International Journal of Recent Technology and Engineering (IJRTE)
ISSN: 2277-3878, Volume-8 Issue-3, September 2019

Design of Probabilistic Patch Based Glaucoma Detection using CDR by Optic-Disc and Optic-Cup Segmentation

Sharanagouda Nawaldgi, Lalitha Y S

***Abstract**:Denoising and Texture features (DTF) within eye images are energetically tracked for more precise and efficient classifications of different diseases in glaucoma images which are captured by very sensitive camera lens. Due to improper lens adjustment and noise usually called speckle and Gaussian noises are the major unwanted component pixels present in the image while capturing and these makes difficult for further accurate diagnosis or automatic image interpretation. To address these issues, this paper develops and demonstrates a new approach for removal of speckle and Gaussian noises using Probabilistic Patch Based (PPB) filter, which is extended version of Non Local means algorithm. The PPB filter is depends on the distribution noise model and maximum weighted likelihood estimation and these weights are training iteratively based on the both noisy patches and patches extracted similarities from the previous estimations as part the this work. In the second part, the features are extracted using Lifting Scheme DWT in terms of low and high frequencies into sub-bands and the required low frequency components are used for further analysis. Cup-to-Disc components are segmented using basic level set function and based on the values of cup and disc values, the glaucoma is affected or not is classified. Comparative analysis has made between proposed results and previously available results and it is found that the present results shows 29% is improvement in accuracy and 15% improvement in accurate identification of glaucoma.*

***Keywords** :Cup-to-Disc, DWT, Glaucoma, Filter, Speckle and Noises .*

I. INTRODUCTION

An eye disorder is the glaucoma which becomes harmful to the eye of the optic nerve and ends up exceptionally excessive over a period. It occurs because of the intraocular pressure inside the eye of the optic nerve. Because of this, Doctors can also have problem to become aware of this little irregularity eye condition. To cope with the difficulty an wavelets modified sub bands are applied to extricate the glaucoma energy levels and the algorithms MLP-BP ANN is analyzed and proposed. The three hundred images of glaucoma of each abnormal and normal eye snap shots aregrouped and also from the websites we are collected the images and these images are placed in the database in JEPG format. From the database, one of the snap is taken and applies for the detection of glaucoma. The energy levels are extricated from the image by using wavelet sub bands. The sub-bands utilized as part of our work are Biorthogonal, Symlet and Daubechies. Execution is achieved by Wavelets primarily based sub-bands using MATLAB 2017a. The average and energy values are figured from the given image and compute CDR, the CDR accommodates cropping of optic disc, segmentation and calculate of CDR. The image which is chosen is cropped from the area which we want to do the segmentation to glaucoma. The ratio of cup to disc is given as optical cup area to optical disc area. The optic disc and cup is first calculated to compute CDR. If the threshold value is greater than CDR then it is consider as glaucoma otherwise normal eye. After calculating the CDR value it is applied to the artificial neural network if classified diseases if disorder such as 1st stage, 2nd stage and 3rd stage or advanced stage.

For finding the glaucoma it consists of three methods. In the eye the pressure is increased this method we called Assessment. It is not so good to identify the disease in the starting stage; here glaucoma will occur sometimes without increased pressure. The second method is the abnormal vision of the assessment. It requires special equipment which is not suitable for screening widespread. The 3rd is the assessment of damage method to head which is reliable and requires professional trained and time consuming. It is expensive and subjective highly. Vertical elongation of optic disc is characterized as glaucoma of the optic disc, at the center white area is present called the optic disc or optic nerve head .The CDR given by the elongation but not affect the vision usually. To measure CDR the computer techniques is improved from the back of the eye of 2D images. Here algorithm technique is used the images are divided into several fragments which we will called it as super pixels and each fragment shows as a part of optic disc or optic cup. To calculate the cup to disc ratio the measurement of optical cup and optical disk are utilized to calculate the CDR. The center of optical nerves head of glaucoma a white area present this can be occur due to the extension of optic cup. The extension alters the CDR, however the vision does not effected typically.

Manuscript published on 30 September 2019
***** Correspondence Author
Sharanagouda Nawaldgi*, Department of E&CE, APPA Institute of Engineering & Technology, Kalaburagi, India. Email: sharan_yn@yahoo.co.in
Dr. Lalitha Y S, Department of E&CE , Don Bosco Institute of Technology, Bengaluru, India. Email: patil.lalitha12@gmail.com

The CDR does not alter by this extension of the cup and vision also not affected by elongation of cup. For calculating CDR the computer methods are used by two dimensional pixel of the image. The images are divided into number of fragments and load the fragments as super pixels and classifies as disc and cup. For computing CDR measurements of the optical cup and optical disc are utilized, and this is shown in Fig. 1.1.

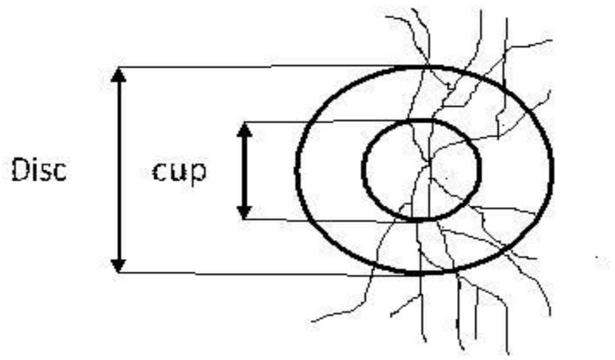

Fig.1.1. Optic disc and optic cup structure

CDR with threshold value and mathematical morphology is the method proposed in this research work. The minimum and maximum operation is based on the nonlinear image processing in mathematical operation. This is mainly aimed extracting the wanted area of the image. The main region of this is to expanding the light or dark areas, based on the size and also shapes of the structuring components. These types of morphological operations will complement the previous ones are geodesic transformations by using reconstruction of geodesic and close a hole operates is defined. In the research we find new method for finding the end result of glaucoma. In this new method we are also making use of ANN and CDR to process the fundus images. The 30 glaucoma images will be collected in which there will be normal and abnormal images of an eye and it is collected from hospital from different patients and in the data base these images are stored. The images which are stored in the database are taken to subject to the glaucoma detection system for further analysis. The input image which is selected from the database will be feed to median filter for removing noise and also to smooth the edges of the image. After filtering the image is applied to the morphological operations for identifying the radius of cup to disc. Cropped gray optic disk, segmentation and calculation are consists by the cup to disk ratio. The images which are taken is utilized for cropping the wanted area of image and do the segmentation for cropped area of image. Abirami .et.al, proposed optic disc and optic cup segmentation using region growing and men shift algorithm for glaucoma screening. A self-assessment reliability score is computed to evaluate the quality of the automated optic disc segmentation. For optic cup segmentation, in addition to the histograms and center surround statistics, the location information is also included into the feature space to boost the performance [1]. Swapna.et.al presented, a novel method is proposed, making use of a combined feature set of Fractal Dimension calculated from extracted texture feature of total fundus images and Local Binary Pattern (LBP) feature along with an efficient Regression, Neural Network decision making unit. An accuracy of 88.70 % has been obtained by the proposed system, with sensitivity of 87.20% and a specificity of 90% [2]. Sreeja Mole .et.al. addresses the various image processing techniques to diagnose the glaucoma and the corresponding images are implemented for feature extraction using five wavelet filters Daubechies (db3), Symlet (sym3) and Biorthogonal (bio3.3, bio3.5, bio3.7). Similarity method is used for classification is done by Baye's method [3]. Iyyanarappan .et.al, goal of this paper is to develop an algorithm which automatically analyze eye ultrasound images and classify normal eye images and diseased glaucoma eye images the two central issues to automatic glaucoma recognition feature extraction from the retinal images and classification based on the chosen feature extracted. Features extracted from the images are categorized as either structural features or texture features. Here, discrete wavelet transform (DWT) using Daubechies wavelet, Symlet wavelet and Biorthogonal wavelet are used to extract features [4].

Inmaculada Dópido.et.al, over the last years, many feature extraction techniques have been integrated in processing chains intended for hyper spectral image classification. In the context of supervised classification, it has been shown that the good generalization capability of machine learning techniques such as the support vector machine (SVM) can still be enhanced by an adequate extraction of features prior to classification [5]. Rahil Garnavi.et.al, these authors are presented a novel computer-aided diagnosis system for melanoma. The novelty lies in the optimized selection and integration of features derived from textural, border based, and geometrical properties of the melanoma lesion [6]. Syeda Fazilath Banu.et.al, demonstrated that Glaucoma is the diagnosis given to a group of ocular conditions that contribute to the loss of retinal nerve fibers with a corresponding loss of vision. Glaucoma is the major cause of blindness in people above the age of 40. The Intra Ocular Pressure (IOP) increases because of the malfunction of the drainage structure of the eyes leading to Glaucoma [7]. Zhuo Zhang et al. proposed a convex hull based ellipse optimization algorithm for a more accurate detection of neuro-retinal optical cup. Comparing with the state-of-the-art ARGALI system, the new approach achieves a better CDR value calculation, which results to more accurate Glaucoma Diagnosis. The good performance of the new approach leads to a large scale clinical evaluation involving 15 thousand patients from Australia and Singapore [8]. Huiqi Li et al. proposed algorithms to extract features automatically and robustly in color fundus images. PCA is employed to locate optic disk. A modified ASM is proposed in the shape detection of optic disk. A fundus coordinate system is established based on the fovea localization. An approach to detect exudates by the combined region growing and edge detection is proposed [9]. Archana Nandibewoor et al. proposed the early detection of glaucoma can be done in this method. An algorithm is proposed in such a way that any disorder found inside the eye with respect to color, an immediate action is taken. By keeping a standard color as reference, the patient's eye color is matched. If this patient's eye color is darker then the reference image then the result is displayed as positive [10]. Inoue et al. developed a glaucoma screening technique using super pixel classification on optic disc and optic cup segmentation. In optic disc segmentation, histograms were utilized to classify each super pixel as disc or non-disc.

The quality of the automated optic disc segmentation is calculated using a self-assessment reliability score. For optic cup segmentation, along with the histograms, the location information is also included to boost up the performance [11].

Bock et al. developed an automated glaucoma classification system that does not at all depend on the segmentation measurements.

They had taken a purely data-driven approach which is very useful in large scale screening. This algorithm undertakes a standard pattern recognition approach with a 2 stage classification step. In this study, various image-based features were analyzed and integrated to capture glaucomatous structures [12]. M muthu rama krishnan et al. proposed a new automated glaucoma diagnosis system using a combination of HOS, TT, and DWT features extracted from digital fundus images. The system, uses an SVM classifier (with polynomial kernel order 2), was able to detect glaucoma and normal classes with an accuracy of 91.67%, sensitivity of 90%, and specify of 93.33% [13]. Grau et al. proposed a new segmentation algorithm, depending on the expectation-maximization. This algorithm used an anisotropic Markov random field (MRF). In this study, structure tensor had been used to characterize the predominant structure direction as well as spatial coherence at each point [14]. Joshi et al. purposed an automated OD parameterization technique An OD segmentation technique is developed which works by integrating the information of local images around each point of interest in multidimensional feature space. This technique is quite robust against any form of variations found in the OD region [15]. Cheng et al. introduced a new technique for glaucoma detection based on RetCam. Wich is used in imaging modality that captures the image of irridocorneal angle. The manual grading and analysis of the RetCam image is quite a time consuming process but it gives expected output. They developed an intelligent system for analysis of iridocorneal angle images, which can distinguish between open angle glaucoma and closed angle glaucoma automatically and which consume less time and give expected result [16]. Vermeer et al. proposed a model for detecting the change in images. This methodology depends on image set of 23 healthy eyes and includes colored noise, incomplete cornea and masking is done by the retinal blood vessels. This system uses two more methodologies for tracking progression by taking up one or two follow-up visits into the account. Then they are tested on these simulated images. Both of these methods are depending on Student's t tests, anisotropic filtering and morphological operations [17].

Huang et al. developed an automated classifier based on adaptive neuro-fuzzy inference system (ANFIS) Stratus optical coherence tomography (OCT) technique was used for calculation of glaucoma variables (optic nerve head topography, retinal nerve fiber layer thickness) [18]. Hatanaka et al.Proposed a technique for detection of glaucoma utilizing a vertical cup-to-disc ratio. The proposed method tries to measure the cup-to-disc ratio using a vertical profile on the optic disc. After that the blood vessels of the disc were removed from the image. Then canny edge detection filter was used for detection of the edge of optic disc. The edge of the cup area on the vertical profile was calculated by the threshold method. as a final point, the vertical cup-to-disc ratio was found out [19]. L´aszl´o G.Ny´ul et.al, Devised a novel automated glaucoma classification technique depending on image features from fundus photographs. First at all size differences non uniform illumination and blood vessels are eliminated from the images. Then extraction of the high dimensional feature vectors is done. Finally compression is done using PCA and the combination before classification with SVMs takes place [20]. Mary et al. devised a technique for glaucoma detection where optic disc segmentation is done by pyramidal decomposition with the help of Hough transformation it guaranteed to converge though it's very sensitive to noise which carried out on the retinal images for better performance than other algorithms. They have proposed a model approach using discriminate analysis which has shown an improvement over the rest [21]. Sobi Nazi et al. proposed a system where the main technique is to identify the cup-to-disk ratio (CDR). The CDR was calculated by taking the ratio between the area of optic cup and disc.CDR > 0.3 indicates glaucoma and CDR ≤ 0.3, is considered as normal image. They examine the mean square error (MSE) pixel signal to noise ratio (PSNR) and signal to noise ratio (SNR) to quantify the performance the pre-processing algorithms [22]. Chandrika et al. adopted a technique for automated Glaucoma diagnosis. In this technique optic disk identification is performed on retinal images for calculating CDR thye first performed Thresholding then image segmentation is performed using k-means clustering and Gabor wavelet transform. Then optic disc and cup boundary smoothing is performed using different morphological features. If the CDR ratio exceeds 0.3 it indicates high Glaucoma for the tested patient [23]. The location of glaucoma for different stages, the neural network become especially gifted for ID. By the use of feed farword and backword proliferation nueral organize the neuron model was improved. The calculation is created with the use of matlab. The pictures which we acquired in emergency clinic and sites are broke down in MATLAB 2017a. For the picture preparing strategies the matlab offers assortment of choice to remove the foreordained capacities and records from the picture. To recognize on the starting phases of glaucoma the product program are used. For the identification and control of glaucoma most recent biomedical pictures advances gives successful quantitative imaging decisions. Manual assessment of eye pictures with in reason and the precision of parameter estimations changes among pros. Wavelet changes (WT) in picture is spoken to in recurrence space are utilized to the surface capacities. In WT, the substance material is the picture space.

Here, Discrete Wavelet Transformation (DWT) the utilization of Daubechies wavelet, Symlet wavelet and Biorthogonal wavelet are utilized to separate capacities. Wavelet Energy highlights is determined from those extricated capacities. PNN is used routinely to arranging and investigating pictures as typical or abnormal. K means Clustering approach is completed ultimately to discover the exudates present with in the typical eye pictures. This plan will diminish the handling time directly taken by utilizing the technologist to break down patient pictures. The standardization and highlight positioning impacts is concentrated to improve the update results. The tale capacities in our proposed work are clinically extensive and may be used to come perceive glaucoma precisely.

It tags alongside an ongoing decimation of optic nerve head (ONH) due to an expansion in intra visual weight inside eye we look at wavelet limits got from Symlet, Biorthogonal and Daubechies wavelet channel. The extricated highlight vitality gained from the use of 2D DWT were proposed in the novel procedure and send those component to include choice method and one of a kind element positioning.

It examines the living tissue non obtrusively. The glaucoma illness is caused because of glitch seepage structure of the eye. The 11.1 million patients on the planet are experiencing the sickness caused individual visual insufficiency in 2020. In the event that the entire nerve is demolished visual impairment results. The normal qualities are determined from the vertical and flat coefficients and from the point by point vertical coefficients the vitality esteems are removed. The high caliber of separated highlights of highlight determination plan decides the total capacity and the asset within the combination of arbitrary backwoods, gullible Bayes procedure, Support Vector Machine (SVM). Difference in Contrast, luminosity and brightness interior retinal a photo make it complicated to extort retinal feature and makes a difference of exudates from different brilliant features in images. Hence photo preprocessing is required in equalization of the abnormal illumination related to retinal snapshots. Each image is issue to Zscore normalization. The standard deviation one and mean of zero converts by Z score normalization to common place scale.

$$Y_{new} = \frac{Y_{old} - mean}{std}$$

The introduction of aggregation distortion avoids the Average of zero. Here the new value is the Y_{new} and the old original value is Y_{old} and Mean is the original standard deviation data range respectively. Due to the large number of nerve fibers damaged, it creates a blind spot which is leading to the loss of vision. The change in the appearance of the optic disc is one of the indicators of glaucomatous eye. The elliptical in shape is the optic disc which is orange pink color, it disappears and become pale. That is the enlargement depression called as cup and become thin in the nueroretinal rim. The devoid of the nuero retinal tissue is the pale center called cup. The CDR is 0.3 to 0.5 for normal eye and for glaucomatous eye the CDR becomes 0.8. Glaucoma risk leaving people are 5 million, in germany 800.000 peoples are suffering from te glaucomatous damages. In this multilayer neural network and vital part based by and large execution investigation is investigated. Determination of the most proper parameters, for example, scope of concealed layers, learning guidelines and move capacities are considered. The grouping results are gotten through thorough experimentation. Diabetic retinopathy is an eye fixed disorder brought about by the obstacle of diabetes and it might be identified before for successful cure. The patient vision begins decorates the diabeties advancement and provides for the diabetic retinopathy. The parameters sets portraying EEG eye informational indexes are consider. The orders of the eye status spoken to by the informational collection are conceivable. The computerized methodology is utilized for characterization of illness diabetic retinopathy exhibited by the pictures. The typical and infected ordered by the exhibitions. Testing evaluations had been situated to with the notable impacts that are imitative from the doctor's immediate examination. The states impacts check that the proposed technique might need to bring up the ability of design of another savvy help examination gadget. Result demonstrates that neural system form is additional right than the inverse NN model. These outcomes demonstrate that this model is incredible for classification of EEG eye states. The Artificial Neural Network is one the foul electronic model in light of neural structure of brain. A few issues are unique verification past the degree of PCs that are without a doughty sensible by proficient bundles of vitality. A less specialized way creates machine arrangement guarantees the copy mind. The psyche fundamentally gains as an issue of experience. It is genuine affirmation that two or three issues that are past the degrees of gift PCs are definitely resolvable by using minimal proficient vitality bundles. These strategies duplicate in addition guarantees a considerably less specific way to deal with make machine game plans. This new procedure to preparing further more gives a progressively agile insult for the term of length over-burden than its more trapped partners.

II. METHODOLOGY

In the research work a new method for finding the end results of glaucoma by making use of PPB filter and level set function for CDR segmentation to process for identification of fundus images in eye images. The 250 eye images are collected from stranded databases such as PubMed, BIOINFORMATION (Discovery at the interface of Physical and biological sciences), BIOMISA and http://pranag.physics.iisc.ernet.in/glaucoma/. In the database there are normal and abnormal images of an eye. The images which are stored in the data base are taken and subject to the glaucoma detection for further analysis. One of the input image is subjected to PPB filter for removing noise and also to smooth the edges of the image. After filtering the image is applied to the feature extraction and segmentation operations for identifying the radius of cup to disc. Cropped gray optic disk, segmentation and calculation are consists by the cup to disk ratio. The images which are taken are utilized for cropping to extract the area of image to classify the image into normal or abnormal. The first main step in this process is to read the selected images and convert those images to YIQ color space and convert it into gray scale image. The NTSC colour is converted by the m by 3 RGB value in the map by RGB2NTSC RGB map). The luminance(y) and chrominance (I and Q) of NTSC are present in the yiq map of m by 3 matrixes. Colour elements are considered as columns which is equivalent to the colour in the RGB colour map. Input image will be converted into grey scale image. RGB2grey command in MATLAB is used to RGB convert into grey scale intensity image. By eliminating saturation, hue and brightness retaining luminance the RGB images can be convert into grey scale by using the RGB2grey function. RGB to NTSC (RGB map) converted images are used applied to median filter.

A. Probabilistic Patch Based Filter

It is an patch based de-noising filter for the Additive White Gaussian Noise with the framework of weighted maximum likelihood estimation technique. In this technique denosing of the image is carried out based on the estimation function of the original image. The input image is said to be defined over the regular grid by every pixel value with its noise distribution function located as likelihood function affected by noise.

This likelihood function of noise is modelled as parametric patch based model by space varying parameter. Hence the recovered input image is assumed as the maximum likelihood estimator function with the random distribution defend by equation (1) and (2), the representation of the PPB filter functioning is as represented in Fig.1.

$$\hat{\theta}^{(MLE)} \triangleq \arg \underbrace{max}_{\theta\, s} \sum_{t \in s\theta} \log p(\{v_t|\theta_s\}) \text{ ……….(1)}$$

$$\hat{\theta}^{(WMLE)} \triangleq \arg \underbrace{max}_{\theta\, s} \sum_{t \in s\theta} w(s,t) \log p(\{v_t|\theta_s\}) \text{ ……….(2)}$$

Where,

θ_s= space varying function
W(s,t)= data driven weights an non zero factor.
This WMLE (Weighted Maximum Likelihood Estimation) is well suited to reduce the minimizing the variance of the estimation of the noise for the biased samples by forming the white Gaussian model given by

$$\hat{\theta}^{(WA)} \triangleq \frac{\sum_t w(s,t) v_t}{\sum_t w(s,t)} \text{ ……….(3)}$$

The exact removal is AWGN is done based on the exact matching of the weights for noisy patches for the exact weight normalization with the set of probabilities of the exact values of the probabilities given by

$$w(s,t)^{PPB} \triangleq p(\theta^*_{\Delta_s} = \theta^*_{\Delta_t} |\, v)^{1/h} \text{ ……….(4)}$$

Where $\theta^*_{\Delta_s}$&$\theta^*_{\Delta_t}$ represent image extract from the parameter θ*. The scheme of the probabilistic patch based filter is summarized as follows:

The proposed system of handwriting based real time user identification is as shown in Fig. 2 and its respective flow chart of operation is as represented in figure 3, the desired system is proposed for the real time identification of the user cumulatively based on the real time handwriting data compared with the existing data base of the same user which is pre-recorded. In the present designed system it is developed for the twenty different users database with different styles of handwritings are considered, which can also be extended for the required number of users. The front end of the desired system is implemented using software development kit by performing the denoising of the input image is done by Probabilistic based filter which works independently by varying the filter weights so that no information will be lost for analysis. The major classification of the handwriting based identification of the user is done by artificial neural network in which it is subjected to testing and training datasets of the user.

A. Feature Extraction Using CDR and Segmentation

CDR with threshold value and mathematical morphology is the method proposed in this research work. The minimum and maximum operation is based on the nonlinear image processing in mathematical operation. This is mainly aimed extracting the wanted area of the image. The main region of this is to expanding the light or dark areas, based on the size and also shapes of the structuring components. These types of morphological operations will complement the previous ones are geodesic transformations by using reconstruction of geodesic and close a hole operates is defined. In the research we find new method for finding the end result of glaucoma. In this new method we are also making use of ANN and CDR to process the fundus images. The 30 glaucoma images will be collected in which there will be normal and abnormal images of an eye and it is collected from hospital narayana hrudalaya and in the data base these images are stored. The images which are stored in the data base are taken and subject to the glaucoma detection. The input image which is selected from the database will be feed to median filter for removing noise and also to smooth the edges of the image. After filtering the image is applied to the morphological operations for identifying the radius of cup to disc. Cropped gray optic disk, segmentation and calculation are consists by the cup to disk ratio. The images which are taken are utilized for cropping the wanted area of image and do the segmentation for cropped area of image.

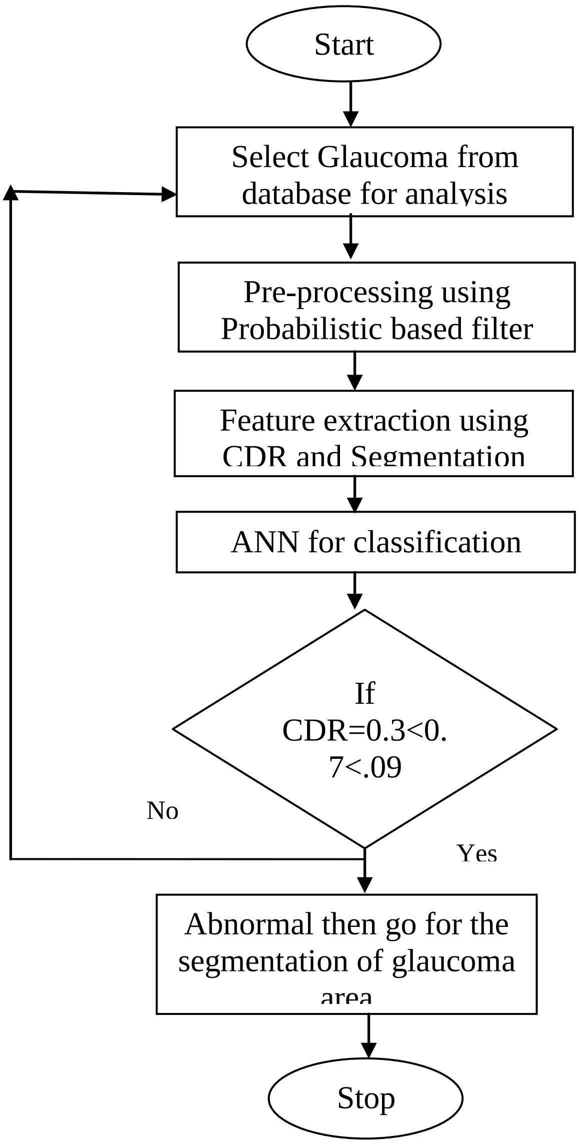

Fig. 3. Flow chart of the proposed system

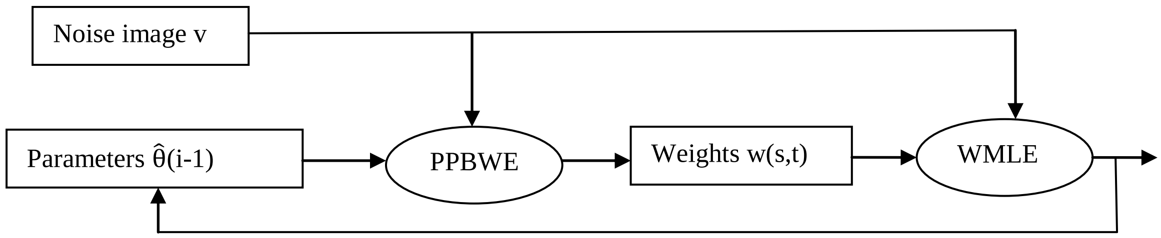

Fig. 1. Representation of Probabilistic patch based filter

PPBW= Probabilistic Patch Based Weights.
WMLE=Weighted Maximum Likelihood Estimation.

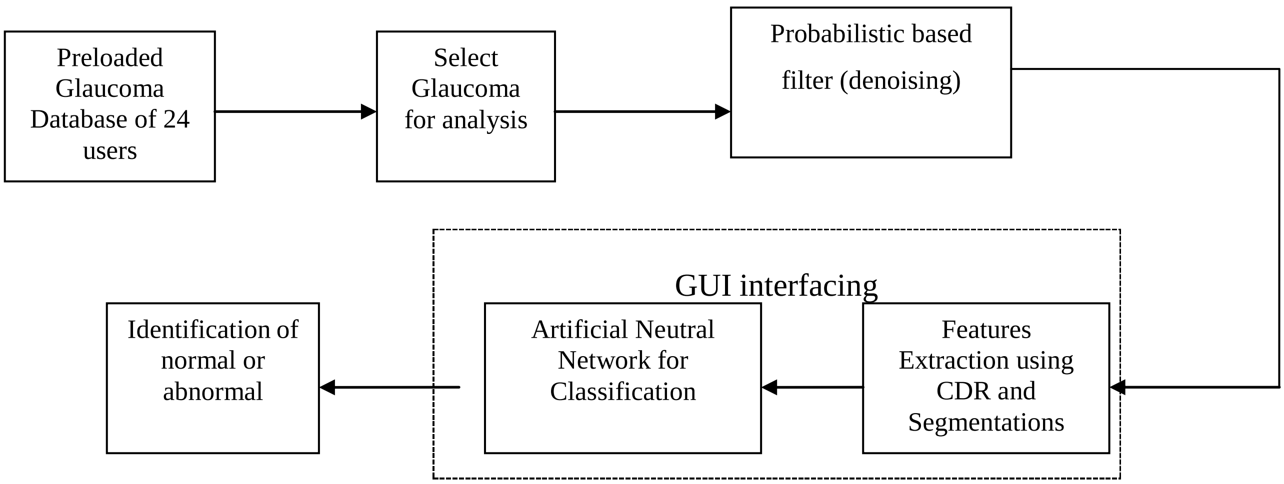

Fig. 2: Block diagram of the proposed system.

B. Conversion of image from RGB to NTSC

The first main step in this process is to read the selected images and convert those images to YIQ color space and convert it into gray scale image. The NTSC colour is converted by the m by 3 RGB value in the map by RGB2NTSC (RGB map). The luminance(y) and chrominance (I and Q) of NTSC are present in the yiq map of m by 3 matrixes. Colour elements are considered as columns which is equivalent to the colour in the RGB colour map. Input image will be converted into grey scale image. RGB2grey the colour image RGB convert into grey scale intensity image. By eliminating saturation, hue and brightness retaining luminance the RGB images can be convert into grey scale by using the RGB2grey function. RGB to NTSC (rgbmap) converted images are used applied to median filter. The normal cup to disk ratio can be calculated and compared with CDR value. If the CDR value 0.3 is consider the image is normal. If it is more than 0.3 then it is consider glaucomatous image.

CDR Ratio

The ratio of the optical cup area to the optical disc area is called CDR . The CDR is determined by the trained ophthalmologist. The CDR is very important in clinical indicator to detect the glaucoma. The CDR can be calculated as

$$\text{CDR} = \frac{\text{Optical Cup Area}}{\text{Optical Disc Area}}$$

For indicating the glaucoma CDR plays a very important role. Fragmentation can be done to optic cup and optic disc to calculate CDR. There will be a fixed threshold value if the CDR is more than threshold, then the eye is abnormal else normal. For the health eye the CDR is of 0.2 to 0.3. The Flow chart of CDR algorithms shown in Fig.6, the entering and exiting point for retina is the optic disc.

Optic Disc

The optic nerve will connect to retina that is the location point of optic disc. In the 2D fundus picture the elliptic area is the optic disc. This will be bright than it's surrounding. The orange pink color of eye will be the normal optic disk. When the color of the image is changed from orange to white it shows, the indication of the disease. The central part of the depression of variable size in the disk is defined as the optical disk and this is white in colour.in the proposed work we need to extract only boundary edge of the image which can be classified into three groups on the Centre of optical disk and it is performed by achieving the k means clustering of the edge of the image.

Retrieval Number: C5683098319/2019©BEIESP
DOI:10.35940/ijrte.C5683.098319
Journal Website: www.ijrte.org

Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication

International Journal of Recent Technology and Engineering (IJRTE)
ISSN: 2277-3878, Volume-8 Issue-3, September 2019

C. Extraction of Optic disc and cup by morphological operation

To find Glaucoma, Finding of cup to disc ratio plays an important role, which can be done by extracting of OD and OC. First, the cropping is done for fundus image and is resized. In the second step removel of blood vessels from the images are done. Equation 6 and 7 defines the erosion and dilation operation. Dilation operation shows the grown in size by adding pixel values to the boundary in the image. Using structuring elements dilation is done. The dilation operation fills the internal gaps and lighten the blood vessels, but by increase in size the OD effects the CDR ratio. After dilation erosion operation is done by the same structuring elements and size. For the contrast of the boundary of the object erosion is done. The result is smoothening of the image without any blood vessel.

$$A \oplus B = \bigcup_{b \in B} A_b \qquad 6$$

The A by B is eroded given by

$$A \odot B = \bigcup_{b \in B} A_{-b} \qquad 7$$

Where A: binary image

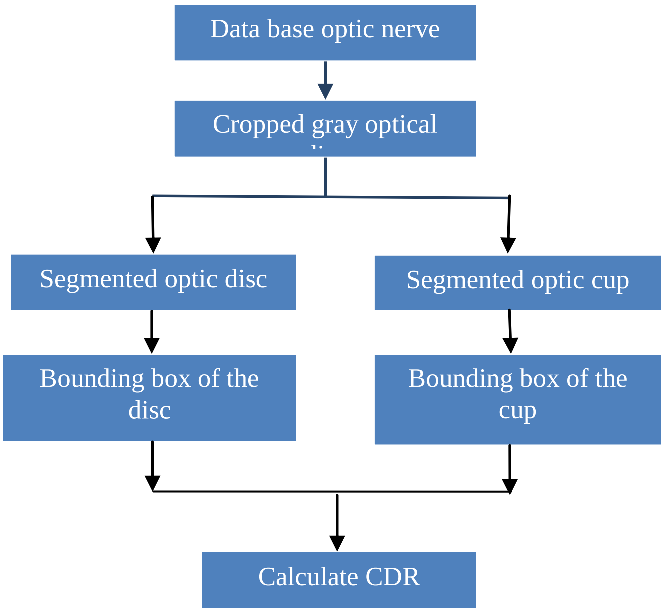

Fig.7. Flow chart algorithm of CDR

In the Fig. 8. Load the image and converted into gray scale image.to enhance the contrast of image and to smoothen the edges of the image histogram equalization is done. Filtering is applied to the image which removes the noise. After getting clarity of the image we do the segmentation for the required area of cup and disc region. Here the bounding boxes of the cup and disc region are done for finding out the extra part of glaucoma. We do the morphological operation for reconstruction of image by dilation and erosion. After finding out of the cropped region of optic cup and disc do the segmentation and calculate the cup to disc ratio. The CDR value compare with glaucoma image and images of eye.

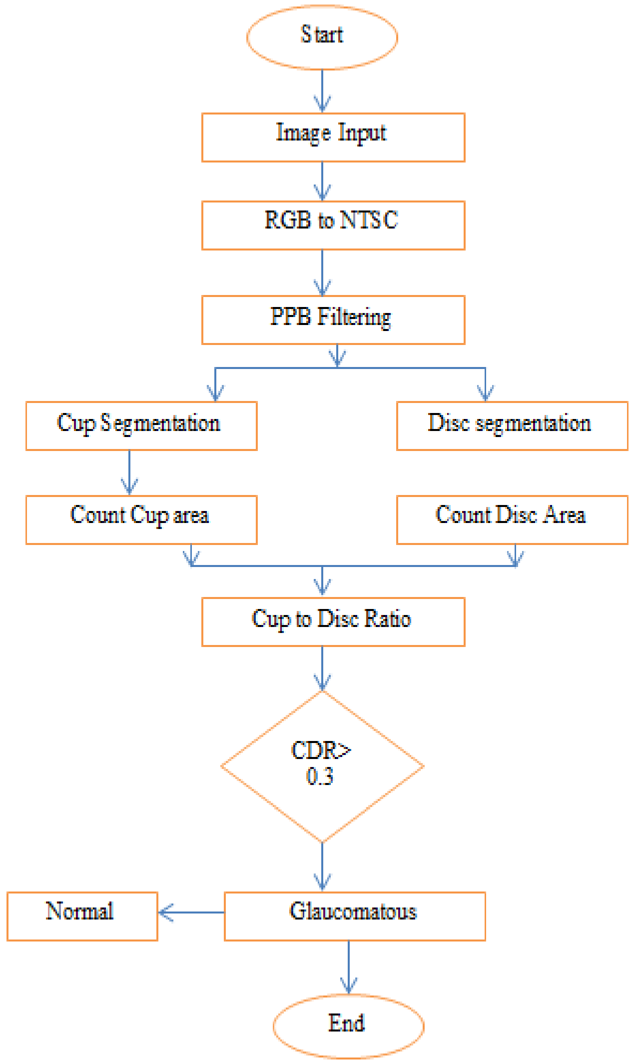

Fig.6.Flow chart for identification of Glaucoma and its Segmentation

Table 1 Cup to Disc ratios of the selected comparison of threshold and CDR

Input image	Threshold	Area of cup	Area of disk	CDR
25	0.62	502.25	980.125	0.5124
25	0.625	495.875	980.125	0.4692
25	0.63	433.375	980.125	0.4422
25	0.635	402.5	980.125	0.4107
25	0.64	383.75	980.125	0.3915
25	0.645	372.125	980.125	0.3797
25	0.65	358.125	980.125	0.3654
25	0.655	344.375	980.125	0.3514
25	0.66	334.75	980.125	0.3415
25	0.665	331.375	980.125	0.3381

Retrieval Number: C5683098319/2019©BEIESP
DOI:10.35940/ijrte.C5683.098319
Journal Website: www.ijrte.org

Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication

Threshold value compare with CDR value shown in figure below

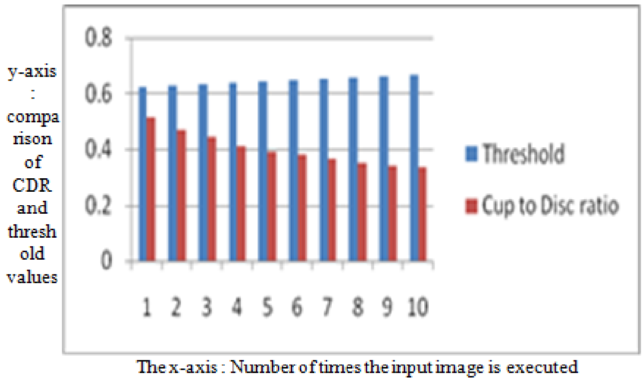

Fig.9. Cup to disc ratio various threshold of sample

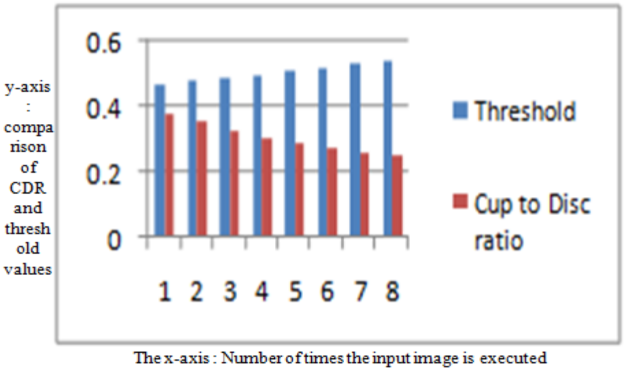

Fig.10. Cup to disc ratio various threshold of different sample

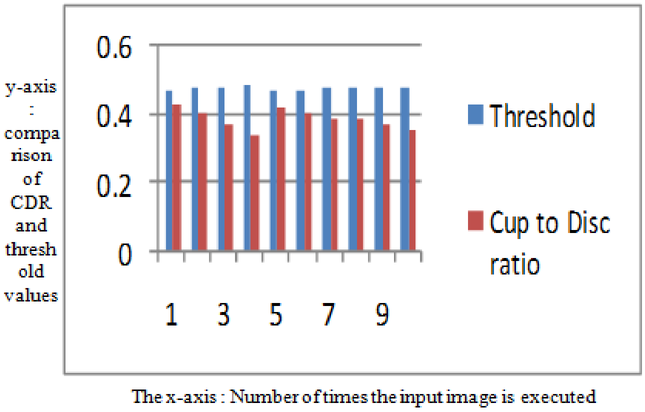

Fig. 11 Cup to disc ratio various threshold of sample

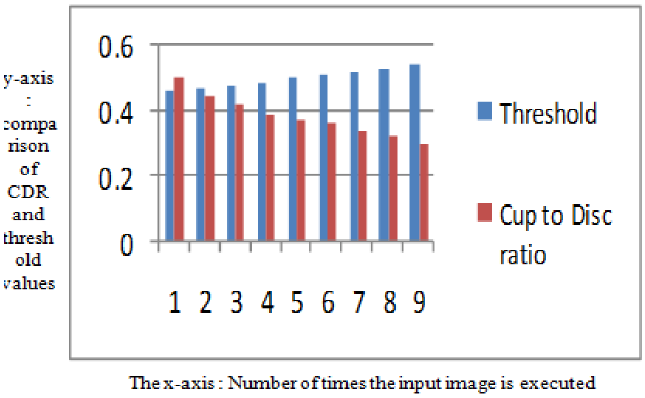

Fig. 12 Cup to disc ratio various threshold of sample

Fig. 9 to 12. (a), (b), (c) and (d) shows comparing the graph CDR with different threshold values.

Table 2 Cup to Disc ratios of the database input images and comparison of existing techniques for normal images

Database images	Area of cup	Area of disk	CDR	Technique previous(CDR)
1	269.25	835.875	0.3222	0.4010
2	367.75	1133.875	0.3243	0.3822
3	264.875	759.625	0.3487	0.5258
4	261.87	749	0.3298	0.5252
5	262.88	753	0.3258	0.5256
6	286	924.875	0.3092	0.3945
7	287.62	944	0.30469	0.3052
8	284.87	1044.75	0.2727	0.3229
9	273.25	1264.62	0.2161	0.3696
10	216.75	939.625	0.2306	0.4436
11	293.87	1192.5	0.2464	0.3784
12	206.5	982.25	0.2010	0.3298
13	187.62	1107.37	0.1694	0.3320
14	199.75	1057	0.1889	0.2796
15	205.87	707	0.2912	0.2914

Table.3 Cup to Disc ratios of the database input images and comparison of existing techniques for abnormal images

Database images	Area of cup	Area of disk	CDR	Technique previous
1	569.25	1134.375	0.5081	0.4932
2	557.75	749.75	0.7439	0.5822
3	558.125	905.375	0.6145	1.0569
4	653.25	808.75	0.8077	0.5432
5	324.75	884.375	0.3672	0.3980
6	363.375	903	0.4024	0.4025
7	328	815.875	0.3850	0.5688
8	476.125	827.875	0.5752	0.6653
9	569.25	1134.375	0.5018	0.4932
10	557.625	749.75	0.7439	0.5822
11	396.625	890.5	0.4454	0.3892
12	285.875	695.625	0.4109	0.3542
13	313.75	800	0.3922	0.3414
14	413.25	767.125	0.5387	0.4438
15	428.625	956.625	0.4480	0.4559

Table 2 and 3 shows the results of previous technique; here thresholding can be done for the required region of the image and Disc area kept constant. By comparing the CDR value with threshold value the result is not good comparing present technique and present technique result are shown in table 5.2 and 5.3.the image normal data set and image abnormal set consists of the cup to disk ratio present in the table 5.2 and 5.3.here results are compared with the previous technique and present technique. Thresholding the region can be done and compared the CDR value with threshold value by keeping the area of disk constant for the same i/p image is done in the previous technique.in the present technique measuring can be done by keeping the structuring element on cup area and disk area and do the segmentation for wanted area which will gives more accuracy of the result compared to previous technique.

Better accuracy we got from the simulation results when compared to the previous result and proposedresearch work is designed using GUI in mat lab 2017a and is depicted in Fig to identifies the glaucoma and its fundus image.

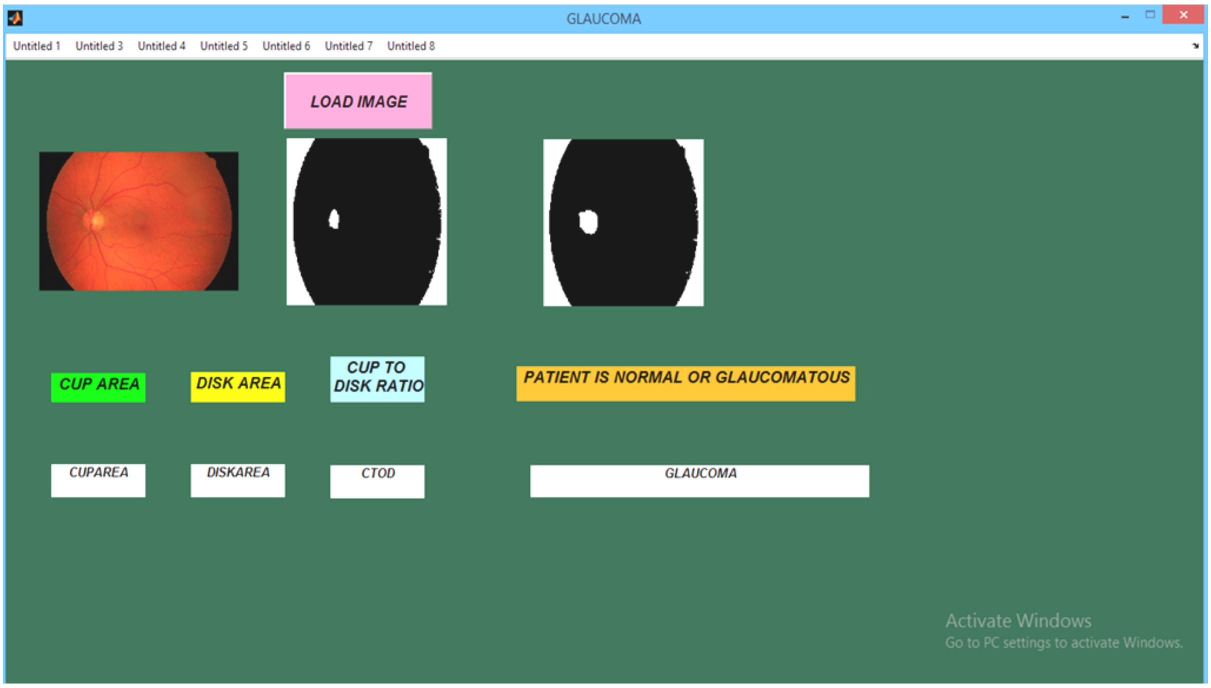

Fig.13. Initial glaucoma detection for initial GUI window

Inthe figure5.19 shows the initial GUI window for proposed glaucoma detection system, the area of cup, area of disk, ratio of cup to disc and patient is normal or glaucomatous are shown in the GUI window.

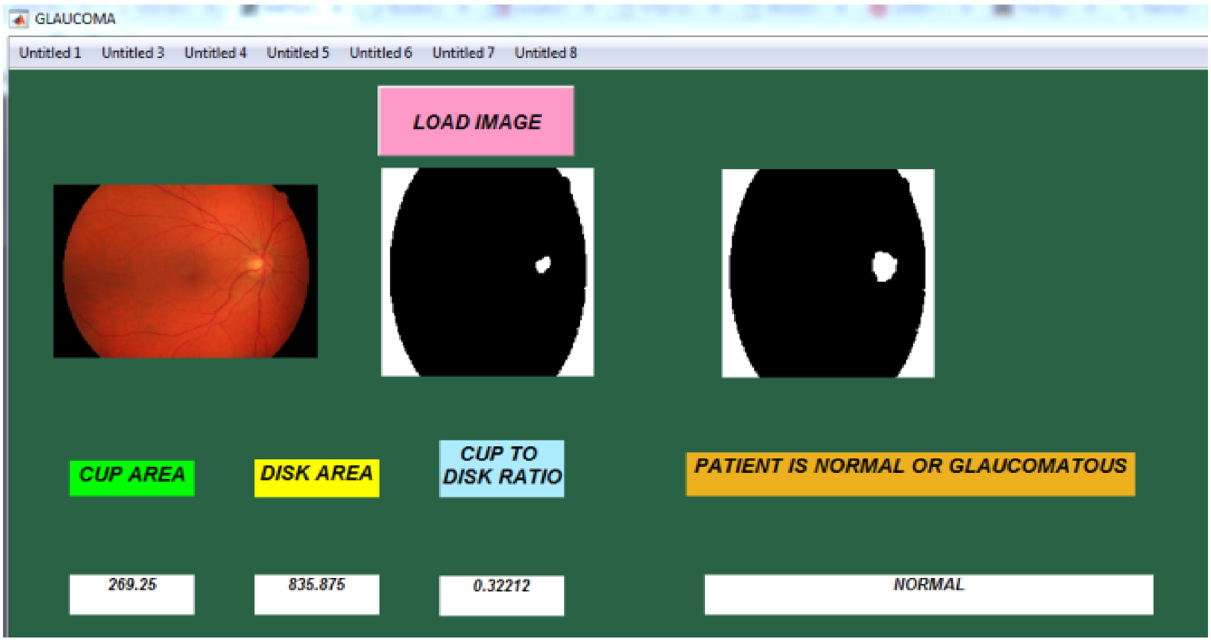

Fig.14. Loading the image from database and its area RoI to measure the CDR ratio

Fig.14 shows loading the image from database and its area RoI to measure the CDR ratio. The normal image will be chosen as a input from our the data base connected to GUI window a normal image is chosen are shown in the figure5.20 the output of normal image are 269.25,836.876 and 0.32212 gives the area of the cup, area of the disk and ratio of cup to disk respectively..

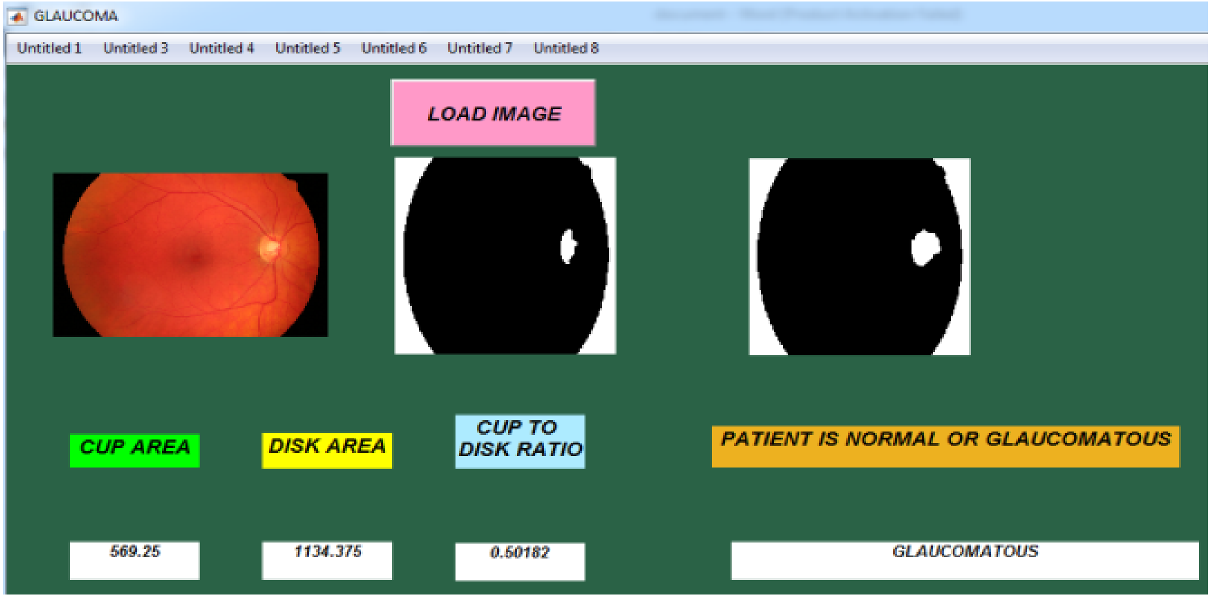

Fig.15. RoI to measure the ratio CDR and detection of glaucomatous or normal

The abnormal image will be chosen as a input from our the data base connected to GUI window a glaucomatous image is choose are shown in the Fig.15. The output of abnormal image are 569.25, 1134.375 and 0.5081 gives the area of the cup, area of the disc and ratio of cup to disc respectively.

III. CONCLUSION

The images which are stored in the data base are taken and subject to the glaucoma detection. The input image which is selected from the database will be feed to median filter for removing noise and also to smooth the edges of the image. After filtering the image is applied to the morphological operations for identifying the radius of cup to disc. RGB2grey the color image RGB convert into grey scale intensity image and RGB2NTSC convert the RGB to NTSC colour space. The Cropped gray optic disk, segmentation and calculation are consists by the cup to disk ratio. The filtered image will be applied for the morphological operations to extract the cup to the disc areas. The normal cup to disk ratio can be calculated and compared with CDR value. If the CDR value 0.3 the consider the image is normal. If it is more than 0.3 then it is consider glaucomatous image. Table 5.1 shows the results of previous technique, Here thresholding can be done for the required region of the image and Disc area kept constant. By comparing the CDR value with threshold value the result is not good comparing present technique and present technique result are shown in table 5.2 and 5.3.the image normal data set and image abnormal set consists of the cup to disk ratio present in the table 5.2 and 5.3. Here results are compared with the previous technique and present technique. Thresholding the region can be done and compared the CDR value with threshold value by keeping the area of disk constant for the same input image is done in the previous technique. In the present technique measuring can be done by keeping the structuring element on cup area and disk area and do the segmentation for wanted area which will gives more accuracy of the result compared to previous technique. Better accuracy we got from the simulation results when compared to the previous result and proposed research work is designed using GUI in MATLAB 2017a and is depicted in Fig..15 to identify the glaucoma and its fundus image.

Acknowledgment. We would like to express our sincere gratitude and deep regard to Poojya Dr. Sharnbaswappa Appaji, President, Sharanabasveshwar Vidya Vardhaka Sangha, Chancellor, Sharnbasva University, Kalaburagi, for his immense support and encouragement. We would also like to give our sincere gratitude to Dr. Niranjan Nisty, Vice-Chancellor, Sharnbasva University,Dr. V D Mytri, Pro-Vice Chancellor, Sharnbasva University, Dr. Anilkumar Bidve, Registrar, Sharnbasva University for their invaluable suggestions and support. We thank Dr. Pradeep Reddy, Dr. Rohit Patil for providing us the clinical insights of glaucoma.

REFERENCES

1. P.K ABIRAMI1, Prof. T.K. GANGA2 , Prof. I. ANETTE REGINA3, Prof. S. GEETHA4, "NEURAL NETWORK BASED CLASSIFICATION AND DETECTION OF GLAUCOMA USING OPTIC DISC AND CUP FEATURES", International Journal of Scientific Research Engineering & Technology (IJSRET), ISSN 2278 – 0882 Volume 4, Issue 7, July 2015.
2. Swapna P.P.1, and Mini M.G, "A Regression Neural Network based Glaucoma Detection System using Texture Features", Int'l Journal of Computing, Communications & Instrumentation Engg. (IJCCIE) Vol. 3, Issue 2 ,ISSN 2349-1469 EISSN 2349-1477,2016.
3. Dr. S.S. Sreeja Mole, Prathu.P.T , Sreesankar.J, "Diagonization Of Glaucomatous Images Using Wavelet Transforms", International Journal of Advances in Engineering, Science and Technology (IJAEST), 2016
4. A. Iyyanarappan, G.Tamilpavai, "Glaucomatous Image Classification Using Wavelet Based Energy Features And PNN", INTERNATIONAL JOURNAL OF TECHNOLOGY ENHANCEMENTS AND EMERGING ENGINEERING RESEARCH, VOL 2, ISSUE 4 , 85 ISSN 2347-4289 ,Copyright © 2014 IJTEEE, 2014.
5. Inmaculada Dópido, Alberto Villa, Antonio Plaza, Paolo Gamba, "A Quantitative and Comparative Assessment of Unmixing-Based Feature Extraction Techniques for Hyperspectral Image Classification", IEEE JOURNAL OF SELECTED TOPICS IN APPLIED EARTH OBSERVATIONS AND REMOTE SENSING ,VOL.5 ,NO.2, APRIL2012.

6. Rahil Garnavi, Mohammad Aldeen, and James Bailey, "Computer-Aided Diagnosis of Melanoma Using Border- and Wavelet-Based Texture Analysis", IEEE TRANSACTIONS ON INFORMATION TECHNOLOGY IN BIOMEDICINE, VOL. 16, NO. 6, NOVEMBER 2012
7. Syeda Fazilath Banu and Chandrashekar M Patil2 1Vidyavardhaka College of Engineering, "Retinal Abnormality Detection Using Artificial Neural Network",Proc. of Int. Conf. on Current Trends in Eng., Science and Technology, ICCTEST,2015.
8. Zhuo Zhang, Jiang Liu, Neetu Sara,Cherian, Ying Sun, Joo Hwee Lim, Wing Kee Wong,Ngan Meng Tan, Shijian Lu, Huiqi Li, Tien Ying Wong" Convex Hull Based Neuro- Retinal Optic Cup Ellipse Optimization in Glaucoma Diagnosis" 31st Annual International Conference of the IEEE EMBSMinneapolis, Minnesota, USA, September 2-6, 2009.
9. Huiqi Li, Opas Chutatape" A Model- Based Approach for Automated Feature Extraction in Fundus Images" Proceedings of the Ninth IEEE International Conference on Computer Vision (ICCV 2003) 2-Volume Set 0-7695-1950- 4/03 $17.00 © 2003 IEEE.
10. Archana Nandibewoor S B Kulkarni Sridevi Byahatti Ravindra Hegadi" Computer Based Diagnosis of Glaucoma using Digital Fundus Images" Proceedings of the World Congress on Engineering 2013 Vol III,WCE 2013, July 3 - 5, 2013, London, U.K..
11. Inoue, Kenji Yanashima, Kazushige Magatani, Takuro Kurihara, Naoto, "Development Of A Simple Diagnostic Method For The Glaucoma Using Ocular Fundus Pictures", in the Proceedings of the 2005 IEEE Engineering in Medicine and Biology 27th Annual Conference Shanghai, China, September 1-4, 2005.
12. R¨udiger Bock, J¨org Meier, Georg Michelson, L´aszl´o G. Ny´ul, and Joachim Hornegger, "Classifying Glaucoma with Image-Based Features from Fundus Photographs", DAGM 2007, LNCS 4713, pp. 355–364, 2007. Springer-Verlag Berlin Heidelberg 2007.
13. M muthu rama krishnan, oliver faust "Automated glaucoma detection using hybrid feature extraction in retinal fundus images" Journal of Mechanics in Medicine and Biology Vol. 13, No. 1 (2013) 1350011 (21 pages) °c World Scientific Publishing Company DOI: 10.1142/S0219519413500115.
14. Vicente Grau, J. Crawford Downs, and Claude F. Burgoyne, "Segmentation Of Trabeculated Structures Using An Anisotropic Markov Random Field: Application To The Study Of The Optic Nerve Head In Glaucoma", IEEE Transactions on Medical Imaging, Vol. 25, No. 3, March 2006. Pg.: 245.
15. Gopal Datt Joshi, Jayanthi Sivaswamy,"Optic Disk and Cup Segmentation From Monocular Color Retinal Images for Glaucoma Assessment", IEEE Transactions On Medical Imaging, June 2011, pp. 1192-1205.
16. Jun Cheng, Jiang Liu, Beng Hai Lee, "Closed Angle Glaucoma Detection in RetCam Images", IEEE Proceedings of the 32nd Annual International Conference, Sep 2004, pp 4096-4099.
17. Koen A. Vermeer, Frans M. Vos, Barrick Lo,"Modeling of Scanning Laser Polarimetry Images of the Human Retina for Progression Detection of Glaucoma", IEEE Transactions On Medical Imaging, May 2006, pp. 517-528.
18. Mei-Ling Huang, Hsin-Yi Chen, Jian-Jun Huang: "Glaucoma detection using adaptive neuro-fuzzy inference system", Expert Systems with Applications 32 (2007) 458–468.
19. Yuji Hatanaka, Atsushi Noudo, Chisako Muramatsu, Akira Sawada, Takeshi Hara, Tetsuya Yamamoto, Hiroshi Fujita: "Vertical cup-to-disc ratio measurement for diagnosis of glaucoma on fundus images", Medical Imaging 2010: Computer-Aided Diagnosis. Proc. of SPIE Vol. 7624, 76243C.
20. L´aszl´o G. Ny´ul: "Retinal image analysis for automated glaucoma risk evaluation". MIPPR 2009: Medical Imaging, Parallel Processing of Images, and Optimization Techniques. Proc. of SPIE Vol. 7497.
21. M. Caroline Viola Stella Mary, B. Jainudhin Sudar Marri: "Automatic Optic Nerve Head Segmentation for Glaucomatous Detection using Hough Transform and Pyramidal Decomposition", International Conference on Recent Trends in Computational Methods, Communication and Controls (ICON3C 2012) Proceedings published in International Journal of Computer Applications (IJCA).
22. Sobia Nazi, Sheela N Rao: "Glaucoma Detection in Color Fundus Images Using Cup to Disc Ratio" The International Journal Of Engineering And Science (IJES) Vol. 3 Issue 6 Pages 51-58, 2014.
23. S.Chandrika, K. Nirmala "Analysis of CDR Detection for Glaucoma Diagnosis", International Journal of Engineering Research and Applications (IJERA) ISSN: 2248-9622. NCACCT-19 March 2013.

AUTHORS PROFILE

Sharanagouda Nawaldgi is pursuing his PhD in the area of Automated glaucoma detecion using Image processging from the Visvesvaraya Technological University, Belagavi. He is currently working as Assistant Professor in the department of E&CE, APPA Institute of Engineering & Technology. His area of interest include Image Processing, Medical Image processing, Image Segmentation, Neural networks, Deep learning. Machine Learning

Dr. Lalitha Y S received Ph.D degree from VTU Belagavi in 2013. She is currently working as Professor in Don Bosco Institute of Technology, Bengaluru, guiding 7 research scholars. She is Fellow member of IETE, Life member of ISTE, member of TIE. Her research interests include image Processing, Wavelet Transform coding. She attended manyNational and International Conferences, published 36 International Journal papers. She is the Reviewer for many National and International conferences.