Blood Vessel Segmentation in Fundus Images and Detection of Glaucoma using SVM

Dr. M. Parimala Devi[1] T. Sathya[2] G. Boopathi Raja[3] S. K. Murugavel[4] S. Kishan Kumar[5]
[1,2,3]Assistant Professor [4,5]Student
[1,2,3,4,5]Department of Electronics & Communication Engineering
[1,2,3,4,5]Velalar College of Engineering and Technology, Erode, Tamil Nadu-638 012, India

Abstract— Glaucoma is an unending and irreversible eye infection in which the optic nerve is consistently hurt due to Intraocular pressure (IOP), inciting disintegrating in vision and individual fulfillment. Survey proposed by Glaucoma Research Foundation (GRF), a committed regional non-profit organization to finding a cure announced results of a national survey for glaucoma designed to assess the impact of glaucoma on patients. As a result of the survey total of 1,548 adults were suffered from glaucoma almost two-thirds (64 percent) of all patients say the disease impacts their lives on a daily basis. There is an existing method for identifying glaucoma which is based upon the ISNT ratio. The proposed system consists of image acquisition, image enhancement, image restoration, morphological processing and segmentation. Preprocessing of retinal image to separate the green channel and retinal image is enhanced. Blood vessel segmentation is done for detection of glaucoma using Support Vector Machine (SVM) algorithm. SVM algorithm is supervised learning algorithm which is mainly used in computer vision projects for artificial intelligence applications. By using this algorithm accuracy of detection of glaucoma is better than all the existing methods.

Keywords: Glaucoma, Fundus, Intraocular pressure, SVM

I. INTRODUCTION

Glaucoma is a common eye illness that is irreversible and the second driving clarification behind outlook weakening screening structure it twists up recognizably watchful just in the last Glaucoma-time. Measurement of glaucoma sufferers was 64.3 million, additionally, is depended upon to rise to 76.0 million per 2020.Early analysis and treatment are crucial to avoid loss of vision in among doctors with glaucoma. By checking retinal fundus State to images. The eye's fundus visual interlinks the retina, optical circle, fovea, macula and poster back. Pictures of the retinal fundus remain the best standard for assessing the changes in retina. Out of a couple of framework utilized for clinical Glaucoma claim, fundus picture exam is the most common Just fit to see. An altered glaucoma-structure is Proposed here, which has an effect on the use of fundus use CDR. The optic nerve plate (OD) or head in the retina where cell axons leave the eye to shape the nerve of the optic. Fundamental stages in the Suggested solution. The optic plate is of focal distress, denied of tissue material causes destruction of nerve tissue extending of this circle region, in the inevitable and inferior localities initially times.

II. LITERATURE SURVEY

Eduardo Pinos et al. (2018) proposed the implementation of support tools for the presumptive diagnosis of Glaucoma through identification and processing of medical images of the human eye. For the detection of Glaucoma the proposed algorithm automatically locates the cup and optical disc with the use of image processing techniques. In the images of the fundus of the eye, the optical disc characterized by its orange color, while the brightest part determines the eye cup.

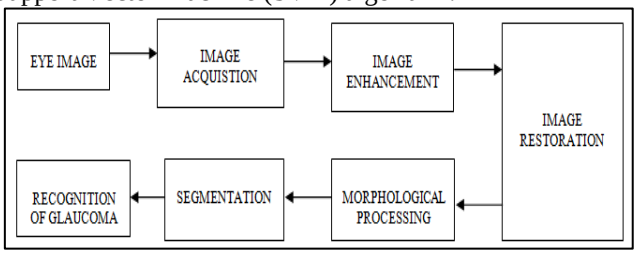
Anum Abdul Salam et al. (2015) proposed the Autonomous Glaucoma detection from fundus image using cup to disc ratio and hybrid features. There are no early symptoms of glaucoma and the only source to detect glaucoma at an early stage is the structural change that arises in the internal eye. Fundoscopy is the one of the modern medical imaging techniques that enable Ophthalmologists to observe structural changes in the optic disc to detect glaucoma. The proposed methodology provides a novel algorithm to detect glaucoma using a fusion of CDR and hybrid textural and intensity features.

Megha Lotankar et al. (2015) proposed the Detection of Optic Disc and Cup from Color Retinal Images for Automated Diagnosis of Glaucoma. an automatic system is developed for glaucoma detection by extracting various features like vertical Cup to Disc Ratio (CDR), Horizontal to Vertical CDR (H-V CDR), Cup to Disc Area Ratio(CDAR), and Rim to Disc Area Ratio (RDAR) from digital fundus images through segmentation of Optic Disc (OD), cup and neuroretinal rim.

Malay Kishore Dutta et al. (2014) proposed the Glaucoma Detection by Segmenting the Super Pixels from Fundus Color Retinal Images.An automated image processing approach for detection of glaucoma which may be a diagnostic tool to help ophthalmologist in mass screening of glaucoma suspects. The proposed approach is based on the segmentation of optic disk and the optic cup and computing the cup-to-disc ratio.

III. PROPOSED SYSTEM

The proposed system consists of Image discovery, image enhancement, image reconstruction, morphology processing and segmentation. Preprocessing of retinal image to separate the green channel and retinal image is enhanced. Blood vessel segmentation is done for detection of glaucoma using Support Vector Machine (SVM) algorithm.



The above block diagram shows the proposed system of Blood Vessel Segmentation in Fundus Images and Detection of Glaucoma using SVM. The first and foremost

block of proposed system is Image Acquisition. In this block the eye image acquired using the camera or scanners like tomography or ophthalmoscope and the fundus image of the eye is obtained and image acquisition is followed by image enhancement in this block the fundus image is enhanced by image histogram stretching techniques. Information about the distribution of grey levels in a specific image is provided by the image histogram. In an exceptionally dark or bright image , the grey level would be clustered to the extremes of the histogram, but in a well-contrasted image these levels would be well spread over a wide range. In low contrast image, the solution is given by histogram stretching algorithms these algorithms are able to distribute grey levels more equally across the range, according to specific user-defined equations, and therefore produce an image with greater contrast than the original. Histogram equalization is a basic automated process, which aims at making the histogram uniformly distributed. When using an adaptive Histogram Equalization method, the image is divided to sub-images, each having a sub-histogram which is then stretched. The neighboring sub-images are stitched together using bilinear interpolation to eliminate the boundaries between them. OCT enhancement is used for the detection of glaucoma.

OCT is extremely useful in assessing optic nerve damages in glaucoma, retinal detachment and macular edema. Evaluation of these pathologies requires assessment of changes over time, which might be very hard to tell in some images. OCT images are subject to various distortions that introduce artifacts in the OCT cross-sections such as floaters, saccades and speckle noise.

OCT retinal image enhancement methods are different from those which we have seen giving such good results on fundus images: signal averaging is one of the most important and effective techniques to improve OCT image quality. This technique has practical limitations due to the inability of patients to maintain fixation during examination and it requires hardware eye-tracking, which is not necessarily available in every clinic using OCT. Due to eye movement (eye saccades, blinks and patient's movement) there is a limitation on the number of frames that can be recorded and averaged.

For that reason, we recommend using an enhancement method by virtually averaging OCT signal (no need for eye tracking). The technique uses Gaussian random distribution for each sampling voxel on a 3x3x3 cube of neighboring voxels; this is repeated an appropriate amount of times such as ensures the optimization of the averaging result.

Both signal to noise ratio (SNR) and contrast to noise ratio (CNR) are improved by this method: these parameters indicate that the non-averaged non-tracking OCT image quality is significantly better.

The next block is restoration of the retinal image in this block the noise is removed and reconstructed with the help of original image. Motion blur in the fundus image is recovered and corrupted parts of the fundus image is corrected. It is followed by some basic morphological processing like smoothening in the fundus images and segmentation undergoes in fundus image of eye. Then at last SVM algorithm is trained to the collected datasets of fundus images.

A. Support Vector Machine:

A Support Vector Machine (SVM)[2] is a supervised learning algorithm that can be used for binary or regression Classified. Vector supporting devices are used such as the processing of natural language, speech and image recognition, and computer vision.

SVM CLASSIFY - Classify data using a vector support system.
GROUP = SVMCLASSIFY(SVMSTRUCT,TEST) Classifies into TEST every board.

Using the machine classifier support vector structure SVMSTRUCT generated using SVMTRAIN, and returns the expected Class category. TEST shall have equal column numbers as the data used in SVMTRAIN to train the classifier. GROUP shall signify the group to which each TEST row is allocated.

GROUP=SVMCLASSIFY(..,'SHOWPLOT',true)
Use the SVMTRAIN SHOWPLOT option to plot test data TEST on the figure produced.

B. Image Acquisition:

Digital image acquisition is the creation of a digitally encoded representation of the visual characteristics of an object, like the structure of a physical or internal scene it's an item. The term is often taken for granted to imply or include how to sort, compress, store, print, and view of these images. A big benefit of digital image analog picture like a photographic images, is the capability to make copies as digital and indefinitely without any loss of image quality.

C. Image Enhancement:

The aim of image enhancement is to improve the interpretability or perception of information in images for people, or better feedback for other digital viewers image Processing methods.

Image enhancement techniques can be broken down into two broad categories:

1) Spatial domain methods, which operate directly on pixels, and
2) Frequency Domain Methods that function on the Fourier transform of an image.

D. Image Restoration:

Image restoration is the operation of taking a corrupt noisy image and Estimating Initial, pure photo. In many cases corruption will happen forms such Noise and camera misfocus as motion blur. Re-saturation picture is performed by reversing the process that blurred the image and such is performed by imaging a point source and use the point source picture called Point Spread Function to restore the image information lost to the blurring process.

E. Morphological Processing

Morphological image processing is a collection of non-linear operations related to the shape or morphology of features on a frame. A morphological operation on binary picture creates a new binary image in which the pixel has a non-zero value only if the test is successful at that location in the input image.

F. Segmentation

Image segmentation is the process of partitioning a digital image into multiple segments (Pixel sets, also known as Image objects). The goal of segmentation is to simplify and change the representation of an image into something that is more meaningful and very simple to examine. The segmentation of images is usually used for locate objects and the boundaries of the pictures (lines, curves etc.) In particular, the process of assigning image segmentation is a label to every pixel in an image such that pixels with the same label share certain characteristics.

G. Confusion Matrix

A confusion matrix[9] is a table that is often used to describe the performance of a classification model (or "classifier") on a set of test data for which the true values are known. The confusion matrix itself is relatively simple to understand, but the related terminology can be confusing.

N=100	NO PREDICTED	YES PREDICTED
ACTUAL NO	30	10
ACTUAL YES	25	35

There are two possible predicted classes: "yes" and "no". If we were predicting the presence of a disease, for example, "yes" would mean they have the disease, and "no" would mean they don't have the disease. The classifier made a total of 165 predictions (e.g., 100 patients were being tested for the presence of that disease).Out of those 100 cases, the classifier predicted "yes" 45 times, and "no" 55 times. In reality, 60 patients in the sample have the disease, and 40 patients do not.

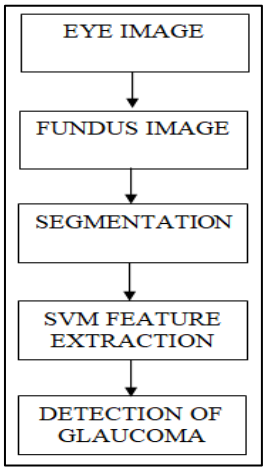
IV. APPLICATIONS

- Hospitals.
- Earlier prediction of blindness.
- Prevents optical nerves.

V. ADVANTAGES

- Glaucoma is a complicated disease that eventually leads to blindness. Glaucoma patients have an elevated intraocular pressure.
- High sensitivity and more accuracy
- Earlier detection

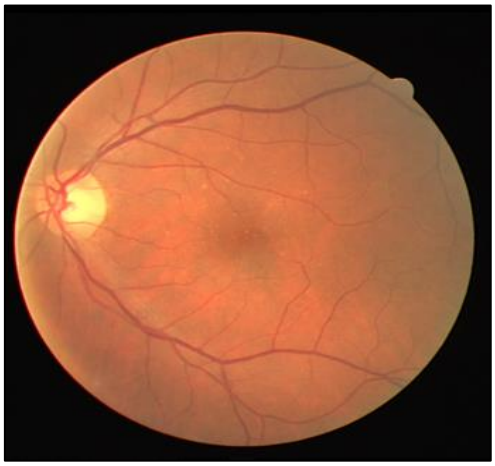
VI. PROCEDURAL FLOW



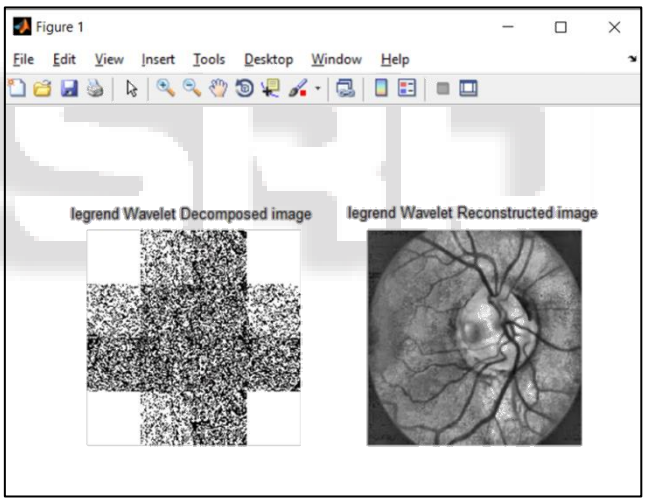
VII. CONCLUSION

Blood vessel segmentation's main aim in fundus images and detection of glaucoma using SVM is to help earlier detection of glaucoma with high accuracy and specificity using confusion matrix and this project helps to prevents from eye blindness and detects the intraocular pressure level of eye and detects the damage of optical nerves.

VIII. OUTPUT



ORIGINAL IMAGE



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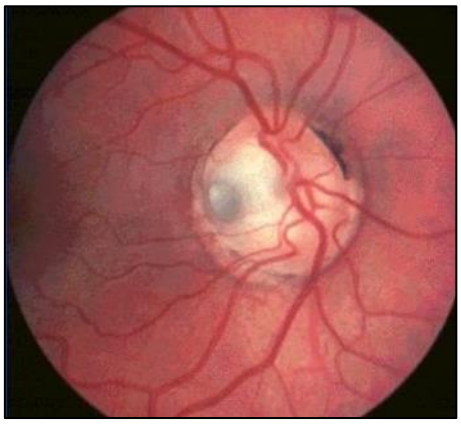

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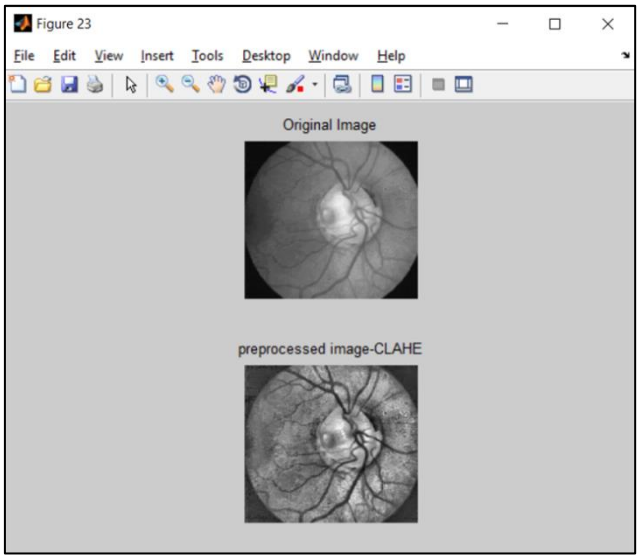
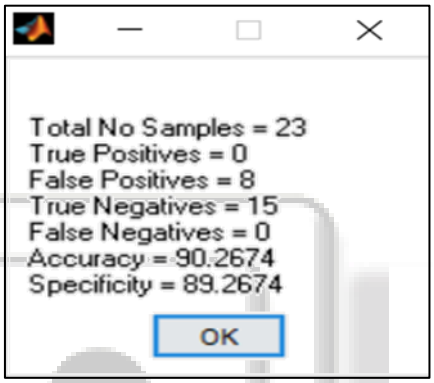
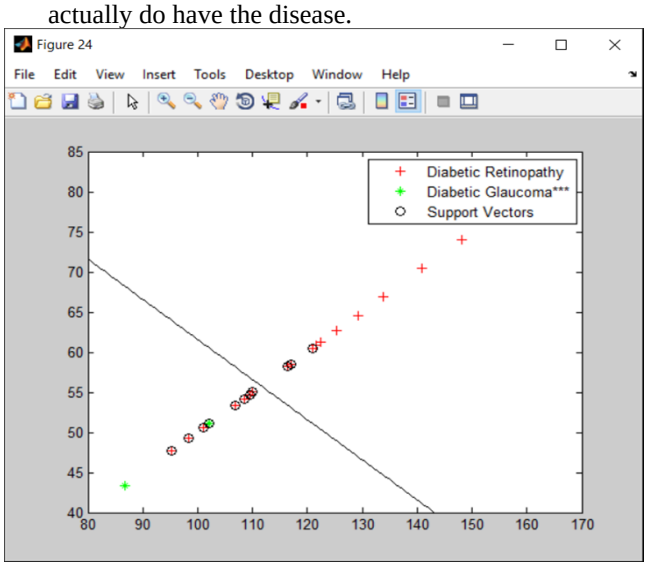


OUTPUT IMAGE



CONFUSION MATRIX

- True positives (TP): These are cases in which we predicted yes (they have the disease), and they do have the disease.
- True negatives (TN): We predicted no, and they don't have the disease.
- False positives (FP): We predicted yes, but they don't actually have the disease.
- False negatives (FN): We predicted no, but they actually do have the disease.



GRAPHICAL REPRESENTATION OF GLAUCOMA DETECTION

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