Detection of Glaucoma using Adaptive Neuro Fuzzy in DWT Domain

N. Ramamurthy, KCT Swamy, G. Ramarao, Molla Riyaz Pasha

Abstract— Glaucoma is that the second leading reason for loss of vision within the world.Examining the pinnacle of the ratio of cup to disc is extremely vital for eye disease diagnosis. This research work provides segmentation technique to calculate the disc and cup geometrical parameters mechanically and accurately. These techniques facilitate professionals with designation and observation eye disease by providing them with clear and correct information concerning the optic nerve headstructure. The individuality of this paper is in demonstrating the segmentation methodology by using adaptive neuro fuzzy algorithms for thsegmentation.

Index Terms—Optic Cup, Glaucoma,Optic Disc, Optic Nerve Head , Ratio of Cup to Disc and Adaptive Neuro fuzzy.

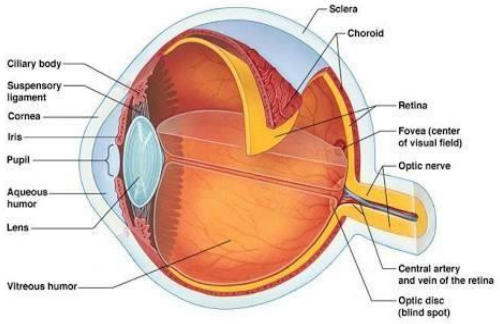
1. INTRODUCTION

The eye decease Glaucoma, now a days is one of the most dangerous eye deceases that damages the human eye sight. As per so many surveys, the Glaucoma is the world's second leading decease which causes blindness.By the year 2020, the glaucoma effected patients may increase further.Early detection of Glaucoma can prevent its progress and minimize loss of eye sight. Based on the models of images, many options of the structures of retina, like associate in nursing eyecup,optic disc, the second cranial nerve head papillary atrophy, and retinal fiber layer, got to be discovered for eye disease detection. [1]. Glaucoma damages the potic nerve by reducing retinal neurons as a result blind spots develop in the eye[2].Some of the proposed methods for disc segmentation are template based mostly technique,pixel classification technique and circular Hough remodel area unit accustomed model the disc boundary due to their procedure potency. From almost all the clinical studies it is clear that a disc incorporates a rather oval kind with the diameter of vertical axis being 7%-10% longer than the diameter of horizontal sxis.The utilization of machine-driven diagnostic tools is fascinating to reduce sound judgment and build the diagnosing sturdy and consistent. Color structure imaging has emerged because the most well-liked procedure for comprehensive large-scale retinal illness screening because of their easy acquisition and smart visibility of retinal structures. [3].The human eye is sown in figure (1.1).

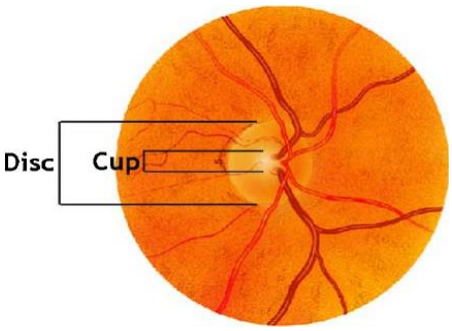
There are three different techniques to doagnise the Glaucoma more accurately.(1)"Evaluation of the intraocular pressure" (IOP) using Goldman tonometry, (2) "Evaluation of the visual field", and (3) "Evaluation of the optic nerve head damage" [4]. The optic disk is formed of more than one million neural structure cell axons .The relation between optic tract and cup and loss of visual view is obtained by examining the eyecup segmentation [5]. The point is split into 3 totally different areas: neuroretinal rim, the cup (central area), and typically parapapillary atrophy[6] . The cup-to-disc quantitative relation (CDR) is that the quantitative relation of the vertical diameter of the cup to the vertical diameter of the disc [7].

In [8], the authors straight a way obtained optic disk and calyculus victimization connected half labeling followed by two-dimensional figure .The cup and disc of fundus image of human eye are shown in figure(1.2)

In this paper, the adaptive neuro fuzzy method is proposed to detect the ratio of cup to disc more accurately. Color structure imaging has emerged because the most well-liked procedure for comprehensive large-scale retinal illness screening because of their easy acquisition and smart visibility of retinal structures.



Figure(1.1): Human Eye



Figure(1.2): Disc and Cup of fundus Image

Revised Manuscript Received on March 10, 2019.

Dr. N. Ramamurthy, G.Pullaiah College of Engineering and Technology, Kurnool, Andhra Pradesh, India.(E-mail: eceramamurthy@gpcet.ac.in)

Dr. KCT Swamy, G.Pullaiah College of Engineering and Technology, Kurnool, Andhra Pradesh, India.(E-mail: kctswamyece@gpcet.ac.in)

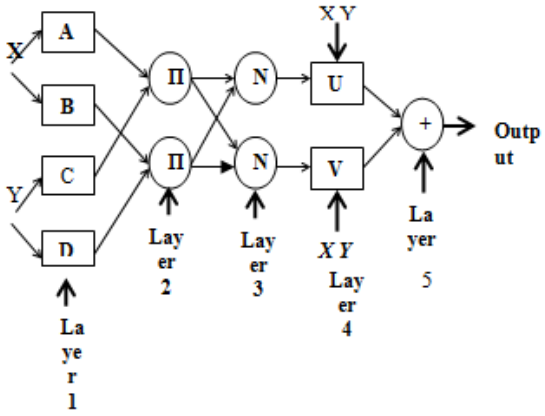
G. Ramarao, G.Pullaiah College of Engineering and Technology, Kurnool, Andhra Pradesh, India.(E-mail: eceramarao@gpcet.ac.in)

Molla Riyaz Pasha, G.Pullaiah College of Engineering and Technology, Kurnool, Andhra Pradesh, India.(E-mail: eceriyaz@gpcet.ac.in)

Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication

II. ADAPTIVE NEURO FUZZY INFERENCE SYSTEM

It is a combination of two soft-computing methods of artificial neural network (ANN) and Fuzzy logic is known as Adaptive Neuro FuzzyInference System (ANFIS). This system changes the qualitative aspects of human information and insights into the tactic of more accurate measure. There is no particular methodology in this system which is used as a guide at intervals the tactic of transformation and human thought into rule base fuzzy reasoning system and it put together takes quite whereas to control the membership functions (MF). Unlike ANN, it is a higher capability inside the training technique to adapt to its surroundings. Therefore, the ANN square measure typically accustomed automatically modify the MFs and decrease the speed of errors inside the determination of rules in fuzzy logic.



Figure(2.1): Adaptive Neuro Fuzzy Inference System

In figure (2.1), different layers of AFIS are :

Layer 1:

- Every node(A,B,C and D) during this layer adapts to a operative element.
- The signal coming from each node could be a degree of membership and is sum of the inputs of the membership functions.

Layer 2:

- Every node in this layer is fastened or non-adaptive. The output node is that the results of product of signal returning into the node and delivered to consecutive node.
- Every node during this layer represents the firing strength for every rule.
- Within the second layer, the T-norm operator with general performance, just like the AND, is applied to induce the output.

Layer 3:

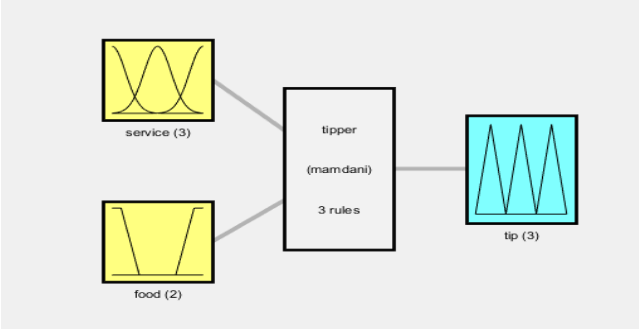
- Every node throughout this layer is mounted or non-adaptive and conjointly the circle node is labelled as N.
- Each node might be a calculation of the magnitude relation between the i-th rules firing strength and conjointly the full of all rules' firing strengths.

Layer 4:

- Every node (U and V) during this layer is associate degree adaptative node to an output, with an outlined node to perform.

Layer 5:

- This is the output which represents sum of signals coming out of the previous layer[9].
- The selection of the inputs of ANFIS play a crucial role in the design of classifier, since the design of improper classifier will perform poorely.
- The proper functioning of ANFIS depends on the training knowledge set and testing knowledge set [10].

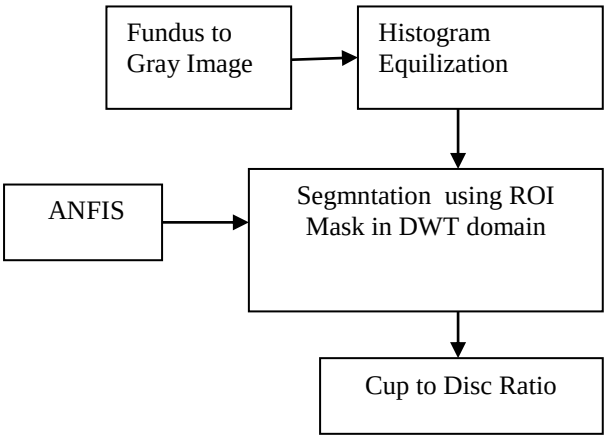


Figure(2.2): The fuzzy infererence system with tipper

In comparison of ANFIS with black-box approach of ANN, the ANFIS approach is a lot of clear. Decoding the ANN is unbelievably difficult. The matter specific qualitative modeling illustration is solely understood and could be translated into medical terms to assist the regular clinical diagnosis. Specialists can incorporate into the selection of the inputs and additionally the manipulation of model rules.

III. ANFIS TRAINED SYSTEM TO DETECT CDR

Glaucoma is associate in nursing insidious illness as a result of it seldom causes symptoms like tearing and emnlargement of cornea.The supervised learning mechanism using adaptive fuzzy inference system clearly enhance the success of the algorithm.The membership fuctions with K-means clustering trained by supervised learning improve the process of optic cup and oprtic disc segmentation to detect the Glaucoma.



Figure(3.1): CDR Estimation

Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication

Dennis Gabor filters offer a singular powerful technique within the field of image process. In segmentation process of cup to disc, the visibility of boundary is sometimes not sensible particularly because of blood vessels. Gabor wavelets in association with adaptive neuro fuzzy inference system is tuned for specific orientations and orientations that are helpful for blood vessels. They act as low level familiarised edge discriminators and additionally separate out the background signal of the image.

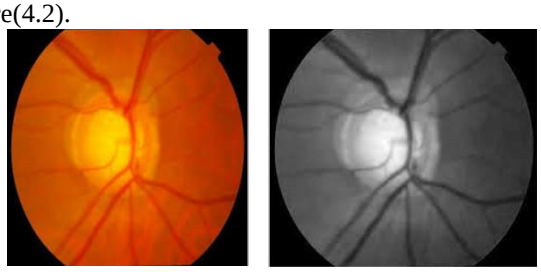
The process of thresholding or another technique known as binarization of Optic Cup division ca be used. This method can convert the image into a thresholded or binarized image wherever we will simply get our calycle. Binary pictures area unit made from color pictures by segmentation. Segmentation is that the method of distribution every picture element within the supply image to 2 or a lot of categories.

Glaucoma detection Algorithm:

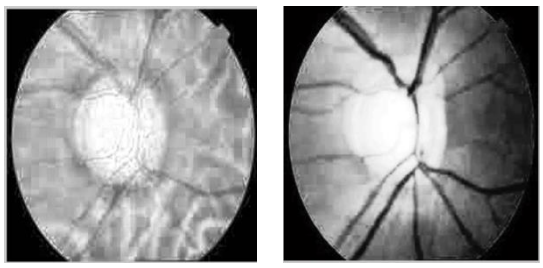
1. Select fundus image
2. Convert the selected color fundus image into gray image
3. Perform histogram equalization on grey image
4. Enhance the histogram equalized image
5. Convert the enhanced image into color image
6. Apply Lab color space with clusters using ANFIS
7. Train the system with predefined membership functions using supervised learning
8. Apply ROI mask using ANFIS
9. perform optic disc segmentation
10. Extract edge map subtracted image image using gabor
11. Extract binay image
12. Extract disc and cup
13. Extract cup to disc ratio
14. Dtetect Glaucoma

IV. RESULTS AND DISCUSSION

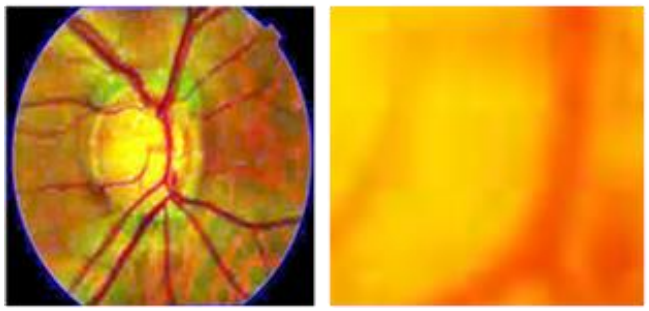
The selected fundus image and the corresponding gray image are shown in figure (4.1). After performing histogram equalization and segmentation, the resulting images are in figure(4.2).



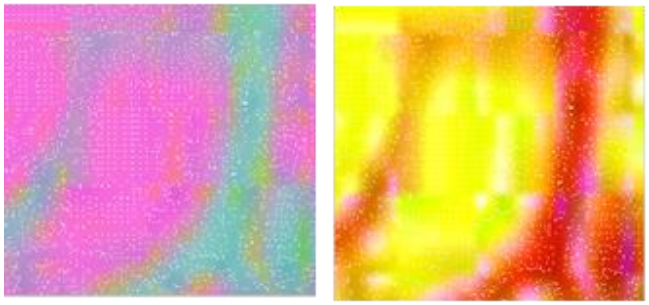
Figure(4.1): Original and Gray Images



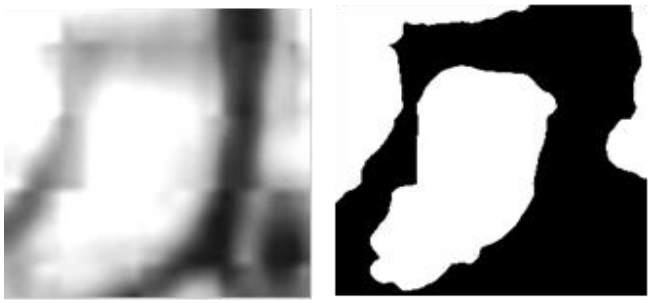
Figure(4.2): Histogram equalized and Enhanced Images



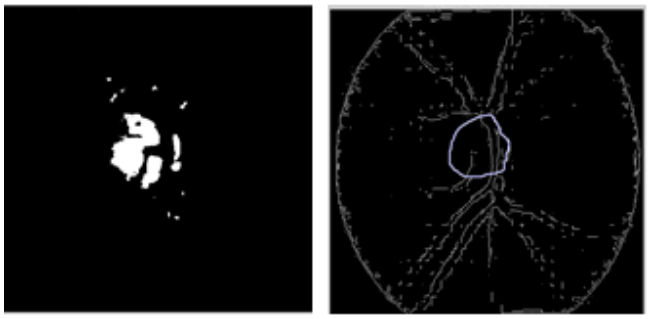
Figure(4.3): Clear Image and selected lab color Space



Figure(4.4): Lab space with cluster centers and Image with cluster centres



Figure(4.5) Gray scale Image and and optic disc segmented Image



Figure(4.6): Binary vein Image and Edge map subtracted Image

Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication

Figure(4.7): Extracted Disc and Extracted Cup

The lab color space and Gabor filters in association with ANFIS provide better technique to identify the Glaucoma.The clustered segments of fuzzy logic trined by supervised larning with different data sets provide better process in the selection of optic cup to optic disc eventhough it is selected manually in binary vein image.

If the cup to disc ratio is less than or equal to 0.4,it is normal eye. If the CDR is between 0.4 and 0.6, moderate glaucoma and for greater than 0.6, severe glaucoma.

REFERENCES

1. Anindita Septiarini, Dr, Dyna M. Khairina, MKom, Awang H. Kridalaksana, MKom, Hamdani Hamdani, MCs, "Automatic Glaucoma Detection Method Applying a Statistical Approach to Fundus Images",Healthcare Informatic Research,pp53-60, January2018.
2. Sharanagouda Nawaldgi et al, "Review of Automated Glaucoma DetectionTechniques" IEEE WiSPNET conference, pp.1435-1438,October2016.
3. Daniel E. Singer, David M. Nathan, Howard A. Fogel, and Andrew P.Schachat, "Screening for diabetic retinopathy," Annals of Internal Medicine, vol. 116, no. 8, pp. 660–671, 1992.
4. W. C. Stewart, Clinical Practice of Glaucoma, SLACK Incorporated, Thorofare, NJ, USA, 1990.
5. M. T. Nicolela, "Optic nerve: clinical examination," in Pearls of Glaucoma Management, J. A. Giaconi, S. K. Law, A. L. Coleman, and J. Caprioli, Eds., pp. 15–21, Springer, Berlin, Germany, 2010.
6. R. Chrástek, M. Wolf, K. Donath et al., "Automated segmentation of the optic nerve head for diagnosis of glaucoma," Medical Image Analysis, vol. 9, no. 4, pp. 297–314, 2005.
7. T. Damms and F. Dannheim, "Sensitivity and specificity of optic disc parameters in chronic glaucoma," Investigative Ophthalmology and Visual Science, vol. 34, no. 7, pp. 2246–2250, 1993.
8. Murthi, A., & Madheswaran, M. (2012, January). "Enhancement of optic cup to disc ratio detection in glaucoma diagnosis", International Conference on Computer Communication and Informatics (ICCCI), pp.1-5, IEEE 2012.
9. Nallagarla Ramamurthy and Dr.S.Varadarajan, "Robust Digital Image Watermarking Scheme with Neural Network and Fuzzy Logic Approach", International Journal of Emerging Technology and Advanced Engineering Volume 2, Issue9, 2012, pp.555-562.
10. Mei-Ling et al " Glaucoma detection using adaptive neuro fuzzy inference system",Elsevier expert systems with applications,2007,pp458-468

Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication