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DETECTION OF OPEN/CLOSED GLAUCOMA USING IRIDOCORNEAL IMAGE

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Abstract

Glaucoma is one of the most serious causes of injury in eye vision and gets worse over time. This is because of the increased pressure that can damage the optic nerve, which transmits images to the brain. Optical Coherence Tomography (OCT) an established medical imaging technique that uses light to capture micrometer-resolution, three-dimensional images from within optical scattering media which is useful for retinal diagnostic imaging. There are various techniques involved in detection of Glaucoma by using optic nerve, blood vessel, optic disc and macular edema. In this paper, we propose a system analyzing using unsupervised training method. Two approaches are classified and compared between their efficiency. By using neural network and also used SOM technique to compare both logical outcomes. It also gives details about public data set on which algorithms are tested and trained.

Key words: Glaucoma, OCT, Retinal diagnostic imaging, Macular edema, SOM technique.

Introduction

Diabetic eye disease embraces a group of eye conditions that attack people with diabetes. These conditions include diabetic retinopathy, cataract, diabetic macular edema (DME) and glaucoma. **Diabetic retinopathy** affects blood vessels in the light-sensitive tissue bellowed the retina that lines the back of the eye. It is the very frequent cause for vision loss among people who has diabetes and the leading cause of vision wreckage and blindness among working-age adults. **Diabetic macular edema (DME)** is a denouement of diabetic retinopathy; DME is bulging in an area of the retina called the macula. Persistently high blood sugar from diabetes is kindred with damage to the tiny blood vessels in the retina, prime to diabetic retinopathy. The retina perceives light and metamorphose it to signals sent along the optic nerve to the brain. Diabetic retinopathy can create blood vessels in the retina to drip fluid or hemorrhage (bleed),

buckling the vision. In its most forge on stage, new abnormal blood vessels multiply (increase in number) on the surface of the retina, which can lead to blotch and cell loss in the retina.

Glaucoma can be approximately divided into two main types: closed angle glaucoma (CAG) and open angle glaucoma (OAG). The angle between the iris and the cornea (said to be iridocorneal) is the key to distinguish OAG and CAG. When this angle is open, it said to be OAG. When it is narrow or even closed, it is CAG. Open angle glaucoma refers to the fluid from anterior chamber voids out of the eye through the open angle where the iris and cornea muster. There is a soft mesh-like tissue at this angle which serves as unload, but in some cases, it may be inadequate to properly evacuate enough of the aqueous humor. If this occurs, fluid spread within the eye and pitch the eye pressure. Closure glaucoma, patients may suffer rapid onset of symptoms. Fig (1) shows the difference between the open and closed angle glaucoma.

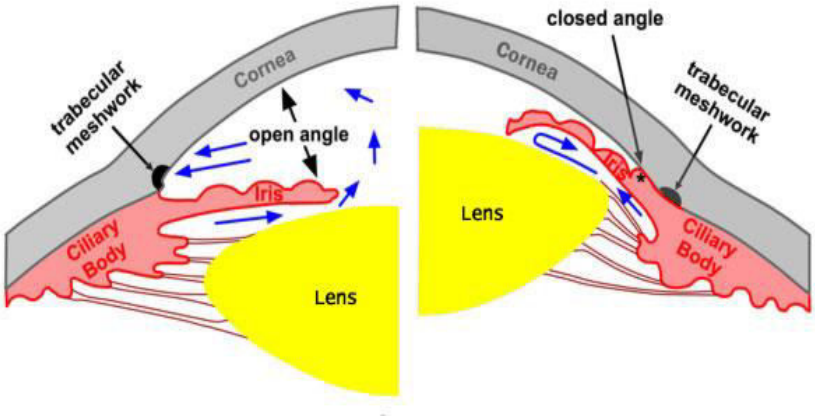


Fig-1: Open Angle and Closed Angle Glaucoma.

2. Literature Survey

There are various methods used to reveal the presence of Glaucoma in human eye. By using optic disk, optic nerve head, macular edema and so on. By using blood vessel said in paper [1], [2] and [14], the authors deal with detection of glaucoma using blood vessels in the eye. The extraction of CDR is calculated by tracking vessel detection technique. Later blood vessel extraction is exposed employ edge detection technique, the misstate angle is calculated. Some use the region growing technique is used to verify for the seed points approaches to all feasible bends in the blood vessels. And also by converting the color image from RGB to HSI via contrast-limited adaptive histogram equalization (CLAHE). Fig (2) shows the output of various methods used to detect the presence of glaucoma.

By using optic cup in paper [3], [5] and [15], the authors show the practical by using optic cup and optic disc for detecting the presence of glaucoma. Using super pixels compute center surround statistics and federate them using

histograms equalization for disc and cup segmentation. It gets forgoing information of the cup by figuring location information for cup segmentation. Super pixel uses simple linear iterative clustering (SLIC) algorithm. It reckons a self-assessment reliability score for better accuracy of disc segmentation result. Center girdle statistics are calculated later the optic disc is stratified using Support Vector Machine (SVM) classifier.

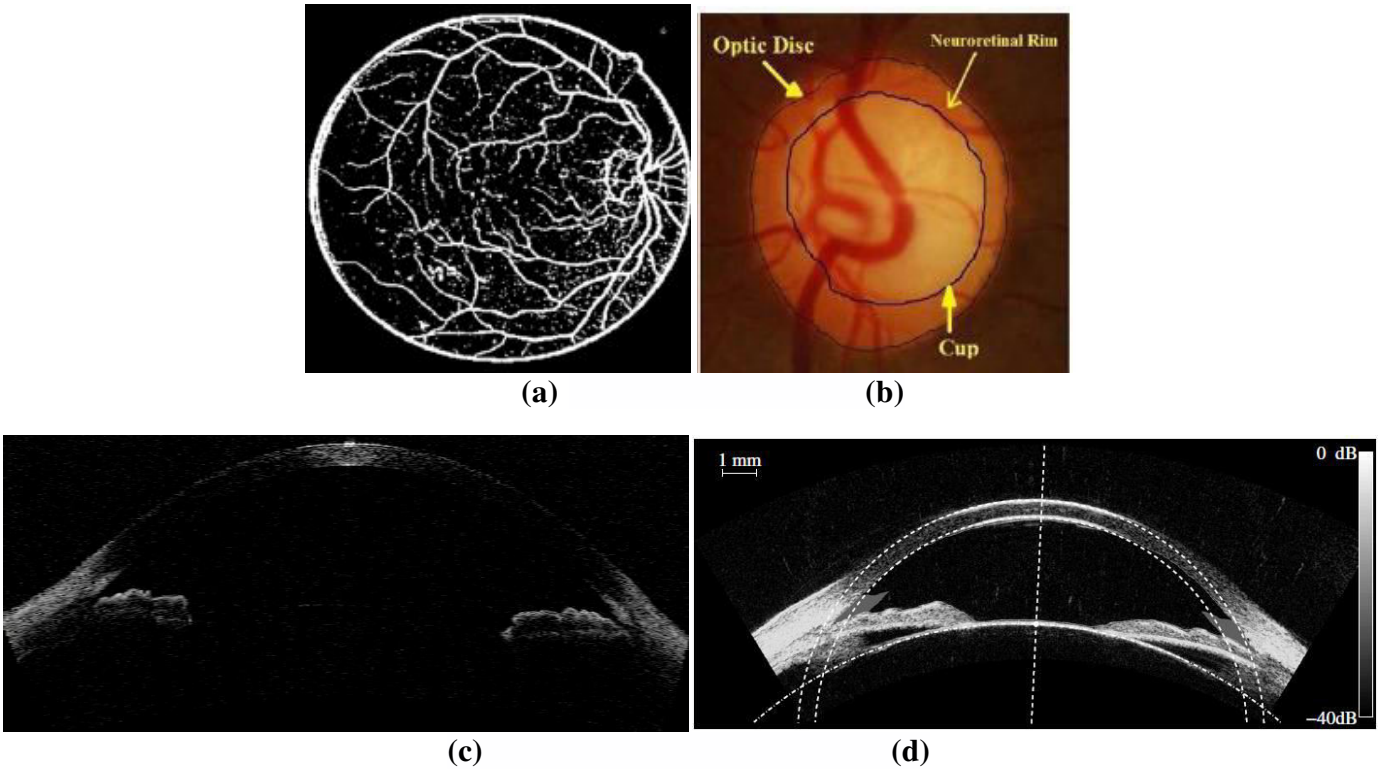


Fig-2: (a) Blood Vessel Images, (b) Optic Cup Retinal Image, (c) Oct Clinical Image, (d) Ultrasound Image.

By using OCT image in paper [6], [7], [8], [9] and [13], the authors exhibit the current trend of detection by using OCT images. The angle is measured through the Fractal Dimension for analyzing quantifies the complexity or changes of angle interior. The FD index with biometric parameters is handed to classify open and closed angle.

This approach provides finer representation of the angle configuration. It wields computer aided diagnostic tool for ACG diseases. By using Ultrasound image in paper [10], [11], [15] and [17], the authors display the current craze of finding glaucoma using ultra sound images. The perception and localization of the cornea is quite satisfactory. The detected circles are always very close to the apex of the cornea. So a circular approximation of the cornea and the lens makes sense. This helps at identifying cornea edges and ridges.

3. Neural Network Approach

Neural Network is a data organizing paradigm that is coruscated by the way biological nervous systems undertaken the information. The keystone of this paradigm is the novel construction of the information system. It is tranquil of a large

number of highly annexed processing elements running in unison to solve specific problems. There is a ample understanding of how an single neuron works, there is still a great peddle of research and chiefly surmise regarding the way neurons mould themselves and the technique used by arrays of neurons to attune their behavior to extrinsic stimuli. There are a lot some of expletory neural network structures presently in use reflecting this state of continuing research. To build a back propagation network, seize a number of neurons and array them to semblance a layer.

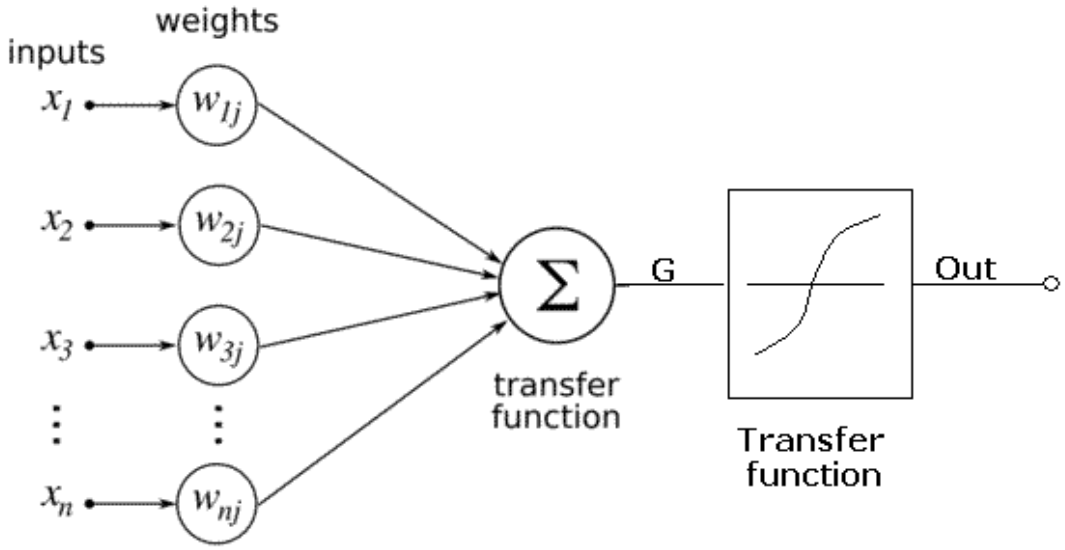
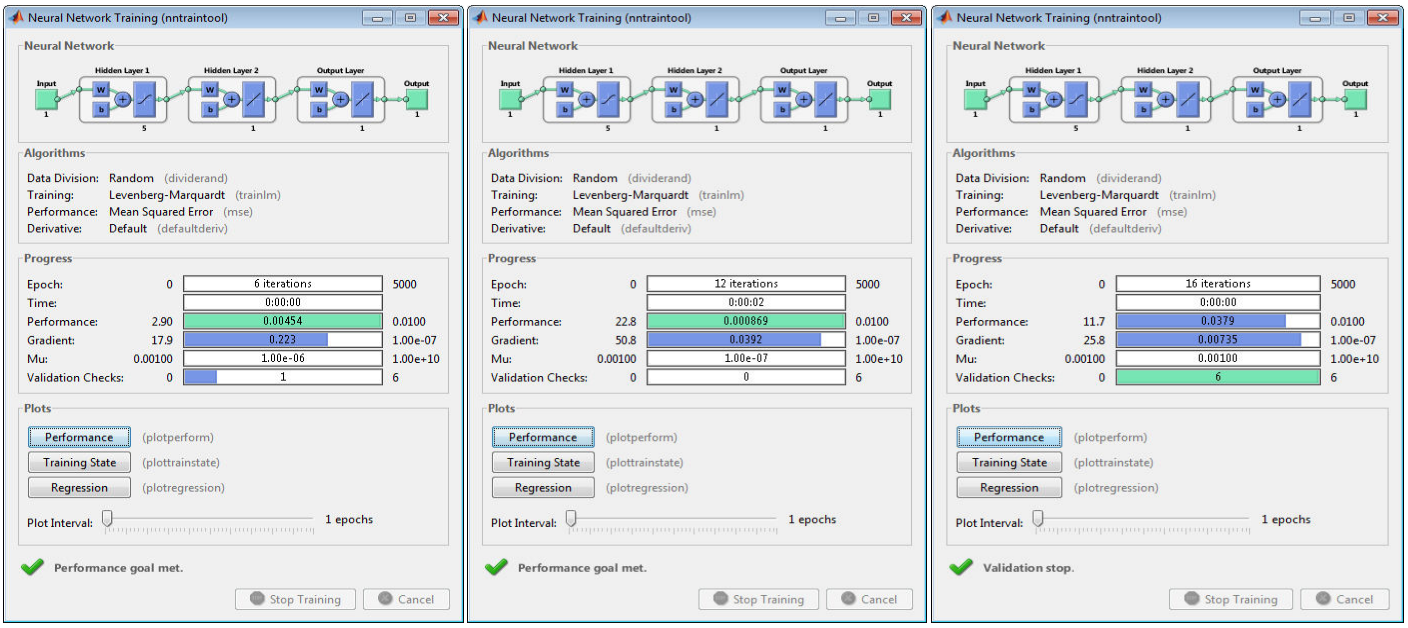


Fig-3: Basic Neural Network Functions.

There are few preprocessing steps to collect the data and train them to provide output. The images are from OCT to be trained in this section for analyzing. Initially the full image is cropped and converted into square format pixel. This helps in providing better accuracy. The image is filtered with help of mean and variance. As many paper preliminary read before states Mean filter provide much better outputs than Averaging filter and Wiener filter. The noises in the image are removed and provide better efficiency image. The cropped filtered input image is done with boundary detection and finds the area between cornea and iris. The major consideration in this paper is extraction of the region between iris and cornea to find the angle. There are few elements used in neural network. Elements like epoch, learning rate, min error and so on used in feed-forward propagation. The sim and learnp are used frequently to current inputs to a perceptron, and to revamp the perceptron weights and biases following to the error, the perceptron will finally plot bias and weight values that solve the problem, given that the perceptron can solve it. For training one epoch, a single pass through the series of all input vectors. The training set categories the inputs in different session and will finish the calculation. Then the outputs are obtained from the training made to select the group it belongs to using loops. In this paper, we classify

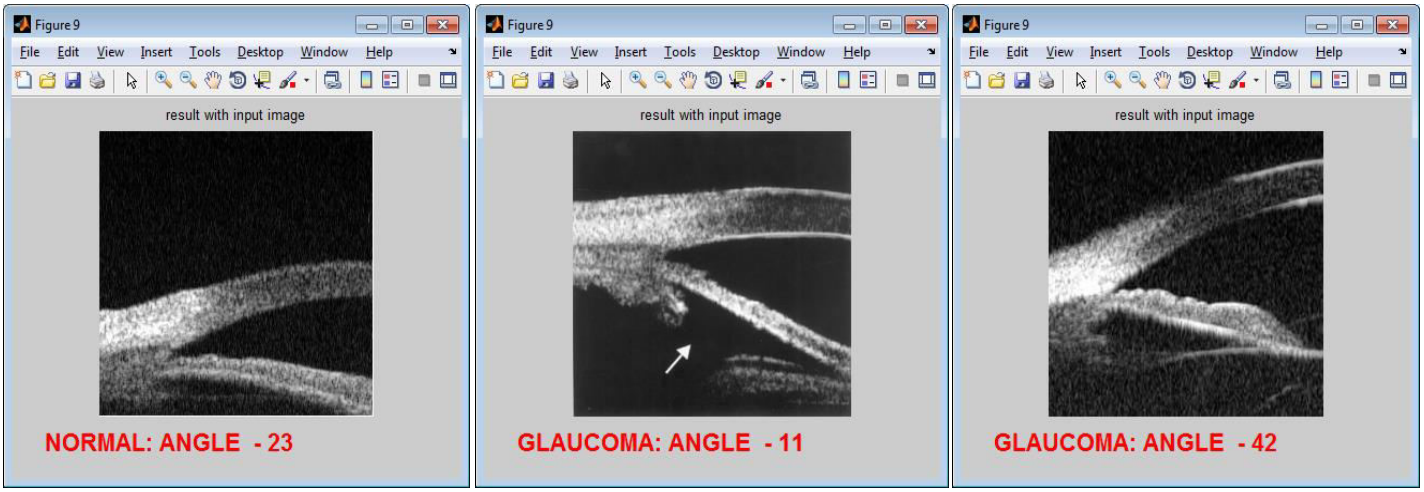
Glaucoma into 3: closed angle, normal vision and open angle glaucoma. According to training set and learning rate, the type of glaucoma is detected in the system. The glaucoma classified into 3: The angle below 11 said to be closed angle, the angle inside 12 to 24 meant for normal vision and the angle above 24 said to open angle glaucoma.



(a) **(b)** **(c)**

Fig-4: (a) Training of Normal Vision, (b) Closed Angle & (c) Open Angle Glaucoma

The following output shows the training period of each type of glaucoma. The fig (4) and (5) shows the training and output of all three visions. The neural network sets for feed-forward back-propagation by calling newff(). The network has numerous neurons in the input layer, corresponding to pixels in the input image. By training our network for 10 complete epochs, using mini-batches of 100 training.As we train we'll monitor the classification accuracy on the validation_data().



(a) (b) (c)

Fig-5: (a) Output of Normal Vision (b) Closed Angle & (c) Open Angle Glaucoma.

4. Self Organizing Map

The Self-Organizing Map (SOM) is a data-analysis method that visualizes similarity relations in a set of data items. For instance in economy, it has been applied to the comparison of enterprises at different levels of abstraction, to assess their relative financial conditions, and to profile their products and customers. On the other hand, in industry, the monitoring of processes, systems and machineries by the SOM method has been a very important application, and there the purpose is to describe the masses of different input states by ordered clusters of typical states. Only in some special cases the relation of input items with their projection images is one-to-one in the SOM.

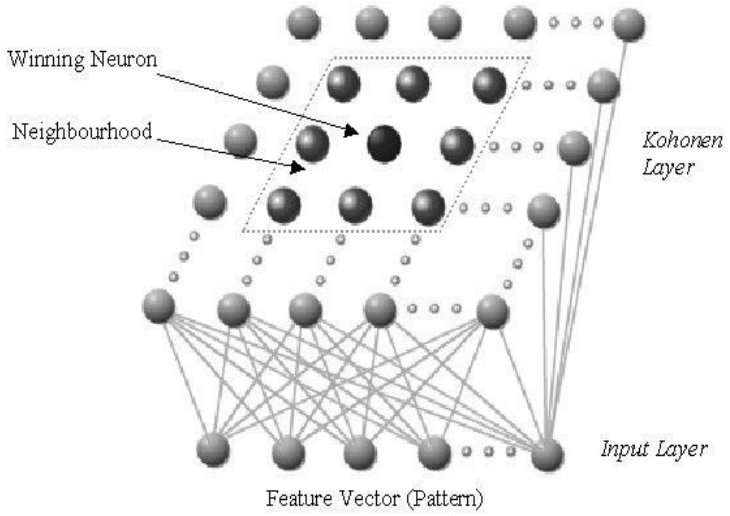


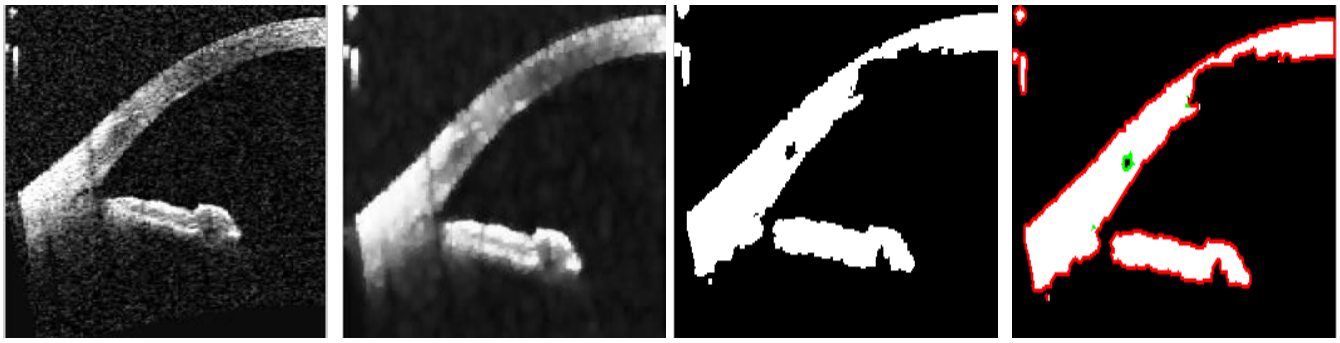
Fig-6 Neighbourhood Selection By Som Algorithm.

The pre-processing steps for SOM are quite similar like steps used for neural network. Initially we get image from OCT clinical kit. The image is cropped into desired size. Then the image is converted into grayscale in-order to metamorphose into binary image. The cropped image is filtered using mean filter. After filtering array is created by using imcomplement(). This will reverse the binary image format (i.e.) the black converts to white and white converts to black. After transformation function bwareaopen() is used to remove object value contain fewer than 1600 pixels. The unsupervised training starts by using the parameter ndim, nepoch, ntrainingvector, etao, eta delay, sgmo and sgmdecay. The rows and columns are mentioned before. SOM use rand() to built random number based on dimension and width. The data are trained to the number of time random number given.

[x y] = meshgrid(1:ncols , 1:nrows);

The above function used in SOM in-order to create grids inside the algorithm. Here we assigned 100 training vector for 1 epoch.Thereby, totally we use 10 epoch which leads to 1000 training happens within the algorithm. The SOM collects

100 values for 1 epoch to produce correct answer. It collects all the neighbor value to analysis the surrounding. Later it uses Euclidean distance calculation to find the minimum distance. Thus SOM is unsupervised technique which is very useful to produce outputs for detection of glaucoma using iridicorneal image. The fig (7) shows the output of each stage of program execution in the system.



(a) **(b)** **(c)** **(d)**

Fig-7: (a) Cropped Image, (b) Filtered Image, (c) Binary Image & (d) Boundary Image

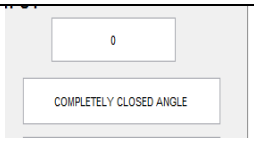
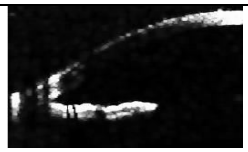
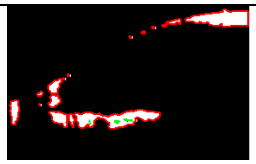
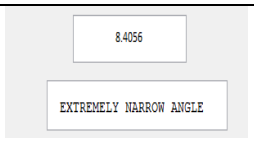
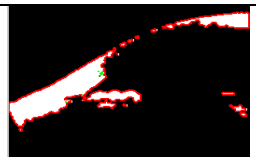
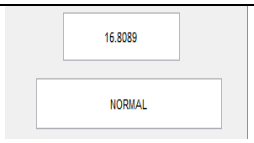
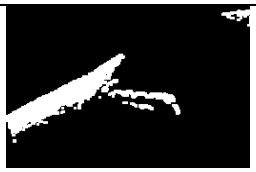
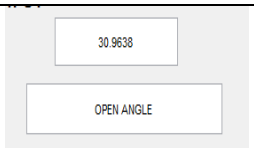
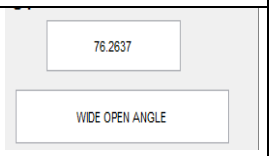
Each glaucoma ranges at different angle. According the division the glaucoma is classified and examined in the system using SOM algorithm. The Table-1 shows the outputs of proposed work at different types of glaucoma.

- Completely closed: 0
- Extremely narrow: 1 - 10
- Normal: 11 – 20
- Open angle: 21 - 35
- Wide angle: above 36

SOM had plenty of practical applications ranging from industrial process control and finance examines to the management of very large document collections. It's very promising applications prevail in bioinformatics. The largest applications so far have been in the management and retrieval of textual documents. Several commercial software packages as well as plenty of freeware on the SOM are available.

The SOM array is mostly taken as two dimensional, regular, and hexagonal. This form of the array is advantageous if the purpose is to visualize the structure overall of the general data base in one image. The SOM Toolbox contains parameters in the initializing functions by which the topology of the array can be defined as a straight sheet, a cylinder, or a toriod.

Table-1: Different Stage of Glaucoma Representation.

S.NO.	ANGLE	FILTERED IMAGE	BINARY IMAGE	BOUNDARIES	OUTPUT
1.	0				
2.	8				
3.	16				
4.	30				
5.	76				

5. Results and Discussion

On experimental analyzing both the results provide similar range of outputs. The data are obtained from eye clinic. The neural network is trained using the basic OCT cropped image. About 100 databases are analyzed within neuro network. The SOM algorithm is unsupervised training. Thereby, it collects the data's of neighboring point's in-order to provide output according to the situation occurs at the instant.

The neuro process can only provide according to the desired output we already given in the system. The data are trained on base of the inputs we already loaded into. And hence, the input given to neuro can process for the desired output only. It can't make its own decision. There are few advantages overcome neural network by using SOM algorithm. As we discussed already the difference between supervised and unsupervised training becomes one of the advantage for proposed method.

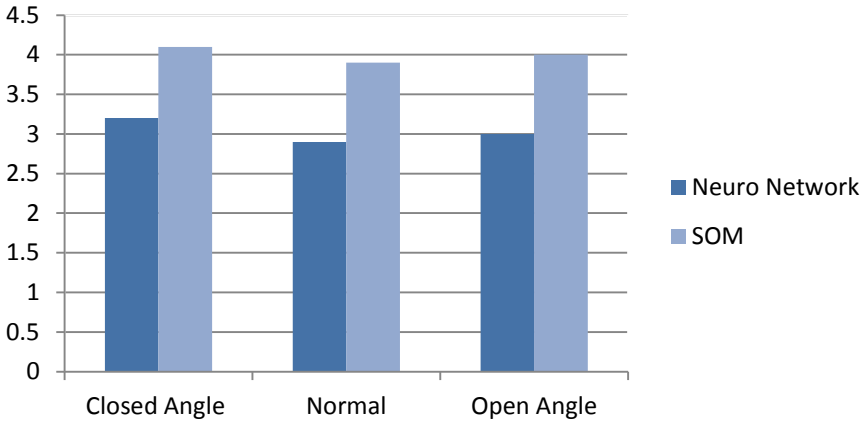


Fig (8) Comparison Between Neural Network And Som Algorithm.

Though neuro algorithm helps in providing better output than any function in Matlab, outputs are mentioned initially. It trains the system according to the desired output. Too much black box i.e. solving of problem is unpredictable. And we can't understand the problem deeply.

6. Conclusion

There are various methods of input to detect the glaucoma and faster way of analyzing the presence. From various input like Fundus images, OCT images and ultrasound for recent trend were described and processed. The paper tries to cover the recognition of the diabetic retinopathy and the vision system which impacts due to the Diabetic retinopathy. Therefore there is a need for automated screening and detection system of various lesions, which may be occurring at the early stages of Diabetic retinopathy, so that obstructive measures can be taken to prevent blindness. Both neural network and SOM training is current trend of analyzing. SOM algorithm has better response on future, since all the machines are trying to cover up with Artificial Intelligent technique.

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