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ADAPTIVE BLOOD VESSEL SEGMENTATION AND GLAUCOMA DISEASE DETECTION BY USING SVM CLASSIFIER

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***Abstract*---Glaucoma is a term for a group of eye disorders which result in damage to the optic nerve. This is most often due to increased pressure in the eye. Glaucoma can permanently damage vision in the affected eye(s), first by decreasing peripheral vision (reducing the visual field), and then potentially leading to blindness if left untreated. The risk of glaucoma increases when the intra-ocular pressure (IOP) increases. The optic nerve head (ONH) structure changes and the neuroretinal rim starts to diminish. The axons degenerate and the cup size increases. In proposed system, the edge based segmentation is used and the bifurcation algorithm is used for vessel extraction. After that, Histogram of oriented Gradients (HOG) is used for extracting the features. Disease is classified using the SVM classifier.**

***Index terms*---Glaucoma disease detection, SVM classifier, Image processing, Histogram of oriented Gradients, Retinal disease detection.**

I. INTRODUCTION

Glaucoma is a condition that causes damage to your eye's optic nerve and gets worse over time. It's often associated with a buildup of pressure inside the eye. Glaucoma tends to be inherited and may not show up until later in life. The increased pressure, called intraocular pressure, can damage the optic nerve, which transmits images to the brain. If damage to the optic nerve from high eye pressure continues, glaucoma will cause permanent loss of vision.

Without treatment, glaucoma can cause total permanent blindness within a few years. Because most people with glaucoma have no early symptoms or pain from this increased pressure, it is important to see your eye doctor

regularly so that glaucoma can be diagnosed and treated before long-term visual loss occurs.

A. Major Factors of Glaucoma

Factors causing glaucoma are age, elevated eye pressure, African ancestry, thin cornea, family history of glaucoma, nearsightedness, past injuries to the eyes, steroid use and history of severe anemia or shock.

B. Symptoms of Glaucoma

Symptoms of Glaucoma are difficulty in focusing on near or distant objects, squinting or blinking due to unusual sensitivity to light or glare,
change in color of iris, red-rimmed, encrusted or swollen lids, recurrent pain in or around eyes, double vision, dark spot at the center of viewing, lines and edges appear distorted or wavy, excess tearing or "watery eyes", dry eyes with itching or burning and seeing spots, ghost-like images.

C. Types of Glaucoma

1) Open-angle glaucoma

Chronic open-angle glaucoma is the most common form of glaucoma. The "open" drainage angle of the eye can become blocked leading to gradual increased eye pressure. If this increased pressure results in optic nerve damage, it is known as chronic open-angle glaucoma. The optic nerve damage and vision loss usually occurs so gradually and painlessly that you are not aware of trouble until the optic nerve is already badly damaged.

2) Angle-closure glaucoma

Angle-closure glaucoma results when the drainage angle of the eye narrows and becomes completely blocked. In the eye, the iris may close off the drainage angle and cause a dangerously high eye pressure. When the drainage angle of the eye suddenly becomes completely blocked,

pressure builds up rapidly, and this is called acute angle-closure glaucoma. The symptoms include severe eye pain, blurred vision, headache, rainbow haloes around lights, nausea and vomiting. Unless an ophthalmologist treats acute angle-closure glaucoma quickly, blindness can result. When the drainage angle of the eye gradually becomes completely blocked, pressure builds up gradually, and this is called chronic angle-closure glaucoma. This form of glaucoma occurs more frequently in people of African and Asian ancestry, and in certain eye conditions.

3) Exfoliation syndrome

Exfoliation syndrome is a common form of open-angle glaucoma that results when there is a buildup of abnormal, whitish material on the lens and drainage angle of the eye. This material and pigment from the back of the iris can clog the drainage system of the eye, causing increased eye pressure. This form of glaucoma responds well to laser treatment.

4) Pigmentary glaucoma

Pigmentary glaucoma is a condition that typically affects young, nearsighted, Caucasian males. This condition is characterized by the iris bowing backwards, and coming into contact with the support structures that hold the lens in place. This position disrupts the cells lining the back surface of the iris containing pigment, and results in a release of pigment particles into the drainage system of the eye. This pigment can clog the drain and can lead to an increase in eye pressure. This form of glaucoma responds well to laser treatment. Other types of glaucoma may be caused by injuries to the eye, tumors, and other eye diseases. A rare type of glaucoma can even be present in children at birth.

II. LITERATURE SURVEY

Research work done by Ana Maria Mendonça, and Aurélio Campilho has proposed an algorithm starts with the extraction of vessel centrelines, which are used as guidelines for the subsequent vessel filling phase. For this purpose, the outputs of four directional differential operators are processed in order to select connected sets of candidate points to be further classified as centreline pixels using vessel derived features. The final segmentation is obtained using an iterative region growing method that integrates the contents of several binary images resulting from vessel width dependent morphological filters. Our approach was tested on two publicly available databases and its results are compared with recently published methods.

Research work done by João V. B. Soares, Jorge J. G. Leandro, Roberto M. Cesar Jr., Herbert F. Jelinek, and Michael J. Cree has proposed a feature vectors are composed of the pixel's intensity and two-dimensional Gabor wavelet transform responses taken at multiple scales. The Gabor wavelet is capable of tuning to specific frequencies, thus allowing noise filtering and vessel enhancement in a single step. We use a Bayesian classifier with class-conditional probability density functions (likelihoods) described as Gaussian mixtures, yielding a fast classification, while being able to model complex decision surfaces. The probability distributions are estimated based on a training set of labelled pixels obtained from manual segmentations.

Research work done by Diego Marín, Arturo Aquino*, Manuel Emilio Gegúndez-Arias, and José Manuel Bravo has proposed a new supervised method for blood vessel detection in digital retinal images. This method uses a neural network (NN) scheme for pixel classification and computes a 7-D vector composed of gray-level and moment invariants-based features for pixel representation. The method was evaluated on the publicly available DRIVE and STARE databases, widely used for this purpose, since they contain retinal images where the vascular structure has been precisely marked by experts. Method performance on both sets of test images is better than other existing solutions in literature

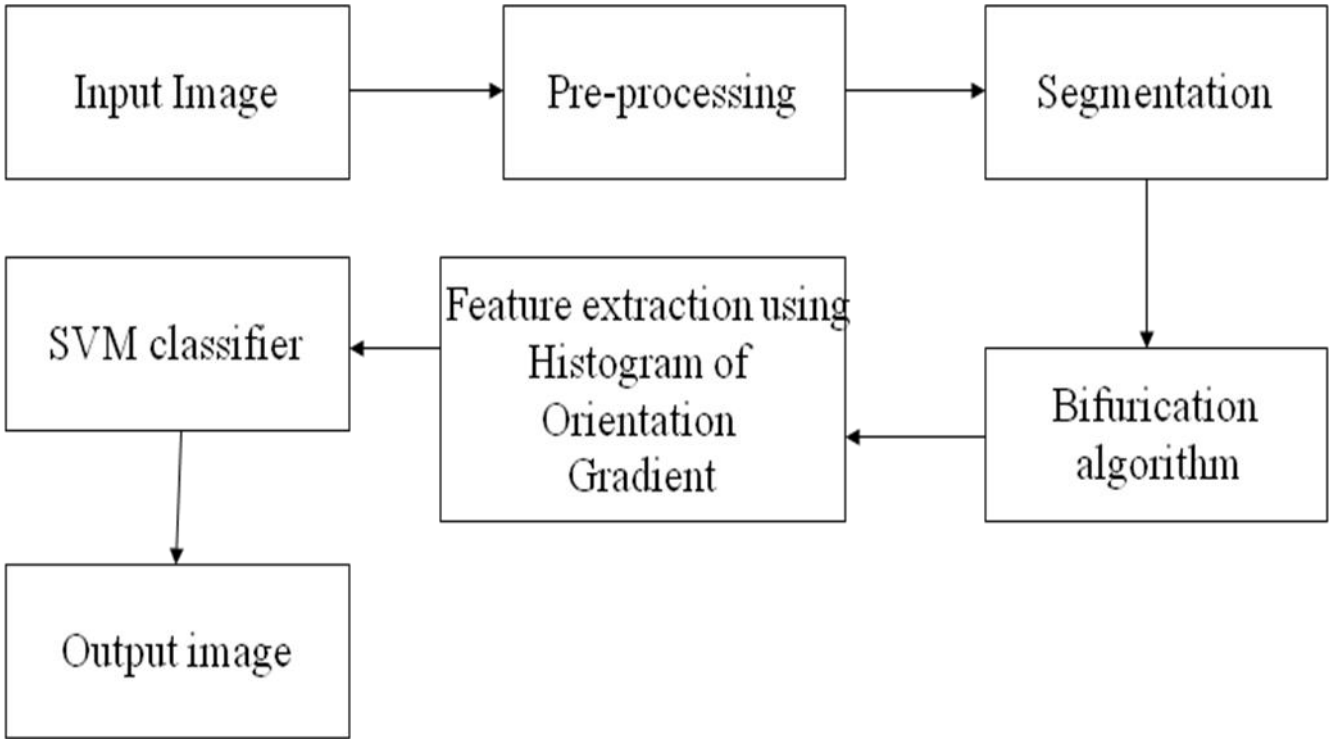

Fig 1: Workflow of Glaucoma disease detection

III. EXISTING METHOD

In the existing system, the first step focuses on segmenting filamentary pixels out of the background. This produces a filament segmentation map used as input for the second step, where they are further separated into disjointed filaments. Key to our approach is the idea that the problem can be reformulated as label propagation over directed graphs, such that the graph is to be partitioned into disjoint sub-graphs, or equivalently, each of the neurons (vessel trees) is separated from the rest of the neuronal (vessel) network.

A. Disadvantage

- Accuracy is less.
- Difficult to visualize individual filaments using tracing filamentary structures.

IV. PROPOSED *METHOD*

Eye retinal Magnetic Resonance (MR) image is taken as input for pre-processing. Pre-processing is used to resize, convert the colour image into gray-scale image and for filtering. Segmentation is used for partitioning a digital image into multiple segments the edge based segmentation is used. Then the bifurcation algorithm is used for blood vessel extraction. After that, HOG (Histogram of Orientation Gradient) is applied. The diseases are classified using the SVM classifier.

A. Advantage

- Pattern recognition performance is good
- Accuracy is high
- HOG and SVM Classifier is combined together to classify the disease.

V. MODULES *DESCRIPTION*

A. Pre-Processing

Pre-processing involves in removing low-frequency background noise. Normalizing the intensity of the individual particles images removing reflections. Masking portions of images. Image pre-processing is the technique

of enhancing data images prior to computational processing. Image pre-processing is the technique of enhancing data images prior to computational processing. Stages in pre-processing are resizing the image, converting to gray scale and filtering using Discrete Wavelet Transform (DWT).

An MRI image input is given for pre-processing. Pre-processing involves in following steps like resizing, converting to grayscale and filtering. The input image is collected from the human eye by MRI scan equipment. The image is processed to detect the stage of disease development.

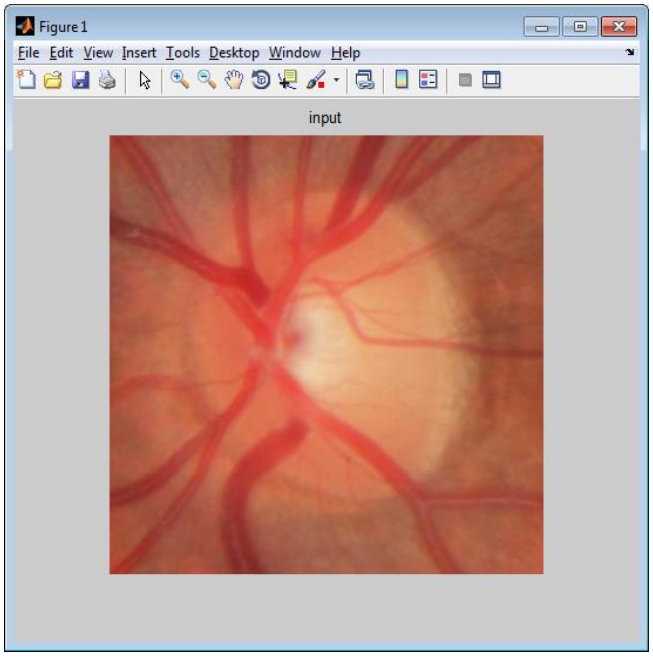

Fig 2: Input Image

Resizing the given image is done to maintain the standard size for all the images whichever given for processing.

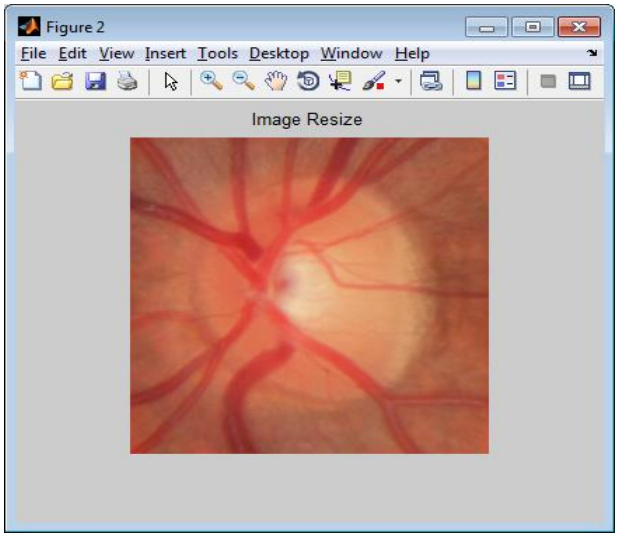

Fig 3: Resized image

Grayscale conversion is done to reduce the code complexity. This is to minimize the analyzing time of a image to detect glaucoma.

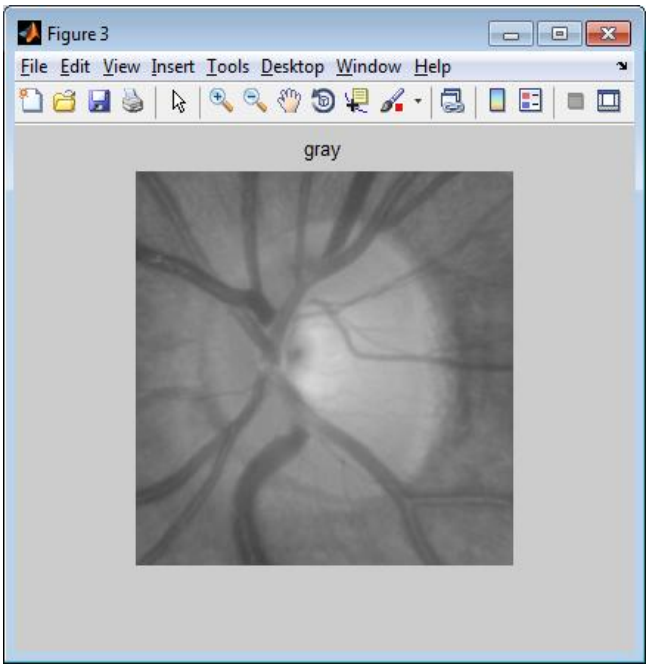

Fig 4: The normal image converting to grayscale

Filtering is done to reduce the low frequency noises in the images, salt and pepper noises and other enhancement techniques are applied. The Filtering is done by *Discrete Wavelet Transform (DWT).*

1) Discrete Wavelet Transform (DWT)

In numerical analysis and functional analysis, a discrete wavelet transform (DWT) is any wavelet transform for which the wavelets are discretely sampled. As with other wavelet transforms, a key advantage it has over Fourier transforms is temporal resolution: it captures both frequency and location information (location in time).

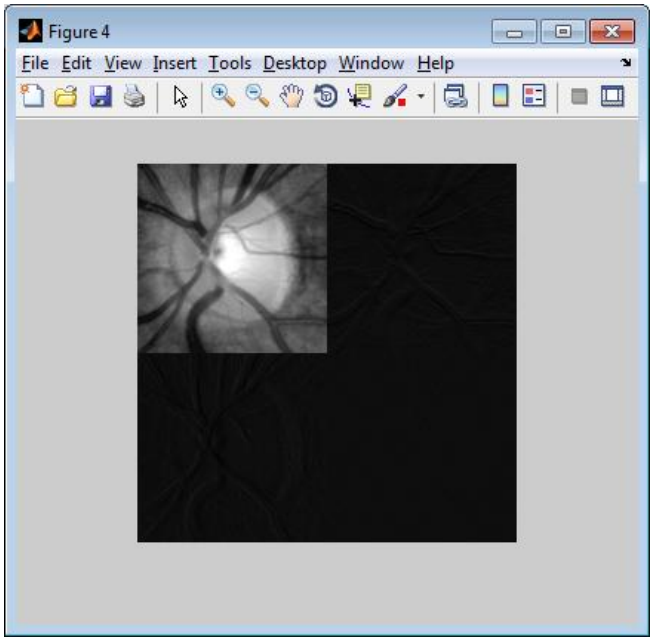

Fig 5: Filtering the image using Discrete Wavelet Transform (DWT)

B. Segmentation

In computer vision, segmentation is the process of partitioning a digital image into multiple segments. The goal of segmentation is to simplify and/or change the representation of an image into something that is more meaningful and easier to analyze. Edge based segmentation is used. Sobel function is used in this segmentation. Sobel is used to find the inner and outer boundary of the vessels.

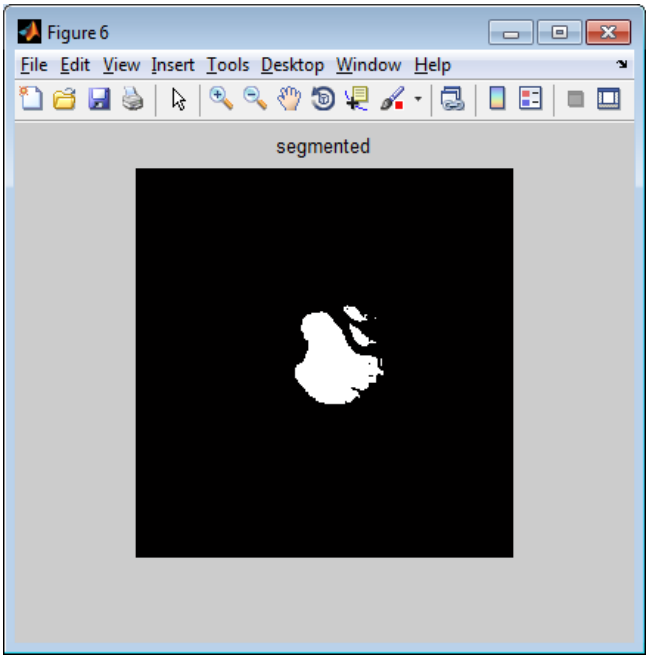

Fig 6: Segmented image

Edge detection is done using the sobel function. Sobel function is used to find the inner and outer boundaries of the vessels. Edge detection finds the joint and disjoint filaments for pattern recognition.

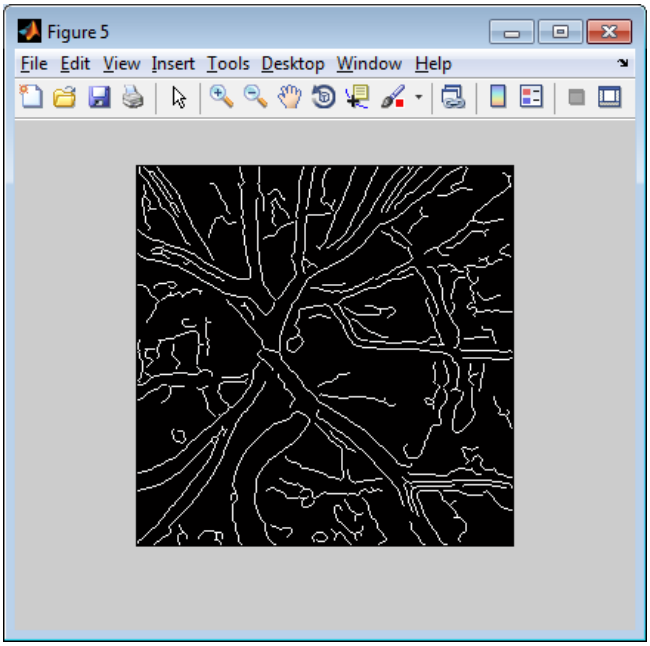

Fig 7: Edge detection

C. Bifurcation Algorithm

Bifurcation theory is the mathematical study of changes in the qualitative or topological structure of a given family, such as the integral curves of a family of vector fields, and the solutions of a family of differential equations. Most commonly applied to the mathematical study of dynamical systems, a bifurcation occurs when a small smooth change made to the parameter values (the bifurcation parameters) of a system causes a sudden 'qualitative' or topological change in its behavior. Bifurcation is used for Blood Vessel Extraction. Finds joint and disjoint vessels.

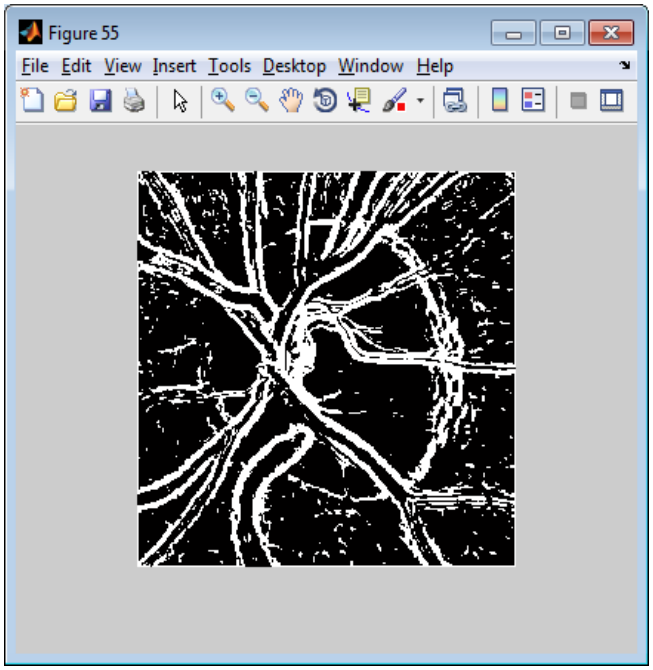

Fig 8: Blood Vessel Extraction

D. Histogram of Orientation Gradient (HOG)

The histogram of oriented gradients (HOG) is a feature descriptor used in computer vision and image processing for the purpose of object detection. The technique counts occurrences of gradient orientation in localized portions of an image. Features in this technique are, Angle, Magnitude and Gradient. By using these features itself we can find the disease level. But, due to high error rate, accuracy is not achieved.

E. Support Vectors Machines (SVM) Classifier

Support Vectors Machines (SVM) have recently shown their ability in pattern recognition and classification. Given a set of points which belong to either of two classes, a linear SVM finds the hyper plane leaving the largest possible fraction of points of the same class on the same side, while maximizing the distance of either class from the hyper plane. According to, this hyper plane minimizes the risk of misclassifying examples of the test set. Support Vectors Machines (SVM) have recently shown their ability in pattern recognition and classification. Classifier is used to detect the development stage of disease. Classifier is used to overcome the error rate occurred after the results of features extraction. We are going to find three stages of disease. They are, normal, medium and abnormal.

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