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A NEW APPROACH FOR DETECTION OF BLOOD VESSEL TRACKING SYSTEM AND GLAUCOMA FOR DIABETIC PATIENT

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ABSTRACT

Glaucoma is a disease affected by an eye which results normally and impaired by the normal optic nerve. It is caused by increase in the pressure which utilize across the outer coats of the eye ball. Glaucoma primarily causes a retinal vessel occlusion and then it alters the optic disc by getting higher the cup size. The blindness will lead to causes and it will detect some problems and treated in a convinced time period. In this proposed method, by using retinal fundus image the green channel is used to extract the optic cup and the optic disk. Circular Hough transformation is used for the feature extraction which is used to detect the circles in imperfect images in this method. Different methods can be used in this proposed method such as preprocessing, thresholding and histogram equalization which is used for the automated detection of blood vessel. The extracted features can be used to find the cup to disk ratio (CDR), if the CDR value is more than 0.3 it indicates the severe stage of glaucoma can be detected in the patients and Adaptive Neuro-Fuzzy Inference System (ANFIS) algorithm can be used to separate the normal eye and glaucoma eye from the retinal fundus image and neural network classifier.

Keywords: glaucoma detection, blood vessel, fundus image, optic disk segmentation, optic cup segmentation, anfis, circular Hough transform.

INTRODUCTION

Diabetic Retinopathy (DR) is a disease which affects the eye and it damages the optic nerve towards the diabetic patients. It normally detects the blood vessels in the inner coat of eye (i.e.) called as light sensitive layer of the tissue. The blindness will leads to causes and it will detect some problems and treated in a convinced time period. It is mainly used to affect the vision loss problem and pressure affected by retina. In every human adults, retina is fully covered ~ 75% of sphere about 24 mm diameter used in eye. Blind spot is also defined as Optic disc mainly used the ganglion cells from the retinal image are removed for further processing. Segmentation uses a starting point of blood vessel separated in the retina and the normal retinal image carried away from neuron range is 1 to 1.2 million in eye to brain. Then the diabetic patient from which blood sugar is normally high damages the blood vessel in the retinal image. Finally retinal image detects the light and then converted the signal transmitted to the optic nerve to the brain. Then the blood vessel may leak the fluid or bleed (blood) in the distortion vision of the blood vessel.

Diabetic Retinopathy mainly used for four types. In first type, mild non-proliferative diabetic retinopathy is used for swelling the small balloon like areas used to leak or bleed (blood) the fluid in the retinal image. In second type, moderate non-proliferative diabetic retinopathy used in blood vessel in the retina nourishes automatically and it might be swelling as well as distort the retinal image. In third type is severe non-

Proliferative diabetic retinopathy, normally retinal image can be blocked by many blood vessels and new blood vessel might grow faster than other methods. In fourth type is proliferative diabetic retinopathy, new blood vessel grow inside the retina and leak their fluid or gel .it is the advanced technique used to secret the grow factor used in the blood vessel.

Figure-1. Comparison of normal vision and glaucoma vision.

Glaucoma is the second leading disease affected by eye in the world. It mainly varies the increase in the pressure utilize across the outer coats by the eye ball. Normally the pressure increases and later damages the optic disc. It may lead to loss the vision permanently. Glaucoma can be mainly divided into two types such as closed angle glaucoma and Open angle glaucoma. Open angle glaucoma has no early syndrome and manifestation. Then the vision loss can be developed slowly to stop the damage of the retinal blood vessel. Closed angle glaucoma is also called as acute angle closure glaucoma. Because it increases in the pressure of eye (IOP) and it damages the optic nerve which leads to the blindness. This glaucoma includes severe symptoms such as redness, eye pain, and it shows the optic cup from Figure-1. Where the white cup

area is present in the center of the optic disc vision of the eye and it can be blurred, mid-size pupil and vomiting suddenly .If the vision of the eye is damaged permanently by reducing the visual field and then ability leads to blindness if not treated in certain time.

LITERATURE SURVEY

The automated technique suggested by Badsha (2013), which is used to extract the required amount retinal blood vessel. It comprises several basic image processing techniques, particularly edge growth by a standard template, entity classification, thresholding, morphological operation and noise removal.

The blood vessel segmentation using mathematical morphology in fundus retinal images was suggested by Nidhal (2013). The technique uses RGB retina image and separates Green channel From RGB image which gives good details. Retinal images are normally noisy and also non uniform illumination. So contrast limited adaptive histogram equalization is used for contrast improvement. The Top-Hat transform method is used for withdrawal of small details from given image.

The edge detection for retinal image by using Super imposing concept and Curvelet transform was suggested by Kavitha and Kumar (2013), which used to make the edge recognition effectively. Back propagation algorithm technique is used for blood vessel detection which is useful to find out the real retinal blood vessels from the image to create the better result.

The automated extraction of the blood vessels in retinal image was recommended by Siva kumar and Jeno (2014). It mainly used for the green channel of RGB fundus image. Graph tracing algorithm is used for segmenting the image by acquire true blood vessels in the form of binary tree. Supervised learning method is used to detecting or extracting the blood vessels automatically in artificial based approach.

The combined approach on the analysis of retinal blood vessel segmentation was recommended by Jeya shree and Sharmila (2014). It is used for the diabetic retinopathy and glaucoma diagnosis. It mainly used for the red channel which is used to extract the optic cup areas and optic disk for detecting the glaucoma. The glaucoma affects both the optic disk and blood vessel by increasing the cup to disk ratio. Finally blood vessel in the optic disk region is detected by using the morphological operations.

The mathematical morphology technique is used to detect and eliminate the blood vessels and optic disc (OD) was intended by Oakar phyo and Aungsoe Khaing (2014). Preprocessing techniques is used to convert the coloured retinal images (RGB) into HSI colour space image. By using these techniques the contrast limited adaptive histogram equalization (CLAHE) technique for the image enhancement is used. It mainly uses three filtering techniques namely Median filter, Averaging filter, wiener filter. By using three filtering techniques median filter is the most suitable filter used to reduce the effect of noise. It must be operated on tiny data region in the retinal image. Adaptive histogram is better result for image enhancement process. Mathematical morphological operation and Otsu's algorithm can be used to eliminate the blur image and provide better output.

A Study on Retinal Disease Classification and Filtration Approaches mainly detects the disease on the medical images was intended by Parul, Neetu Sharma (2015). It mainly discussed the filtering methods such as SVM, DCT, HMM and PCA techniques used to detect the glaucoma. Support vector machines also called as supervised learning method used to assume the data and patterns in the learning algorithms used for analysis and classify the output. Hidden Markov model (HMM) based technique is used for the face detection and recognition, and it uses a useful pair of vectors which is obtained from the 2D-DCT coefficients. It uses two-dimensional techniques to select the DCT frequency bands with support their linear separable functions. It might be discussed for filtering methods to improve the image features so powerful to recognize their diseases.

PROPOSED METHODOLOGY

The retinal fundus image has concluded for four main types namely Segmentation, Pre-processing, classifier and feature extraction is shown in the Figure-2. This method is used to reduce the process time which is used to detect the glaucoma.

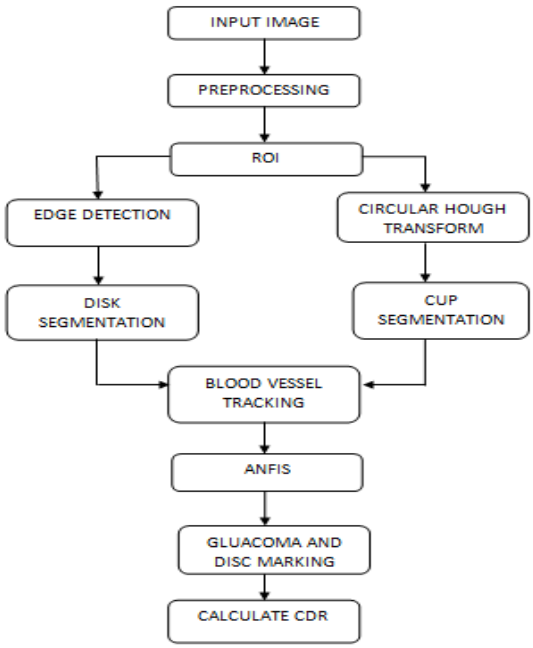

Figure-2. Flow chart of the work.

A. Preprocessing

The objective of the pre-processing is used to remove all the low frequency noise, intensity variation, and resizing process which is used to normalize the retinal images

Three main steps in pre-processing step are:

1) Gray scale conversion

- Original retinal image is converted to gray scale image for easy implementation.
- It used for decrease the data size and computational time.
- All input image size is resized to 256 x 256 for gray scale conversion.

2) Edge detection

- Edge detection is mainly used to find the objects within the images are shown in the Figure-3(D).
- It is used to detect any interrupt in brightness
- It mainly used for image segmentation

3) Filtering

- In filtering, Median filter is often used for the non-linear digital filter technique are shown in the Figure-3(B).
- It is used to reduce both the noise and distortion
- It used to improve the results in later stages

B. Segmentation

Segmentation is a process in which it is used to split an image into its component objects which are homogenous corresponding to some criteria. These algorithms are area-oriented rather than pixel oriented. The main objective is to extract numerous features or parts of the image which can be split in order to construct an object of interest on which any interpretation can be performed. Optic disc and optic cup can be used to various morphological operations to detect the edges and spaces which are fully filled with each other. These methods can be used to detect the optic cup region by pursuing the erasure of the blood vessels. This segmentation method can be used to know the difference of pastiness to differ with the cup-disc boundary.

C. Feature extraction

It can be extracted for retinal fundus image as input used in pixel classification. Normally fundus image used for image techniques such as preprocessing technique used to convert the original image into gray level images. It mainly used for median filter to remove the noise. Histogram is used to find the intensity level of the retinal images. Blood vessel can be extracted without map minimization method. It is used to find the CDR ratio with efficient technique will help to check the level of glaucoma in diabetic patient. Region of interest decides the particular region is cropped on and further segmentation process takes place. Masking takes place to find the accurate position to affect the glaucoma in gray scale image. Finally calculate the cup to disc ratio by using CDR=cup height/Disc height

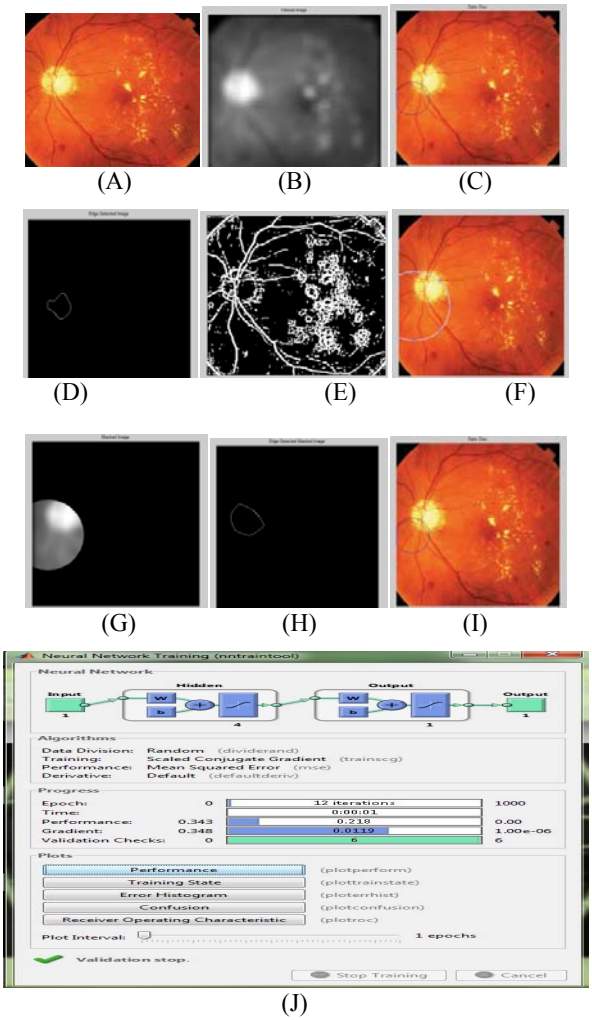

Figure-3. The detection of blood vessel and glaucoma for neural network analysis method. It have several images such as A) Input retinal fundus image B) Filter method (median filter) C) Optic disc segmentation D) Edge detection E) Blood vessel extraction F) Circular Hough transform used for feature extraction technique to detect the circles of the boundary G) Masked image for boundary H) Masked image of edge detection I) Glaucoma detection from where affected (small circle indicated) in retinal fundus image (J) Neural network classifier used to find the error histogram, performance etc.

D. Adaptive neuro fuzzy inference system (anfis) classifier

ANFIS algorithm combines both Artificial Neural Networks and Fuzzy System. It provides smoothness due to fuzzy control interpolation, Back propagation adaptability, and neural network.

Design of ANFIS

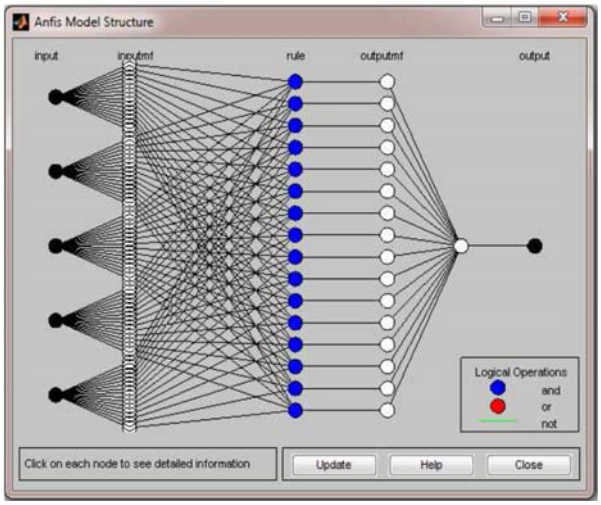

Figure-4. ANFIS structure.

ANFIS uses a hybrid learning algorithm to tune the parameters of a Sugeno-type fuzzy inference system (FIS).

Using a given input/output data set, the toolbox function anfis constructs a fuzzy inference system(FIS) whose membership function parameters are tuned using either a back propagation algorithm alone or in combination with least squares type of method in the Figure shown in Figure-4.

ANFIS is implemented in the MATLAB software. Features of ANFIS to the blood vessels are entropy, area of exudates, and Homogeneity properties. This will give an input to the ANFIS. By using this window

In this above window, the two steps of classification is carried out by using ANFIS:

- Training
- Testing

a) Training

The training system is used to load the statistical features of the retinal fundus images. In the given output image for training network, the Fuzzy Inference System (FIS) is generated to a given model of the training ANFIS data. Here If-Then rules are generated from ANFIS functions and Membership functions. The membership functions are constant for the individual parameters which are used as a back and forth training in ANFIS methods. The trained system of FIS methods is mainly used for the hybrid learning algorithm. This algorithm combines both the least square value types along with the back propagation gradient descent algorithm to training up the membership function parameters to compete all the training data is shown in the Figure-5. The training error goal is achieved and stopped by the current training process which is noted by the value of the training error.

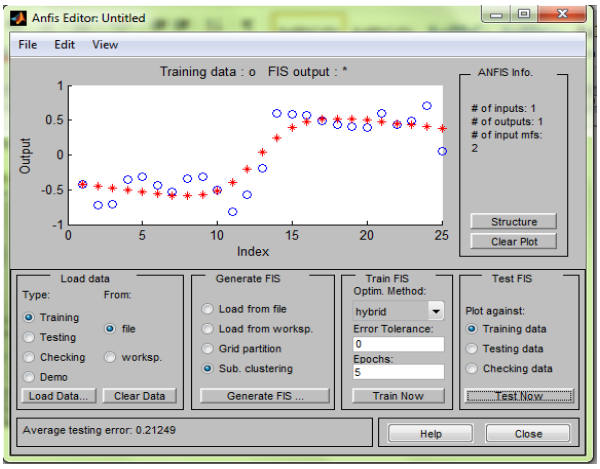

Figure-5. The training data by using hybrid learning algorithm.

b) Testing

Testing is used to build the testing model with the help of testing data. The testing data can be loaded from and to the workspace is shown in the Figure-6. The data versus Fuzzy Interference System (FIS) output gives a clear view of all the classification data's and the testing error.

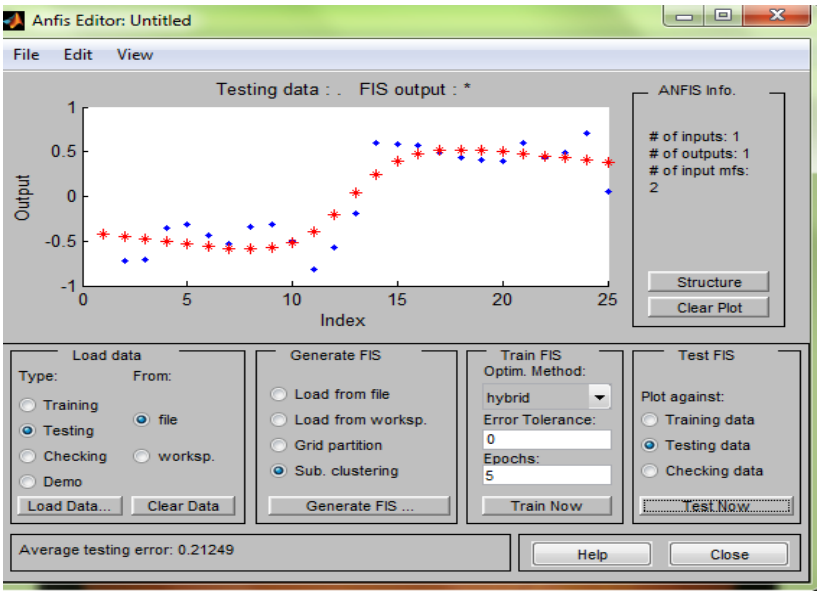

Figure-6. The testing data by using hybrid learning algorithm.

By using these trained and tested data can be loaded successfully to calculate the accuracy with different set of values performed .in this method combines both back propagation algorithm and least mean square values can be performed to identify the epoch values to trained and tested data accurately.

PERFORMANCE ANALYSIS

A. Optic cup segmentation by using blood vessel extraction

It assumes the area which is overlapped between the ground truth and computed region of the optic cup pixel wise precision and then it is recalled by the vales which are computed automatically which are described in Table-1.

Specificity = T.P / T.P+F.P
Sensitivity = T.N / T.P+F.N
Accuracy = (T.P+T.N) / (T.P+T.N+F.P+F.N)

Where TP = no. of True positive,
TN = no. of True negative,
FN = no. of false negative.
FP = no. of false positive.

Table-1. Optic cup segmentation values.

Images	Threshold	Component analysis	Proposed approach
1	0.64	0.76	0.84
2	0.71	0.79	0.91
3	0.63	0.73	0.86
4	0.54	0.60	0.78
5	0.73	0.78	0.89

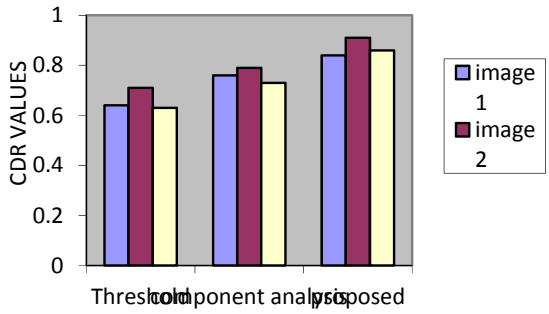

Figure-7. Performance graph.

B. Performance analysis for glaucoma detection:

In Glaucoma detection, both area of blood vessels and Cup-to-Disc ratio (CDR) are too high, due to the increase in pressure (IOP). Two parameters can be used to detect the glaucoma. Values are listed out in Table-2.

CDR ratio If the value 0.3 less than or equal to ±0.22 (i.e.) called as normal eye and value 0.5 greater than or equal to ± 0.24called as glaucoma eye.

Table-2. Values of glaucoma detection.

Image	Cup-to-disc ratio
Normal	0.206
Glaucoma	0.527

C. Performance analysis in the proposed technique

In this proposed technique, five features can be used and selected in that the number of input variables is used as five. In the fuzzy samples if /then rules are framed and formed for the fundus image classification. In this

image, if /then rules form an input for the ANFIS system architecture. By using the dataset, the data is splited into number of sets and testing sets. The classifier is trained by using training set and tested set on the validation set and this is initialized by 100 iterations with 0.001 step size value. Set is additionally sub-divided into training set and validation set. The process of this proposed technique is repeated by selecting the various combinations of validation set and training set. The classifier will gives a best performance and this will be selected for the future and it is used to get better performance in the testing part.

Table-3. Performance analysis of proposed method.

Images	Training data	Test data	No. of class /images
Normal	25	120	145
Suspect	25	80	105
Abnormal	25	100	125
Total	75	300	375

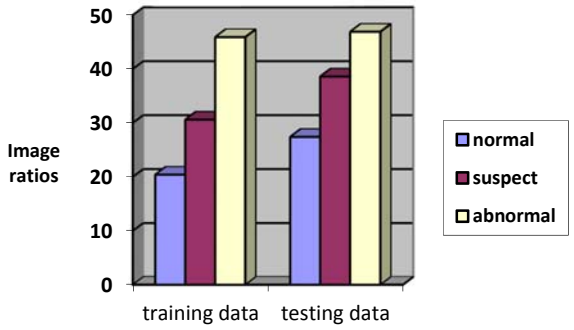

Figure-8. Performance of finding train and test data's.

In this proposed method, there are 75 images can be used. These images can be used for training and testing. In testing, 300 images is used from that 25 images can be used for each class for training and remaining used for classification is shown in Table-3.

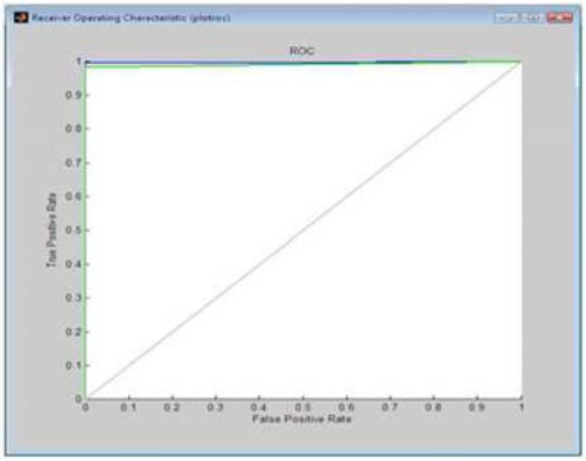

Figure-9. Performance curve created by ANFIS.

The performance curve of ANFIS shows the Membership functions. This can be generated by ANFIS as per the applied inputs and desired outputs. The average of training set error is used for 100 images and for testing error it used 50 images, they are 0.61623 and 0.68864 respectively. Finally it shows the receiver operating characteristic curve which is generated by the ANFIS system is shown in Figure-9.

CONCLUSIONS

The methods presented in the paper are based on morphological operations and tested for large number of images and trained by accurate values in neural network using anfis algorithm. In an automated system, it is capable to detect the blood vessels in the fundus image and its performance approaches the trained clinical observers. Thus it has been successfully developed by the ANFIS system. The method which is proposed and developed by here is very simple. Then it is very efficient for retinal blood vessel segmentation, which gives good information about the presence of diabetes and as well as the classification of retina images.

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