal image to find the CD R. This proposed technique is based on OTSU's segmentation method to locate the Optic cup and disc. Calculating only the CDR (Cup-to-Disc ratio) does not help to distinguish all the images as Glaucomatous or normal. Thus, RDR (Rim-to-Disc ratio) is considered another feature for Glaucoma assessment. The SVM (Support Vector Machine) algorithm plays an important role.

Keywords: Cup to Disc Ratio (CDR), Rim to Disc Ratio (RDR), Support Vector Machine (SVM), Optic Disc (OD), Optic Cup (OC), and Region of Interest (ROI).

I. INTRODUCTION

Our connection to nature is the human senses. The human cerebrum consolidates the neuron explosions of seeing, hearing, smelling, degusting, and touching into a substantial whole. Our eyes are the most important sensory organs by a long shot. Glaucoma damages the optic nerve in the eye, leading to visual impairment and loss of vision. Glaucoma seems to be developed and does not occur in life until later. The elevated pressure, called intraocular eye pressure, will affect the optic nerve that carries the images to the brain.

Early Glaucoma treatment will decrease the blindness risk by about 50 percent. A major cause of vision loss is Glaucoma which is identified by neuron generation of the optic nerve. It is difficult to revitalize the degenerated nerve fibres of the optic nerve and so early diagnosis and prompt treatments are necessary to avoid visual damage. In fundus images, current works related to Glaucoma detection focus only on CDR estimation to detect Glaucomatous events. CDR has, however, been found to be inconsistent in determining how much OD damage Glaucoma causes. For example, some patients have small CDRs with substantial loss of the visual field, while others have large CDRs but little loss of the visual field. So, CDR is calculated as well as RDR thereby classifying the images into four different stages.

II. LITERATURE SURVEY

Pooja Chaudhari proposed a method for detecting glaucoma. Using a cup-to-disc ratio and feed-forward artificial neural networks, glaucoma can be detected more accurately. It is discovered that this strategy gives more trustworthy findings than the ones that were previously available.

This extensive new technique, its applications, and its potential range According to Anju Soman et al., features are extracted from retinal pictures using DWT for classification, and various classifiers, including SVM, Dual Sequential Minimization, Random Forest, and Artificial Neural Networks, are used from the images. These characteristics are employed in categorization. The three employed filters each have unique wavelet characteristics. These characteristics are utilized to distinguish between and diagnose glaucomatous and normal retinal pictures.

IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

ISO 3297:2007 Certified ⁜ Impact Factor 8.102 ⁜ Peer-reviewed / Refereed journal ⁜ Vol. 12, Issue 5, May 2023

DOI: 10.17148/IJARCCE.2023.12589

III. PROPOSED SYSTEM

Image processing is a process where images use mathematical operations with the support of certain signal processing types where the input is an image. The challenge here is to execute some simple tasks to make the resulting image more suited for the assignment. In this case, it can include enhancing contrast, eliminating noise, and recognizing regions that are likely to include the postcode. By using the SVM classifier the retinal image is classified as Glaucoma eye or non-Glaucoma eye. The image is classified according to the CDR value.

2.1 Flow chart and Implementation

The Flow chart for the proposed methodology is depicted as shown in Fig 2.1.

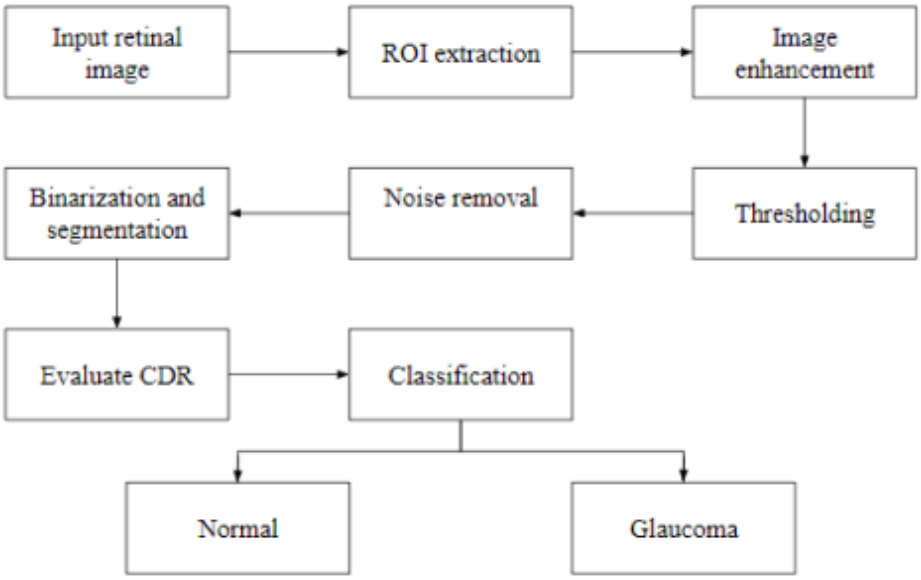

Fig 2.1. Flowchart for Proposed system

Input retinal image

The retinal image is uploaded to MATLAB software.

ROI Extraction

The optic cup and optic disc are the main features to be extracted from the retinal image. The Target region is extracted from the whole region using the Bounding box.

Image Enhancement and Thresholding

To make the results more appropriate and for further study the image should undergo some modifications. The main characteristics of an image can be recognized by eliminating noise and sharpening the image. The binary images are produced from grayscale images by Thresholding.

Noise Removal

Different types of noises can affect digital images. The pixel value does not represent their true intensity values during the image Acquisition. After the noise removal, the image consists the evenly distributed intensities and has more contrast than the original image.

Binarization and Image Segmentation

The binary image consists of only values which can be either black or white. Segmentation is used to partition the image into segments. Each pixel is assigned to either foreground or background depending on the greyscale intensity level. A threshold and compare it with each pixel. Based on this comparison the pixels are classified as foreground or background images.

International Journal of Advanced Research in Computer and Communication Engineering
ISO 3297:2007 Certified ⁜ Impact Factor 8.102 ⁜ Peer-reviewed / Refereed journal ⁜ Vol. 12, Issue 5, May 2023
DOI: 10.17148/IJARCCE.2023.12589

Evaluate CDR

The normal CDR of the human eye is 0.4. The occurrence of glaucoma has been predicted by taking the area of the Optic Cup and Optic Disc and calculating CDR (cup-to-disc ratio).

CDR= Area of optic cup/Area of optic disc

Glaucoma is implied if the calculated CDR value is higher than the cutoff value. The increase in cup size also has an impact on the neuro-retinal rim (NRR). The NRR is the region between the OD and OC rims. Compared to the NRR area in the superior and inferior regions, the ratio of the NRR area in the temporal and nasal regions is thicker in cases of glaucoma. After CDR, the rim-to-disc ratio (RDR) plays a key role in glaucoma detection.

RDR= Superior region (S)-Nasal rim region (N)/ Disc Region

Classification

For categorization, we need both the training and testing sets. The Support Vector Machine classifier is used to differentiate between healthy and glaucomatous eyes. The goal of SVM is to produce a training data-based model in which the target values of the data are exclusively predicted using the characteristics of the test data. Here, a collection of training images is divided into two distinct classes using the labels (y1, z1), (y2, z2),...(yn, zn), where ai is the dimensional feature space in Rd and bi is in the range of (-1,+1) with i=1..n. K ideal separating hyperplanes are constructed depending on a kernel function.

Class -1 applies if the feature vector of the images is on one side of the hyperplane; otherwise, class +1 applies. The linear SVM comes into the picture when the data of the different groups are separated. This is not the case if nonlinear SVM cannot be isolated. It defines the margin between the two classes. Linear SVM classifier is given by

$X(y) = mT\ b+ a$ ---------(1)

whereby for all training sample yi, the function $X(yi)> 0$ for bi = +1, and $X(yi)< 0$ for bi = -1.

IV. SOFTWARE

The Glaucoma detection in retinal images is implemented by using MATLAB R2022a version.

MATLAB R2022a

Matrix Laboratory is the abbreviation for MATLAB R2022a. The original purpose of MATLAB R2022a was to make it simple to utilize matrix software created by the linear system package and Eigen system package projects. A high-performance language for technical computing is MATLAB R2022a. It incorporates programming environment, calculation, and visualization. When it comes to tackling technological issues, MATLAB R2022a has numerous advantages over traditional computer languages (like C and FORTRAN). Every area of computational mathematics uses MATLAB R2022a.

V. RESULTS AND DISCUSSIONS

In this proposed system, the desired optical disk and optical cup are obtained by using Digital Image Processing in the detection of Glaucoma. The Extraction, Thresholding, Binarization, and Segmentation of the retinal image are computed. Applying the SVM algorithm, the retinal image is classified as either a normal retinal image or Glaucoma retinal image.

The input retinal image is uploaded to the MATLAB software. It is taken as input to the code and the code is executed. The features are extracted from the retinal image.

(i) From Fig 5.1 it is observed that the input image is a non-Glaucoma image. The CDR value is 0.3 which is less than 0.4 which is classified as a Normal eye.

IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

ISO 3297:2007 Certified ⁜ Impact Factor 8.102 ⁜ Peer-reviewed / Refereed journal ⁜ Vol. 12, Issue 5, May 2023

DOI: 10.17148/IJARCCE.2023.12589

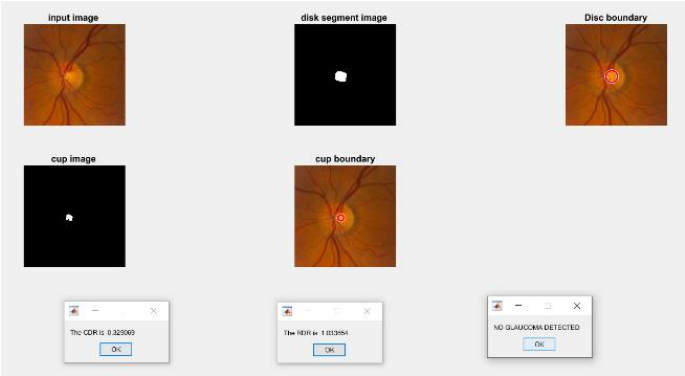

Fig.5.1. Output of Normal eye

(ii) From Fig 5.2 it is observed that the input image is Early stage of Glaucoma. The CDR value is 0.4209 which is greater than 0.4 and less than 0.6 which is classified as the Early stage of Glaucoma.

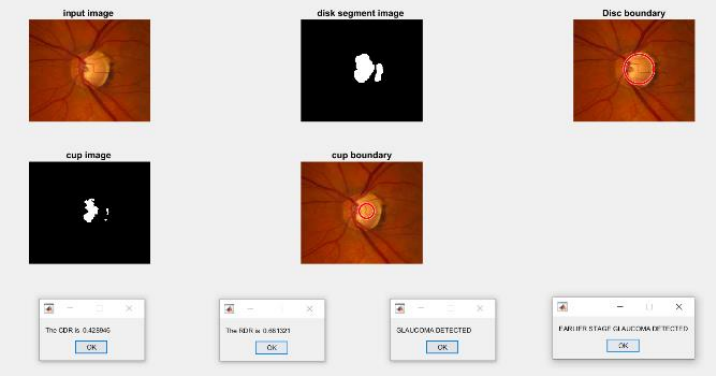

Fig.5.2. Output of Early stage of Glaucoma

(iii) From Fig 5.3 it is observed that the input image is a Moderate stage of Glaucoma. The CDR value is 0.6156 which is greater than 0.6 and less than 0.8 which is classified as the Moderate stage of Glaucoma.

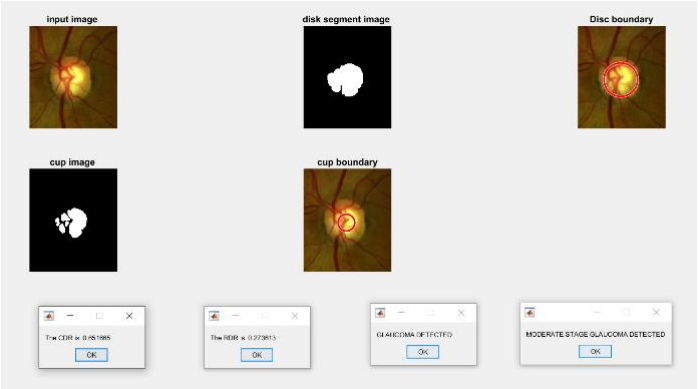

Fig.5.3. Output of Moderate stage of Glaucoma

(iv) From Fig 5.4 it is observed that the input image is the Advanced stage of Glaucoma. The CDR value is 0.8268 which is greater than 0.8 thus it's classified as an Advanced stage of Glaucoma.

IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

ISO 3297:2007 Certified ⁜ Impact Factor 8.102 ⁜ Peer-reviewed / Refereed journal ⁜ Vol. 12, Issue 5, May 2023

DOI: 10.17148/IJARCCE.2023.12589

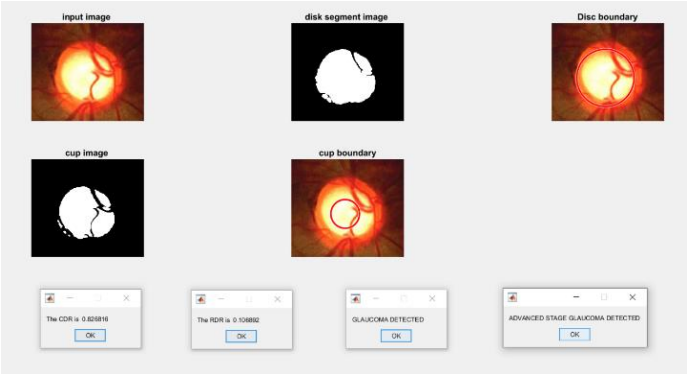

Fig.5.4. Output of Advanced stage of Glaucoma

VI. CONCLUSION

Glaucoma is a common eye disease found in eyes. It is caused by damage to the optic nerves, which leads to visual field loss. Loss of peripheral or side vision is the first sign of Glaucoma. When it is identified at the early stages it can be treated. In this proposed system, the optical disc and optic cup are extracted from the input retinal image. Input Image undergoes thresholding, segmentation, enhancement, and binarization to improve the quality of the image. OTSU's method was used in segmentation. SVM classifier is used for training and testing the dataset. Optic disc and optic cup radii were calculated and the CDR values are evaluated. According to the values of the CDR the given input image is classified as Normal eye or Glaucoma eye.

REFERENCES

[1] M. J. Greaney, D. C. Hoffman, D. F. Garway-Heath, M. Nakla, A. L. Coleman, and J. Caprioli, "Comparison of optic nerve imaging methods to distinguish normal eyes from those with Glaucoma," Investigative Ophthalmology and Visual Science, vol. 43, no. 1, pp. 140–145, 2002.

[2] M. R. K. Mookiah, U. R. Acharya, C. M. Lim, A. Petznick, and J. S. Suri, "Data mining technique for automated diagnosis of Glaucoma using higher order spectra and wavelet energy features," Knowledge-Based Systems, vol. 33, pp. 73–82, 2012.

[3] R. Bock, J. Meier, L. G. Ny´ul, J. Hornegger, and G. Michelson, "Glaucoma risk index: Automated Glaucoma detection from color fundus images," Medical Image Analysis, vol. 14, no. 3, pp. 471–481, 2010.

[4] S. Kavitha, N. Zebardast, K. Palaniswamy, R. Wojciechowski, E. S. Chan, D. S. Friedman, R. Venkatesh, and P. Y. Ramulu, "Family history is a strong risk factor for prevalent angle closure in a south Indian population," Ophthalmology, vol. 121, no. 11, pp. 2091–2097, 2014.

[5] S. Y. Shen, T. Y. Wong, P. J. Foster, J. L. Loo, M. Rosman, S. C. Loon, W. L. Wong, S. M. Saw, and T. Aung, "The prevalence and types of Glaucoma in Malay people: The Singapore Malay eye study," Investigative Ophthalmology and Visual Science, vol. 49, no. 9, pp.3846–3851, 2008.