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Early Stage Glaucoma Detection in Diabetic Patient

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Abstract: ***The photograph of the funds of the retina is widely used in the diagnosis and treatment of various eye diseases such as diabetic retinopathy, cataract and glaucoma. Normally funds image are classified manually by clinicians trained in time and process resources. Segmentation imaging of the eye provides an important role in the calculation the shape and size of the optic disc and the anterior segment and the abnormal growth of any geometry in the eye region. It automatically and precisely calculates the values of location, position and contour area and a structural part of the image required by ophthalmologists. But these segmentation methods suffer from many problems such as the optimization, and initialization inadequate in noisy images results. Segmentation in medical imaging is difficult for researchers. In this research work tried to locate the most important region of the eye optic disc and optic cup using a Based on morphological operations. The optic disc is the area on the retina optic nerve axons that enter and leave the eye. The proposed work consists in steps in first step the image pre processing is done using morphological operations and the second step is segmentation optic disc and optic cup by using the morphological operations. These operations are minimizing errors detection limit of the optic disc due to blood vessels cross. Then find the cup to disc ratio using these operations. The normal cup to disc ratio is 0.3 if they increase then patients are glaucoma patient and if they decrease then those are normal patients.***

Keywords: Glaucoma Detection, Optic Disc Segmentation, Optic Cup Segmentation, Cup to Disc Ratio, Morphological Operations.

I. INTRODUCTION

Diabetes is often referred to as diabetic. In this disease the person has hyperglycemias (blood sugar), production of insulin is insufficient and body cells do not produced insulin to properly both. Many people suffer from Diabetes and they have many eyes problems like Diabetic Retinopathy, Cataract and Glaucoma. The Glaucoma is the most common cause of blindness Glaucoma is a disease that occurred in whole the world and their cause of a permanent blindness. According to WHO (World Health Organization) glaucoma is the third leading cause of blindness. Glaucoma was named the "sneak thief of sight" because the vision is loss a long time. In this disease the optic nerve is permanently damaged and cannot be recovered.

The optic nerve is a blind spot and they can destroyed a vision is permanently. They can transmit the message to the eye from the brain. Once a nerve is damaged then eye side and vision and can never be recovered. Glaucoma is a third leading cause of blindness in world in especially those people that suffer from diabetes. The Glaucoma is not a cured but progression is slow down by a regular treatments. Many countries more than 85% patients are unaware this condition .The Glaucoma have a many sign and symptoms and vision loss and blindness. The three methods are used to detect the glaucoma first is the Assessment of raised intra ocular pressure second is the Assessment of abnormal vision loss and third is the Assessment of the damaged Optic nerves. The glaucoma having an intraocular pressure when this intraocular pressure is increased and blood sugar in increased then the level of glaucoma is also increased.

The intraocular pressure is used in the eye. Tonometrs are professional eye care method used to determine this intraocular pressure. Most are Tonometrs pressure measured in millimeters of mercury (mmHg). Normal range of pressure is 15 mmHg. These blood vessels are very important part of the circulatory system in body. They are using to transfer blood to whole the body. In which the arteries are used to carry blood from the heart. And the Capillary that are used to exchange of water and chemicals between the bloods and then the tissues and veins they are used to carry blood capillaries back to the heart.The optic disc or optic nerve head is presented in that location where ganglion cell axons exit from the eye there are no roads and cones .This is known as a blind spot. It is the starting point of entrance in which the main blood vessels are entered. Optic nerve having a 1 to 2 million of neurons. Average dimensions of optic disc are 1.76 mm to 1.92 mm high. The Optic Cup is the center of the Optic Disc. The optic Cup is a white cup like area in the centre of the optical disk. The ratio of the size of the optic cup on the optical disc (disc cup ratio) is measured to diagnose glaucoma. Normal cup disc ratio is 0.3. If more than it suggests glaucoma. The Cup to Disc Ratio is the important indicator are used to detect the glaucoma .The normal Cup to Disc Ratio is 0.3 if the Cup to Disc Ratio is less than this ratio then the patients are normal patients and if the Cup to Disc ratio is more than this ratio then patients are glaucoma patient.

The existing techniques such as Multi-thresholding Segmentation to detect the optic cup, optic disc and Cup to Disc Ratio (CDR) but the problem is that the CDR is complex process due to unclear color texture between the optic cup and optic disc . In this Super pixel Classification technique in which the segmentation of cup, optic disc and cup to disc ratio but the problem is that the cup boundary at the nasal side of the cup is often difficult to be determine due to the presences of blood vessels. In optic disc detection is difficult due to poor visibility of optic cup with in the optic disc and the nervous architecture surrounding the optic cup boundary challenged the final output. In this level set component analysis the segmentation of optic disc and optic cup is more challenging due to a cup's inter weavement with blood vessels and surrounding tissues. In which Gabor wavelet transform the cup boundary at the nasal side of the cup is often difficult to be determined even manually due to the presence of blood vessels.

The Morphological Operations are using in this research work the mathematical morphology is a nonlinear image processing methodology based on minimum and maximum operations whose aim is to extract the relevant structures of an image. Their purpose is to expand the light or dark regions respectively according to the size and shape of the structuring elements. The morphological operations are used to first segment the optic disc to detect and smooth their boundaries and then detect optic cup and smooth their cup boundaries. Then these morphological operations are using to find cup to disc ratio. These operations are using to enhance the cup and disc boundaries to remove the blood vessels then cup to disc ratio can be detected and better results performed. Firstly these operations are using to detect optic disc the detection of optic disc is very difficult task. Then the optic disc is detected the segmentation of those detected part and region of interest can be obtained and particular area is detected. Then cup is detected and smooth their cup boundaries. Find the cup to disc ratio the normal cup to disc ratio is 0.3 if they increase then the patients are glaucoma patients and if they decrease then the patients are normal patients.

II. Related Work

Burana. C et.al [9] "Image Processing Techniques for Glaucoma Detection Using the Cup disc ratio". The ratio of the size of the optical cup of known ratio optic disc cup disk. To calculate the ratio of disc cup non-stereographic funds from the retina picture. The two methods using a method of edge detection and a control method are proposed variational level. Component analysis of color and cut method sets the threshold level are evaluated. The 44 retinal images are used to obtain from the hospital mettapracharak, Nakhon Pathom Thailand and find out the cup to disc ratio. The limitation of this technique is that is that the proper performance is not evaluated and the cup and disc segmentation is not proper due to the presence of blood vessels these blood vessels are detected and obtained by an inpaintaing. The training technique of the machine will be applied to find the correct setting.

Chandrika.S et.al 2013 [8] "Analysis of CDR Detection for Glaucoma Diagnosis". To segment the image of the camera fund colors and calculate the characteristics of optical disk segment and k-cup technical means clustering of pixels and Gabor wavelet transform. Image segmentation is followed by a description of the region and feature extraction. The limitation with the cup and disc segmentation is the visibility limit is generally not a good reason to blood vessels. If the ratio exceeds 0.3 CDR, it is a sign of glaucoma patients tested.

Cheng. J et.al [4] "Super pixel classification Based Optic Disc and Optic Cup Segmentation for Glaucoma Screening". This optical disk and optical manufacturing paper cup segmentation according to the classification of super pixel to screen for glaucoma. Segmentation methods are proposed in a 650 images in dataset with an optic disc and optic cup. Segmentation of the optic disc and cup are used to calculate the ratio of disc cutting in patients with glaucoma. But the main challenge in cup segmentation is to determine the cutting limit when pallor is low. Limitation of this study is that the cutting limit on the nasal side of the cut is often difficult to determine because of the presence of blood vessels.

Deepak S. K. et. al [2] "Automatic Assessment of the Macular Edema from Color Retinal Images". This method is used for the detection and classification of the DME color to backgrounds in images. This DME detection is too performed by a supervised learning approaches are using to the normal funds images. Performance is measured in available dataset. Performance has sensitivity 100% and specificity is between 74% and 90 %. This supervised learning is applied to normal patients. Where in no need for pretreatment and post-treatment to manage the false alarm in iris color pictures.

Fuller R.A.et.al [18] "Segmentation of the Three-dimensional Retinal Image Data". It is used in a combination between in two the volume visualization and the analysis of data to be better diagnose and to treat this diseases that occurred in retina .Apply this techniques to visualizing the 3D images in Retina. This plan is to create the training data that are used to applied to the several volumes that eliminating the needs to keep the SVM in patients. This method is very fast and desired results in ten minutes. These improvements are used over the application of the machine learning past the segmentation process. Most of the disadvantages of this method are that the SVM classifies some bad voxels resulting dispersed noise.

Godse.A.G et.al [21] "Automated Localization of Optic Disk in Retinal Images". This paper presents an automated system for locating an OD and center in all types of retinal images. Images of local databases are collected from eye clinics. It is able to locate its center in OD and 98.45% of the cases tested. The results obtained by different algorithms can be compared when the algorithms are applied to the same standard databases. The precise registration of retinal images can still be used for the detection of retinal image and super-resolution change.

Gopal datt Joshi et.al [5] "Optic Disc and Cup Segmentation from Monocular Color Retinal Images for Glaucoma Assessment". OD automatic parameterization technique based on the regions of segmentation and DO cup obtained from monocular retinal images. The segmentation method in which the cup and boundaries are detected by experts in glaucoma defected images. This method was evaluated in normal and abnormal images that are defected by glaucoma and not defected. The qualitative and quantitative results obtained show the effectiveness both in segmentation and after the setting of the OD for the evaluation of glaucoma. The limitation of this method is that the ambiguity in the 2-D images these images are extended in 3D images.

Kande B.G. et.al [23] "The Segmentation of Exudates and Optic Disc in Retinal Images". Both approaches are effective to the detection of optic disc and automatic extraction of exudates in the optic disc in funds eye images. The location of optic disc is composed of into three steps. To estimate the center of the optic disc by finding points this is the maximum local variance are used. In this Morphology that are used color space for laboratory homogeneous region of optic disc. This method is tested on the normal retinal images but this work is tested on abnormal retinal images this is pending. The principal component analyses are used to find the center of the papilla. The proposed method is using 92.53% accuracy to locate the optic disc position .This process is classifying into two classes the exudates and non-exudates classes in segmentation process.

Kavitha D et.al [25] "Automatic Detection of Optic Disc and Retinal Exudates in Retinal Images". Fast and reliable and effective to detect the optical disk and exudates on the bottoms of retinal images method. The product of the three steps is the algorithm through first segmentation of a blood vessel using morphological operations and median filtering and detecting the focal point by adjusting the blood vessels data using least square polynomial curve fitting algorithm, the second is the extraction of light through regions thresholoding several levels including the optical disc and exudates, and the third is the determination of optical disc between the brightest regions of the fact that the point of blood vessels converging optical disc and notes another label light exudates region. . This method has been tested on normal retinal images, abnormal. This method can be used for the determination and classification of the severity of diseases of the eye after the macula is located in the queue.

Lalonde.M et .al [29] "Fast and Robust Optic Disc Detection Using Pyramidal Decomposition and Hausdorff -based Template Matching". Wherein the two procedures use a pattern matching the technique that is based on the Hausdorff-board edge and a pyramidal decomposition for tracking objects in a large scale. Both approaches are that is tested on a database of the images 40 as well as normal and young pupils. Detection which indicates that it is a difficult level detector must identify the position of OD and shape. The approach separately has very good chances to find the contour of OD, so the center of fast and reliable OD. It fails on the image where OD contour is very diffuse.

Lowell J. et .al [31] "Optic Nerve Head segmentation". The algorithm used in the segmentation process and localization of the optic nerve head in which the structured that are analysis in the retina that can use in this eye diseases such as diabetic retinopathy. Optic nerve head segmentation by active contours has not been studied in detail in the past and the problem is that the long edges of distracters blood vessels and pallor. Edge detection algorithm for general use often fails to segmentation of optic disk by the fuzzy boundaries, inconsistent to image that can improve the contrast and detect the edge features. This is used in segmentation of the low-resolution images in the optic nerve head. The algorithm is evaluated in a 100 images of a screening program in this diabetes disease. In which the ten images were using to classify the unusable in variable quality. The limitation of this document they evaluate the method for detecting the rim glaucomatous images.

Manjiri. P.B et.al [33] "Detection and Counting the Micro aneurysms Using Image Processing Techniques". This process of algorithm first three steps is preprocessing operations on high-resolution frames per second fund for the detection of micro aneurysms, morphological operations funds High resolution images and enhancement techniques such as histogram equalization and the transformation function of the intensity and the third is the segmentation to find the limits of microaneurysms.Performance extract of this algorithm is tested in using 245 funds based image data.

Morales et.al [3] "Automatic Detection of Optic Disc Based on PCA and Mathematical Morphology". This method is used to find the region of interest and then segmentation of the optic disc from the funds images. This is used in to find the contour using the extraction method of the optic disc in which the mathematical morphology and with this principal component analysis are using. It makes use of various generalized function of the distance, the transformation of watersheds, river basins and stochastic geodesic transformation operations. The purpose of the use of PCA is to get the image to grayscale, which represents the original color like RGB. This technique is implemented in five public databases. This is very effective method to work correctly and to improve the results.

Noor .M.N et.al [6] "Optic Cup and Disc Color Multi- thresholding Segmentation". The technique is used to segment the optic cup and the optic disc using several colors threshold find Cup disc (C / D). The optic performance of the optic disc and cup color using multi-thresholding segmentation was evaluated and compared to each other. Segmentation of optic disc and optical measuring cup. The 27 funds the images were segmented with success and cup disc ratio are calculated. The results presented herein indicate that the features are clinically significant in the detection of glaucoma. The limitation of this technique is that the detection ratio of the cup disk is not clear because of the presence of blood vessels.

Preeti .P.J et.al [10] "Review of Image Processing Technique for Glaucoma Detection". Techniques image processing to detect eye diseases include image registration, image fusion, image segmentation, feature extraction, image enhancement, morphology, filtering, image classification, analysis and statistical measures. Optical disc and cup is segmented using various techniques like Hough transform, k-means, fuzzy c-means, active contour method, the matched filter approach, elbows vessels, morphological operations etc. Then CDR is calculated and the classification is made to determine whether the condition of the eye is normal or glaucoma.

Shijian Lu et.al [7] "Accurate and Efficient Optic Disc Detection and Segmentation by a Circular Transformation". Circular Transformation circular is used to design and captures the Optic Disc. Each pixel with a maximum variation along segmentation is determined. The accuracy of the optic disc detection is 99.75%, 97.5% and 98.77% from ARIA dataset is very similar to the prior method 14-29 pixels from the art. The proposed technique needs only about 5 s for detection of both the principal and the segmentation and the other state of most methods of the art must 2 to 4.5 min to perform the optic disc the detection

Tan.M.N et.al [39] "Mixture Model – based Approach for Optic Cup Segmentation". This method can propose an approach to segmentation of the optic cup that is based on the Gaussian mixture models. This algorithm was tested on SIMES database in 71 images. This approach can improve the performance of 8.1% in the cup area and 14.1% of the difference of two areas cup area and disc area. This method is used in the segmentation of this process.

III. NEED AND SIGNIFICANCE

The Detection of Glaucoma is plays a significant role since it allows timely treatment to prevent major visual field loss. The diagnosis of glaucoma can be done through measurement of CDR (cup to disc ratio).The cup to disc ratio is evaluated by this Super pixel Classification technique, The problem is that the cup boundary at the nasal side of the cup is often difficult to be determine due to the presence of blood vessels. And this Multi- Thresholding segmentation in which cup to disc ratio is detected but the problem is that the detection CDR measurement process is complex due to the unclearly defined color texture between the optic cup and optic disc. The OD boundaries cannot clear due to the presences of blood vessels. The perfect segmentation is difficult to due to the complexity of funds images their high number of elements. In this work Mathematical Morphology operations are used to overcome this problem and to detect better cup to disc ratio.

IV. PROPOSED METHODOLOGY

Glaucoma Detection using Region based Property

Step 1**:-** Detection of Area of Optic Disk (A_disk).

- Take a colored Image (I).
- Separate the all three components of Image (i.e. Red, Green and Blue).
- Select the Red Component of Image and Remove the mean values of image from each pixel.
- As the Optic Disk is brighter than the surroundings, convert it to Binary Image using im2bw function.
- Remove small Objects from this Binary Image using bwareaopen function as we know that Optic Disk will have the largest area among them.
- Fill the holes inside using imfill function.
- Smoothen the boundary of Disk and calculate the area using region props function.

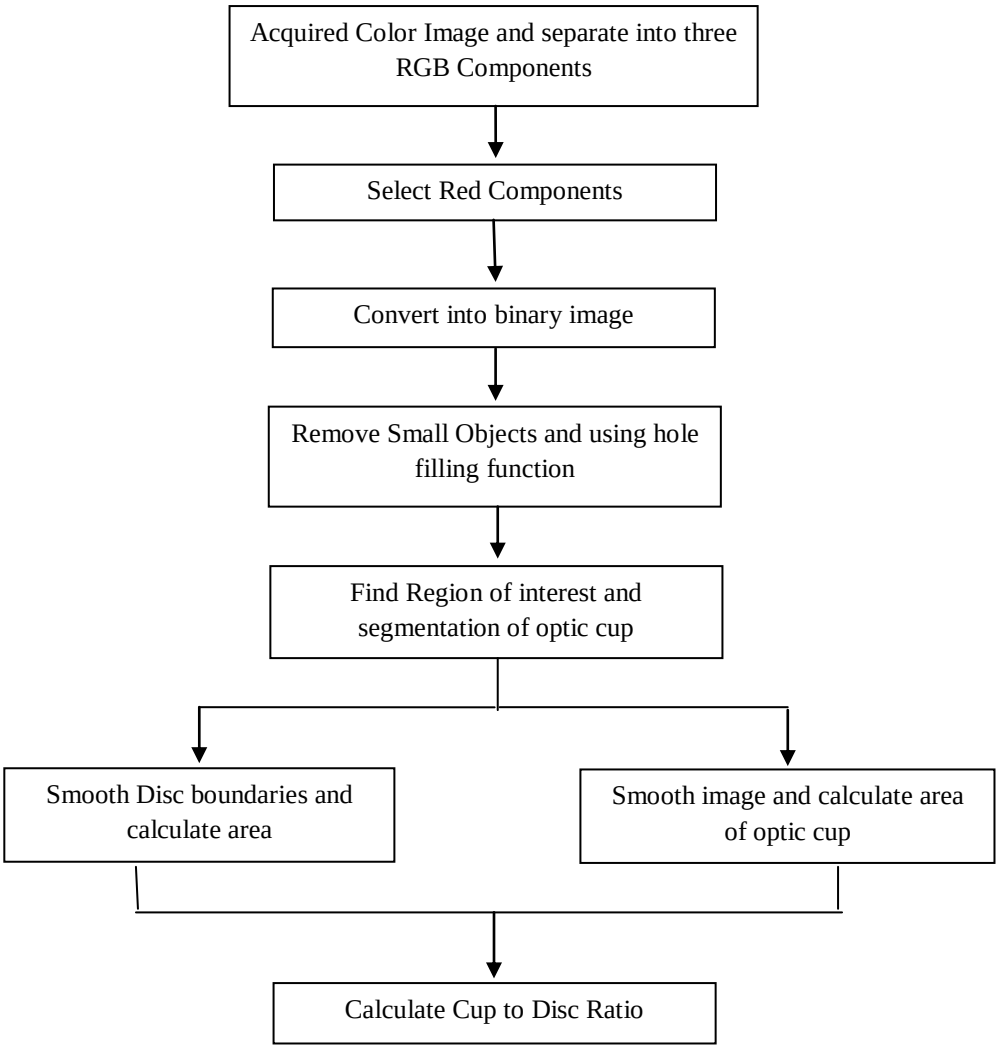
Step 2:- Detection of Area of Optic Cup (A_cup).

- Convert the segmented Optic Disk to L*a*b color space.
- Do the thresholding and get the Temporal Region of Cup.
- Do the Vertical Symmetry of above got image.
- Smoothen the image and calculate the area using region props function.

Step 3:- Calculate Cup to Disc Ratio

- Calculate the Cup-to-Disk Ratio (R=A_cup. /A_Disk).
- If R > Threshold (say Threshold=0.33), Image is Glaucomatous.
- Else Image is Normal.

CDR= Cup height/Disc height



V. RESULT AND DISCUSSION

In which the detection and segmentation of optic disc and optic cup is using from various morphological operations and then calculates the cup to disc ratio from the glaucoma patient and normal patient . If the cup to disc ratio is above 0.3 then those patient are glaucoma patient and if they decrease then those patient are normal patient. The Cup to Disc Ratio is finding out in this work from the glaucoma patient and normal patient and check the level of disease if the disease is high then Cup to Disc Ratio is high and if the disease is low then the Cup to Disc Ratio is low.

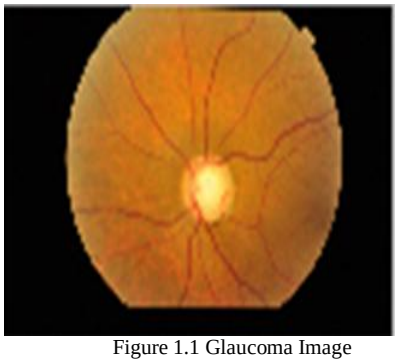


Figure 1.1 Glaucoma Image

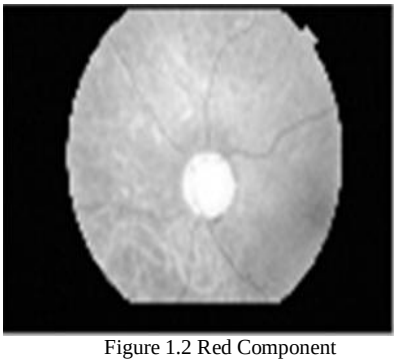


Figure 1.2 Red Component

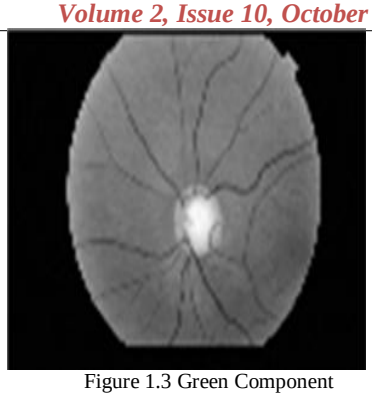


Figure 1.3 Green Component

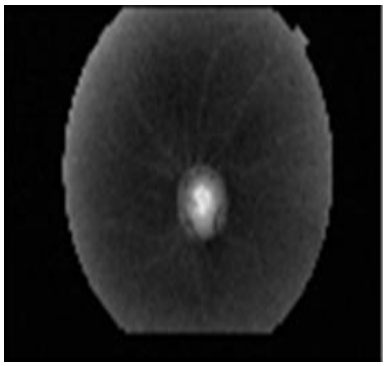


Figure 1.4 Blue Component

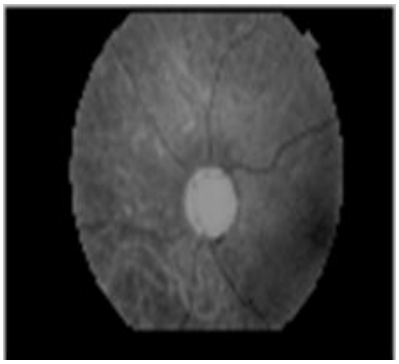


Figure 1.5 Red Component after

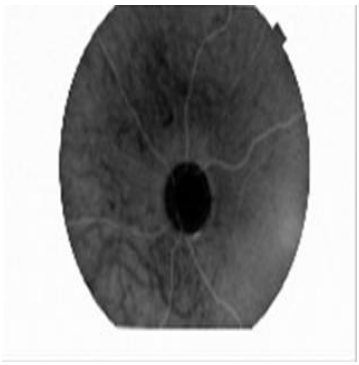


Figure 1.6 reverse image of red Components

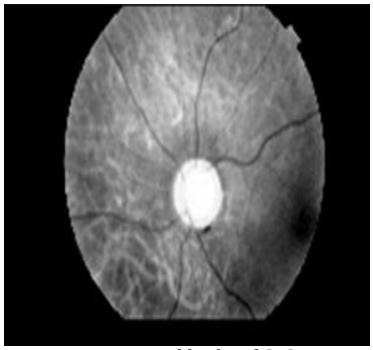


Figure 1.7 Neighborhood 3*3 Mean

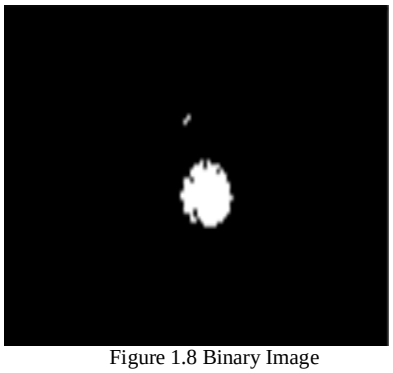


Figure 1.8 Binary Image

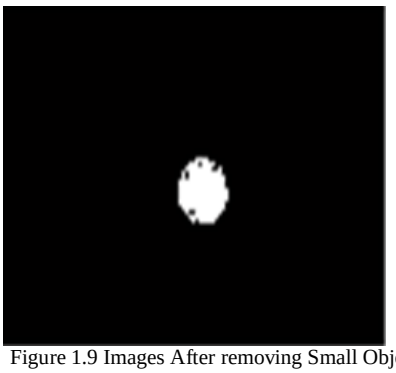


Figure 1.9 Images After removing Small Objects

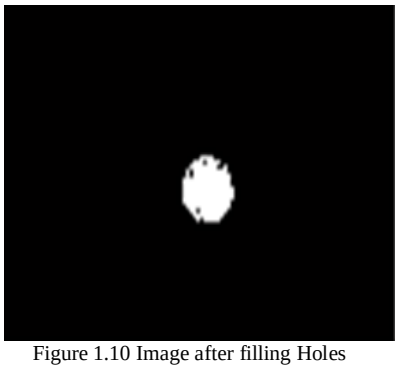


Figure 1.10 Image after filling Holes

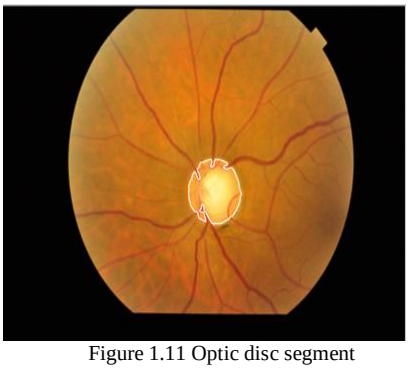


Figure 1.11 Optic disc segment


Figure 1.12 Mask of Optic Disk

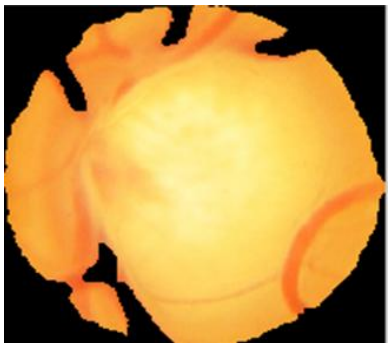


Figure 1.13 Segmented Optic Disk


Figure 1.14 Optic Disc

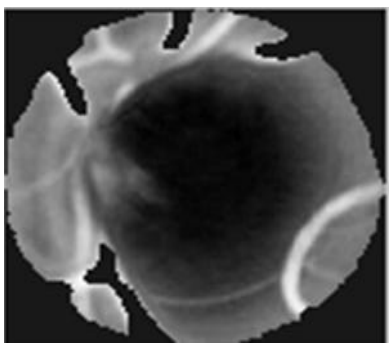


Figure 1.15 Color Space

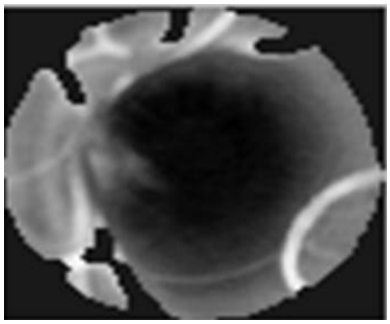


Figure 1.16 Open Image

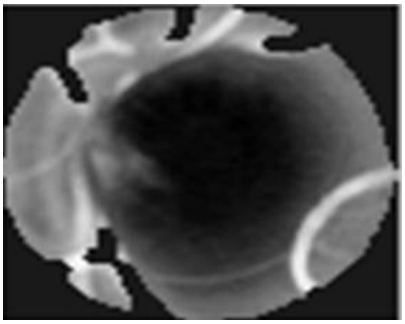


Figure 1.17 Normalized Image


Figure 1.18 Binary Image


Figure 1.19 Region of Cup

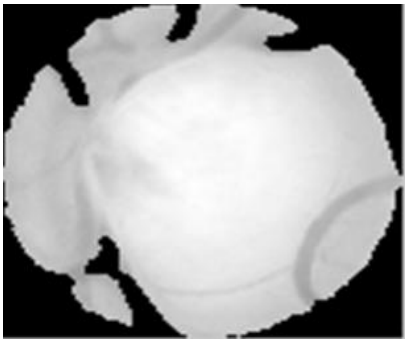


Figure 1.20 Color Space l

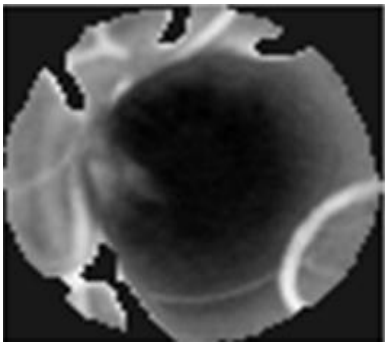


Figure 1.21 Color Space a

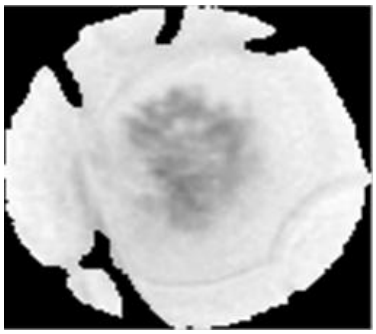


Figure 1.22 Color Space b

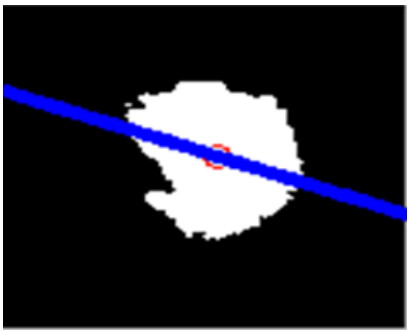


Figure 1.23 Minor Axis

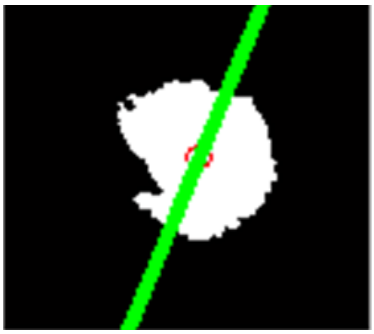


Figure 1.24 Major Axis

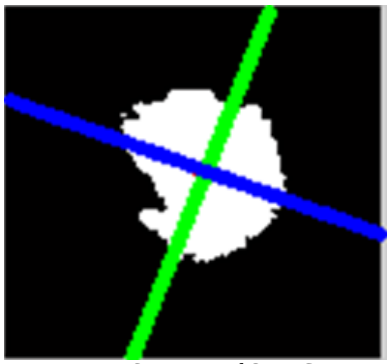


Figure 1.25 Symmetry of Optic Cup

Figure 1.26 Glaucoma Image

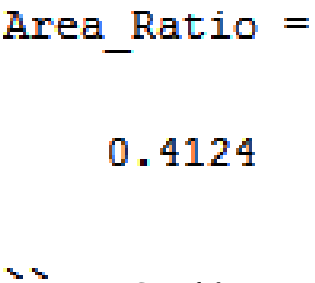


Figure 1.27 CDR of glaucoma Image

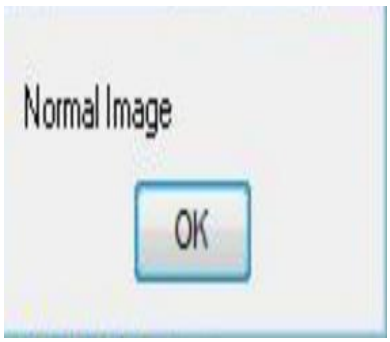


Figure 1.28 Normal Images

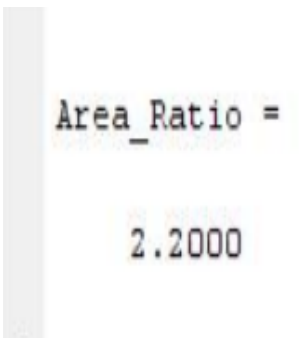


Figure 1.29 CDR Normal image

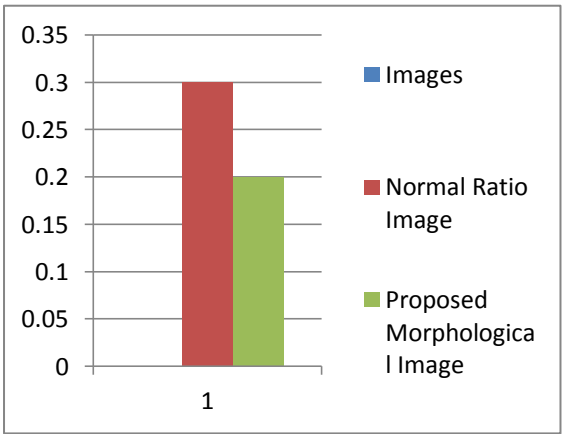
Table 1-Normal Patients

Images	CDR(Cup to Disc Ratio)
Normal Image Ratio	0.3
Proposed Morphological Image	0.2000

Table 2- Glaucoma Patients

Images	CDR(Cup to Disc Ratio)
Hospital Image	0.5
Proposed Morphological Image	0.4124

Graph 1 Glaucoma Patient



Graph 2 Normal Patient

VI. Conclusion

The Optic Disc segmentation is very important task to detection and diagnosis the Glaucoma. The detection of optic disc is very difficult task. In this work firstly to detect the optic disc and then segmentation is applied on Optic Disc and Optic Cup by using the morphological oprtaions. Then calculates the CDR (cup to disc ratio). The cup to disc ratio is an important indicator in the presence of glaucoma in diabetes patients. In this work the segmentation of optic disc, optic cup and smooth their boundaries by using morphological operations. The mathematical morphological is a non linear image that is based on minimum and maximum operations these aim to extract the relevant structures of an image .These operations are efficient to detect the cup to disc ratio in glaucoma patients and normal patients and then check the level of disease. If the cup to disc ratio is more 0.3 then those patients are glaucoma patients and if the disc ratio is less than those are normal patient. This operation has been tested on different funds images.

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