AUTOMATED DIAGNOSIS OF GLAUCOMA USING CUP TO DISC RATIO

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***Abstract:* Image processing does the operations to get the enhanced image that will extract useful information. Glaucoma is one of the leading sources of irreversible blindness in people above 40 years old. It is an Eye disease also known as "Sneak thief of sight" caused when the IOP (Intra Ocular Pressure) of the Aqueous Humor fluid present in between Iris, Lens and Cornea, Iris increases. This fluid is produced and drained at the same rate by maintaining the constant Intra Ocular Pressure (IOP) at 16mm Hg. The IOP of the Aqueous Humor increases due to any block in the canal of schlemm, because of this increase in pressure of Optic Nerve and retina are compressed. This paper proposes a computational tool for detecting Glaucoma automatically.**

***Index Terms* - Aqueous Humor, Intra Ocular –Pressure, Glaucoma detection, discrete wavelet transform.**

I. INTRODUCTION

Glaucoma is a diverse group of eye diseases. It is the second cause of blindness with about 710 million in the world likely afflicted with the Glaucoma by the year of 2020.

Fig 1: Glaucoma

Glaucoma is shown in Fig 1.It is further classified as: a) Inflammatory Glaucoma b) Neuro vascular Glaucoma c) Traumatic Glaucoma shown in Fig2.

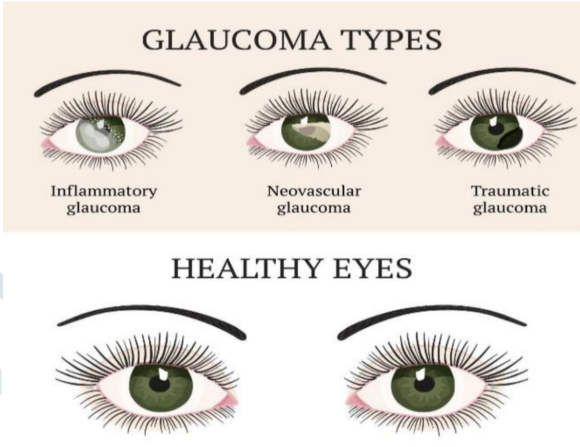

Fig 2:Glaucoma Types

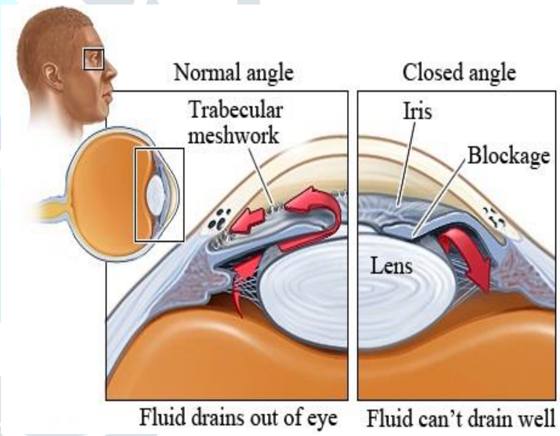

Fig 3 AH fluid

Normal IOP is in the range of 11-20 mm Hg.

When the pressure in the eye gets higher the Optic Nerve is damaged which is responsible for sending visual images to the brain.When the Aqueous outflow is lower than the inflow the eye vision gets damaged thus gives rise to galucoma. High IOP inside the eye which leads to risk factor for Glaucoma, it requires constant monitoring through medical scomapecialist, hence there is a need to diagnose Glaucoma. The Fig 7 shows the different stages of Glaucoma.

II . RELATED WORK

Huanzhu Fu proposed (DENet) takes into account two levels of fundus image information, that is the global image and the local disc region[7].The cup region will be shown clearly in Fig 13.

Muhammad Nauman Zahoor proposed an image processing pipeline for automated estimation of Glaucoma in retinal images. A fast and robust Optic Disc segmentation methodology is the first step[4].This provides the classification of Glaucoma stages.

Fan Guo proposed a mobile app **Yanbao** it helped users conveniently share high-quality Glaucoma screening service by using the proposed Glaucoma [6] screening algorithm based on clinical parameters.

Ganesh proposed a non-invasive method that used GMR sensor to detect Glaucoma through acquisition of AH fluid[3].This bio magnetic signal shows the presence of Glaucoma.

Yuchao Ma proposed a cycle detection framework [2] for providing an examination that gives accurate and reliable data analysis method.

Dheeraj Kumar Agarwal proposed a method CAD for diagnosis of Glaucoma [5].For feature extraction DWT method is used.

III.**PROBLEM AND MODULE EXPLANATION**

The existing methods can be implemented but it leads to some unavoidable errors and needed more hardware requirements. The proposed method aims to provide the measurement of IntraOcular Pressure for the treatment of Glaucoma easily. The damage of the Optic Nerve is found using the fundus images.The Fig 3 shows the comparison of Aqueous Humor production of normal and blocked eye. Calculation of cup to disc ratio is one of the methods in assessment of damaged Optic disc and Optic Nerve.The Optic disc and Optic Nerve is shown in Fig 4 and Fig 5.The normal Optic Nerve and Optic Nerve with Glaucoma are shown in Fig 6.

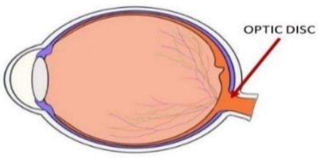

Fig 4:Optic disc

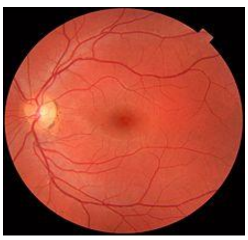

Fig 5: Optic Nerve

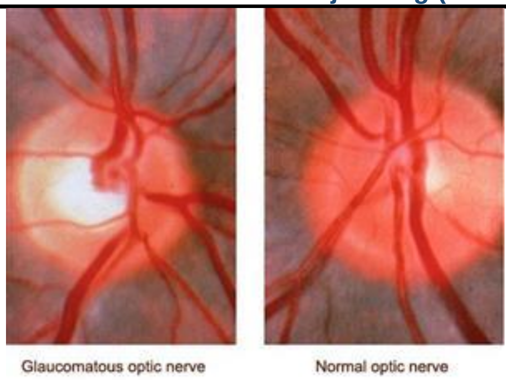

Fig 6: Optic Nerve with and without Glaucoma

<u>Cup to disc- ratio (CDR):</u> The Cup to Disc – Ratio will compare the diameter of the cup part of the Optic Nerve head with the whole diameter of the Optic disc.

Fig 7: CDR ratio

Conditions for the CDR-- if the CDR is less than 0.210 then it will be mentioned as early stage of the Glaucoma.

If the CDR is greater than 0.3 and less than 0.6 then it will be mentioned as medium stage of Glaucoma.

If the CDR is greater than 0.6 then it leads to high risk of Glaucoma.

The CDR will be displayed as shown in Fig 6.

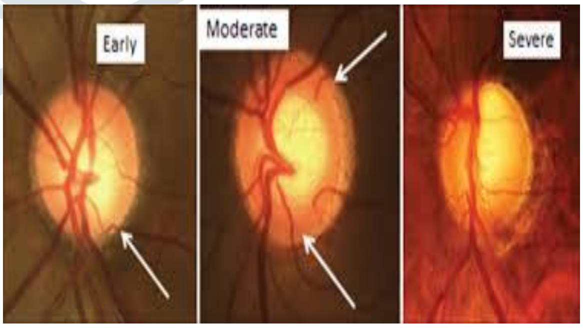

Fig 8: Stages of Glaucoma

SYSTEM ARCHITECTURE

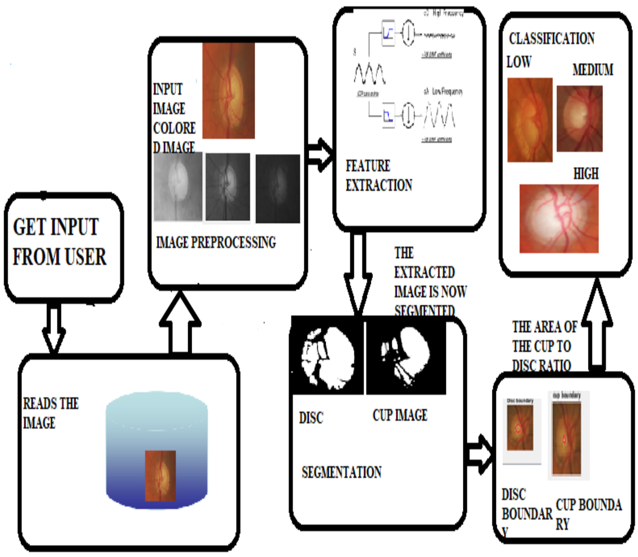

Fig 9: System architecture

A.DATA COLLECTION

The data will be in the form of fundus image as shown in Fig 7 is first collected and resized.

In real time applications the Intra-Ocular Pressure (IOP) in the eye is measured by a instrument called as tonometer.The image of the eye measured by the tonometer is shown in Fig 11.

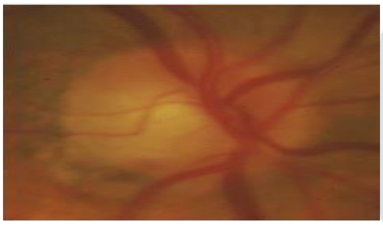

Fig 10: Fundus image of an eye

Fig 11:Tonometer

B.IMAGE PREPROCESSING:

Preprocessing techniques are based on the process where the fundus image is converted into gray scale image from RGB using MATLAB software. The RGB channel of the fundus image is shown in Fig 12.Many applications use grey or black and white images since processing colour images is computationally high. The colored images contains non-uniform background making it difficult to extract the document text from the image. The result of the preprocessing is a binary image.Gaussian filter is used for smoothening the images.

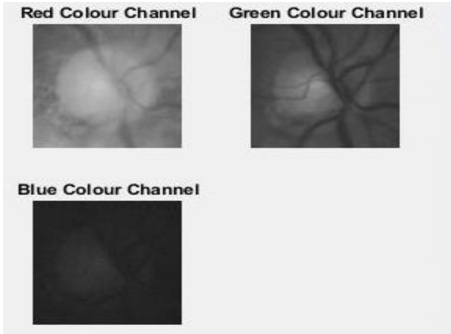

Fig 12: RGB Channel of the fundus image

C.FEATURE EXTRACTION

Discrete wavelet transform is a method which samples images discretely as shown in Fig 13.

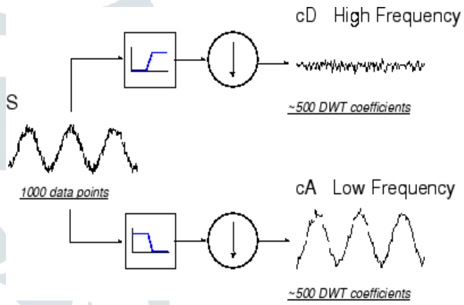

Fig 13: Discrete wavelet transform

There are different types of Discrete wavelet transform.

- Haar wavelet: Haar wavelet is a collection of square shaped wavelet functions.
- Daubechies: This wavelets defines DWT characterized by scaling function.
- Coiflets: Coiflets are wavelets that are symmetric and have N/3 vanishing moments.
- Symlets: The Symlet is a wavelet transform generates the scaling filter coefficients.

Algorithm

The steps to apply discrete wavelet transform (Symlet):

- The grey scale will be applied to the images with the pixel value 256*256.
- Then apply the code in MATLAB for the wavelet transform like Haar, Symlet, or Daubechies.
- Now plot the stem functions for the image that has been obtained from original and the wavelet transform image.
- The different wavelet transform like Haar , Symlet are applied .

- Plotting of the original image for DWT will be done in the last step.

Symlet Wavelet Transform

Symlet wavelets are improved version of Daubechies with an increase in symmetry. In Symlet wavelet coefficients are different than Daubechies by vanishing the moments of the function in wavelet. There are different versions (2-8) for Symlet as shown in Fig 13.For this paper Symlet version 4 is used.

w=symaux(_,sumw) (1)

is of order n with Symlet sacling filter such that

sum(w)= sumw. (2)

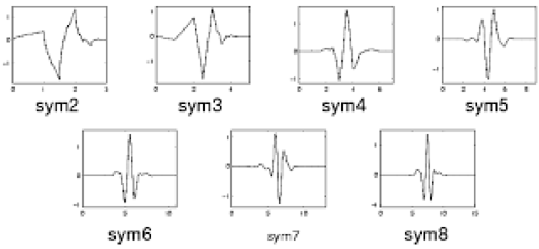

Fig 14:Symlet various versions

The feature extraction can be done as follows:

1. To find all the feature subsets which is formed from the initial data.
2. All the features must be meaningful.
3. The variations between the interclass and Intraclass should not be high.
4. The selected sets should be smaller.
5. It should be similar with patterns of the same class.

D.SEGMENTATION

Segmentation is a technique for separating or partition an image into many parts and these partitions are based on the pixels and size of the images. The segmented images are shown in Fig 15.The Cup size is measured is shown in Fig 16. The algorithm used for segmenting of fundus image into cup image and disc image is k-means clustering.

- The image is first segmented into k clusters by using k-means clustering method and output will be stored in A.

A=imsegkmeans(I,k)

- The I and k shows the centroid locations of the cluster.

[A,centers]=imdegkmeans (I,k)

- The arguments Names and values are used to control the aspects of this algorithm.

A=imsegkmeans(I.k,Names,values) (3)

Algorithm

- ➢ It reads the image into the workspace.

b=imread([pathname,filename]); (4)

- ➢ Then segmentation of images into three regions is done.

subplot(2,2,1); imshow(Red); subplot(2,2,2); imshow(Green);subplot(2,2,3); imshow(Blue); (5)

- ➢ The third step involves reducing the size of image as

RGB=imresize(RGB,0.6) (6)

- ➢ Then the image is segmented as cup boundary and disc boundary as shown in Fig 15.

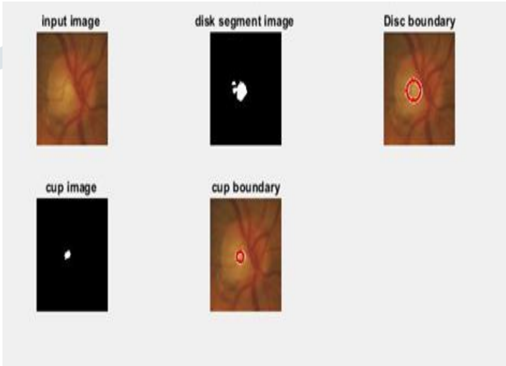

Fig 15: The segmented images

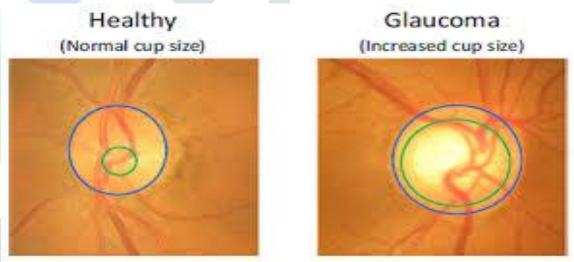

Fig 16: Cup size of healthy and Glaucoma affected eye.

E.CLASSIFICATION

Support Vector Machine can classify the data into two classes only, so Multi SVM (Support Vector Machine) is used.

- The data will be formatted first.
- Then parameters for SVM is defined as x and y.

$w=x^2+y^2$ (7)

where x and y are two classes in x , y plane.

- The cross validation of data is done.

s(x)=A(0)+sum(bi*(x,xi)) (8)

- The trained model will be applied with the SVM forecasting process and final classification will be displayed.

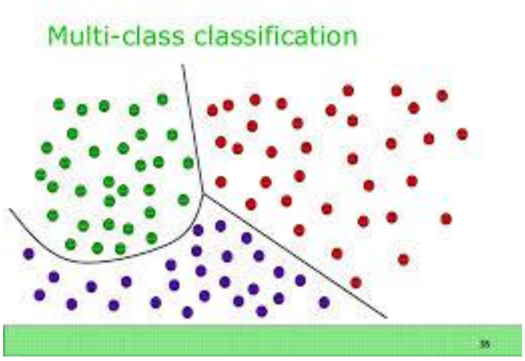

Fig 17: Multi class SVM classification

IV.RESULTS AND DISCUSSION

The proposed system detects the eye disease easily and hence Glaucoma can be detected and treatment can be given faster which results in cure of the disease at the earlier stage.

V.CONCLUSION AND FUTURE ENHANCEMENT

The presence of the cup in the disc is a strong indicator of Glaucoma, a method to detect Glaucoma was presented here by properly detecting the location of the cup. The disc segmentation was done by thresholding, the vessel segmentation was done using edge detection, and for the cup segmentation it was presented a method that uses the vessels and the cup intensities. Future work concerns to obtain a bigger dataset of fundus images to make a deeper test of the algorithm. The vessels segmentation requires an improvement due to some fails in different images and residual noise after the segmentation. The use of convolutional neural networks is part of the future work to improve the classification.

VI.REFERENCES:

[1] Mohammad Aloudat, Miad Fazipour , And Ahmed EL-Sayed, "Automated Vision-Based High IntraOcular Pressure Detection Using Frontal Eye Images",IEEE journal transactions engineering in health and medicine,20 may 2019.

[2] Yuchao Ma , Zhila Esna Ashari , Mahdii Pedram,Robert , Catena, and Hassan Ghasemzadeh, "CyclePro: A Robust Framework for Domain-Agnostic Gait Cycle Detection",IEEE sensors journal , Vol. 110, No. 10, May 15, 20110.

[3] Ganesh E., Shankar N.R., and Priya .M, "Non-Invasive Measurement of Glaucoma Disease at Earlier Stage Through GMR Sensor AH Bio magnetic Signal From Eye and RADWT Algorithm",IEEE sensors journal,2019.

[4] Muhammad Nauman Zahoor And Muhammad Moazam Fraz ,"Fast Optic Disc Segmentation in Retina Using Polar Transform",IEEE access journal , February 28, 2018.

[5] Bhupendra Singh Kirar , Dheeraj Kumar Agrawal1, "Computer aided diagnosis of Glaucoma using discrete and empirical wavelet transform from fundus images", IET Image Processing journal , 8th October 2018.

[6] Huazhu Fu, Jun Cheng, Yanwu Xu, Damon Wing Kee Wong, Jiang Liu, and Xiaochun Cao,

"Joint Optic Disc Cup Segmentation Based on Multi-label Deep Network and Polar Transformation", IEEE TRANSACTIONS ON MEDICAL IMAGING,2018.

[7] Fan Guo ,Yuxiang Mai1, Xin Zhao, Xuanchu Duan4, Zhun Fan, Beiji Zouand Bin Xie1, "Yanbao: A mobile App using the measurement of clinical parameters for Glaucoma screening",IEEE access , 2018.

[8] Huazhu Fu, Jun Cheng, Yanwu Xu, Changqing Zhang, Damon Wing Kee Wong, Jiang Liu, and Xiaochun Cao,"Disc-aware Ensemble Network for Glaucoma Screening from Fundus Image",IEEE transactions on medical imaging ,2018.

[9] Shishir Maheshwari, Ram Bilas Pachori, and U. Rajendra Acharya,"Automated Diagnosis of Glaucoma Using Empirical Wavelet Transform and Correntropy Features Extracted from Fundus Images", IEEE Journal of Biomedical and Health Informatics,2016.

[10] Malay Kishore Dutta, Amit Kumar Mourya, Anushikha Singh, M.Parthasarathi ,Radim Burget,Kamil Riha,"Glaucoma Detection by Segmenting the Super Pixels from Fundus Colour Retinal Images", International Conference on Medical Imaging, m-Health and Emerging Communication Systems (MedCom),2014.