EARLY DETECTION OF GLAUCOMA USING SVM

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***Abstract*— Glaucoma is the retinal disorder which is leading cause for blindness. Glaucoma is classified into two types namely open angle glaucoma and closed angle glaucoma. Earlier detection of glaucoma will prevent the vision loss. Parameters involved in assessing glaucoma are intra ocular pressure (IOP), visual field and cup- to-disc ratio (CDR). Glaucoma causes an increase in CDR value, thus affecting the peripheral vision loss. With the help of Image Processing techniques, CDR values can be estimated. These CDR values can be used to detect the presence of Glaucoma. There are a number of common image processing techniques involved such as pre-processing, feature extraction and classification. The classifier used below is Support Vector Machine (SVM) because the process is simple and accuracy is so high, performance is very good.**

***Keywords:* Glaucoma, CDR, Features, SVM, Classification.**

1. INTRODUCTION

The human eye is the organ which gives us the sense of sight. The eye allows us to see and interpret the shapes, colors and dimensions of objects in the world by processing the light they reflect or emit. Retina places a major role in the human vision system. The retina gets affected by diseases called glaucoma which is leading cause for blindness.

1.1 Glaucoma

Glaucoma is an eye illness. It affects eye's optic nerve after which it deteriorates. Due to this, there is a development of weight at the interior of eye.

This Causes harm to the optic nerve. If this is not cured at the early stage, glaucoma can cause complete blindness.

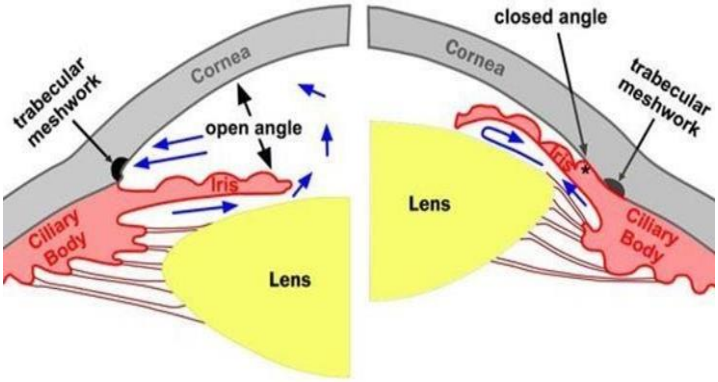

Fig 1: Open and close angle glaucoma

1.2 Types of Glaucoma

Glaucoma is of two main types:

1. Open-angle Glaucoma
2. Angle Closure Glaucoma

1.2.1 Open-angle Glaucoma

It is the most common type and is also called as wide-edge glaucoma. The trabecular meshwork (channel structure in eye) looks normal, but liquid doesn't stream out like it should

1.2.2 Angle Closure Glaucoma

This type of glaucoma is also known as acute glaucoma or narrow angle glaucoma. It is much rarer and is very different from open-angle glaucoma in that the eye pressure usually rises very quickly.

2. PROPOSED GLAUCOMA DETECTION SYSTEM:

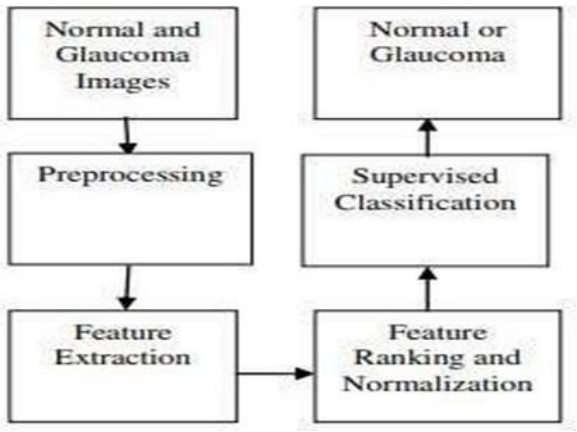

FIG 1.3: PROPOSED SYSTEM

Preprocessing:

Pre-processing is usually done before the main processing of the image. It is normally done to remove unwanted portions of the image to be processed. This helps in improvement of the image.

Feature Extraction:

Feature extraction helps in extraction of the region of interest which is represented for further processing.

Optic Cup Segmentation:

The segmentation of Optic Cup is quite challenging because of density of blood vessels covering parts of cup and gradual change in color intensity between rim and the cup. Sometimes the kinks present in the blood vessels help in detection of cup boundaries.

Optic Disc Segmentation:

Optic Disc is considered as one of the most fundamental part of retinal image. The detection of Optic Disc is considered as a pre-processing component in various methods of image segmentation of retinal images. It is a most common step in retinal image screening procedures. The Optic Disc is of vertical oval (elliptical) shape. It is divided into two separate zones: central zone (cup) and peripheral zone. Presence of Glaucoma is indicated by the variations in color, shape or depth of Optic Disc.

Cup to disc Ratio:

The CDR calculation is used in optometry and ophthalmology to detect the glaucomamovement. There is a region called optic circle which belongs to anatomical area of eye's "vulnerable side". The "vulnerable side" is the region where the optic vein and nerve enters the retina The CDR ratio deals with the space between the cup a part of the optic circle and therefore the width of optic plate. The high value of CDR infers the risk of Glaucoma.

Classification:

This is an important step in which the decision is made. The classifier used here is SVM (Support Vector Machine) which is a simple classifier are supervised learning models with associated learning algorithms that analyse data used for classification and regression analysis

2. LITERATURE REVIEW

1) Juan Carrillo [1] This Paper concluded 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.
2) Khan F [2] This Paper we designed and implemented an algorithm to identify Glaucoma. The novel method uses

Morphological Techniques to extract major features of glaucoma.

3) Vahabi Z [3] this paper we have investigated methods to automatically extract OD from images taken from diabetic patients with no dilated pupils. The work is based on wavelet transform for pre-processing on green component and feature selection for coarse segmentation. These features are intensity, gradient, color and entropy which select with some morphological operations fine segmentation is of 2 basal features to precise identification of OD. The performance of the algorithm is measured against ophthalmologist's hand-drawn ground- truth. Accuracy is used as the performance measurement of OD detection because it combines true positives and false positive rates.
4) R. Manjula Sri [4] the algorithm has been tested with DRIVE data set and clinical images. 94% of the images tested matched with the ophthalmologist's reports. The objective of developing this simple embedded system is to provide screening system for identifying retinal diseases at low cost.
5) Carlos M. Treviso [5] the efficient technique to detect glaucoma is proposed in this paper. In order to classify the input fundus image as glaucoma tic or healthy, two different ocular parameters, cup to disk ratio and rim to disk ratio are considered. Adaptive image threshold technique is used to segment optic disk and optic cup which makes the proposed method independent of image quality and invariant to noise.
6) Maya M Jeyaraman [6] Tele glaucoma is beneficial to offering services in underserviced regions and rural areas. It considerably reduces patient access times and cycle times. The time required for service is shorter than in-person examination and physician commitments are reduced. As a result, tele glaucoma saves costs to patients and costs to the health care system as a whole.

3. FLOW DIAGRAM:

The image to be processed is obtained as a raw image. The region of interest is extracted from the input image. The region of interest in glaucoma detection is Optic disc and cup. These are used in the estimation of CDR values. Based on the CDR values, the input image is classified as Normal eye or Glaucoma affected eye.

There are a number of methods available in image processing. The techniques utilized in detection of glaucoma are Image Enhancement, Image Segmentation, Feature extraction, Morphology, etc.

Degeneration of optic nerves causes Glaucoma. Therefore, the fall in cardiovascular system to the nervous optics accommodate the field of vision surrenders related with glaucoma.

Morphological features of fundus images are often wont to detect the damage caused to nervous optics

1. Cup-to-disc ratio (CDR)
2. Ratio between area of blood vessels in inferior- superior side and the nasal-temporal side
3. Ratio of distance between the optic disc center and optic nerve head to diameter of the optic disc

The main parts involved in detection of glaucoma are Optic Cup and Optic Disc. Image Segmentation process is carried out for Optic Cup and Optic Disc. This helps in calculation of CDR (cup-to-disc) value. Changes in CDR

value are viewed because the significant sign of glaucoma

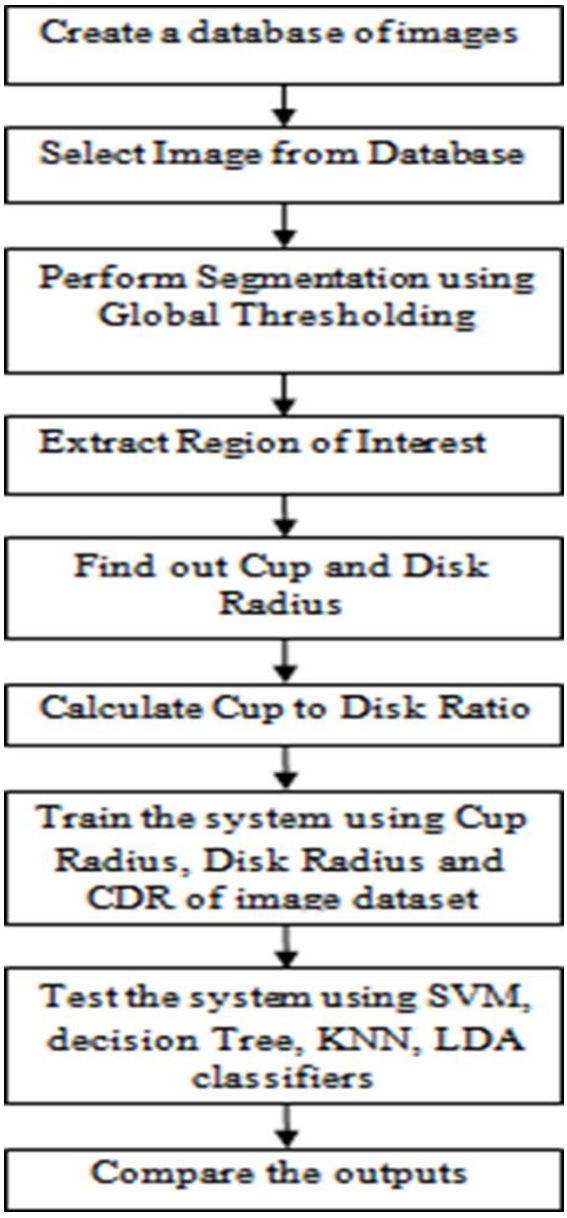

Fig 2.1 Flow Chart of The Proposed Method

4.OUTPUT DESCRIPTION:

4.1 Input Image Acquisition:

The below images are the pictures given as input to detect the presence of Glaucoma.

Fig 4.1: a) Glaucoma affected eye b) Normal eye

From the above image, the glaucoma is detected and therefore the corresponding disk segment image, disc boundary, cup image and therefore the cup boundary is identified

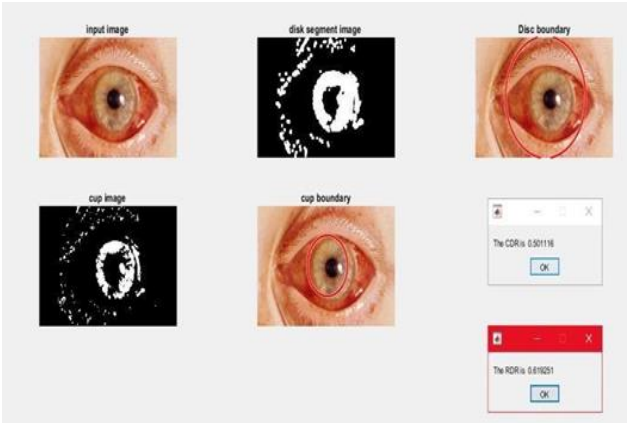

Fig 4.2 Image with Glaucoma

Glaucoma are often detected using the subsequent features,

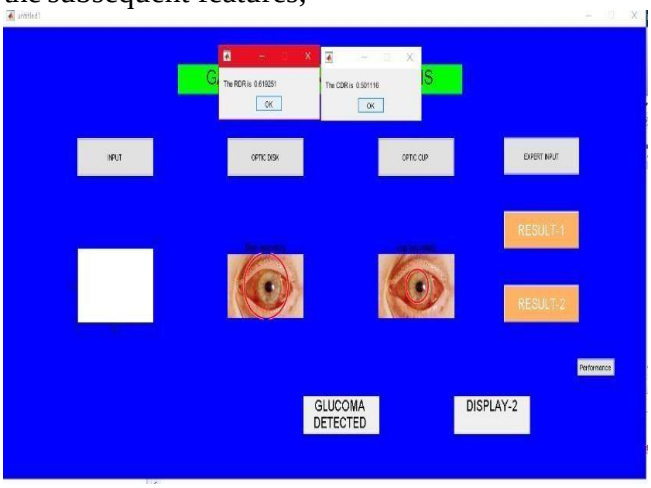

Fig 4.3: Presence of Glaucoma

The output image acquired for Glaucoma affected eye is given in Fig 4.2. As per the details given in Fig 4.3, the presence of Glaucoma is detected. The key factor for glaucoma detection is the CDR value. CDR value greater than 0.4 indicates the presence

of Glaucoma. Since the value here is 0.837794 which is greater than 0.4, there is a risk of Glaucoma.

4.2 Image Without Glaucoma:

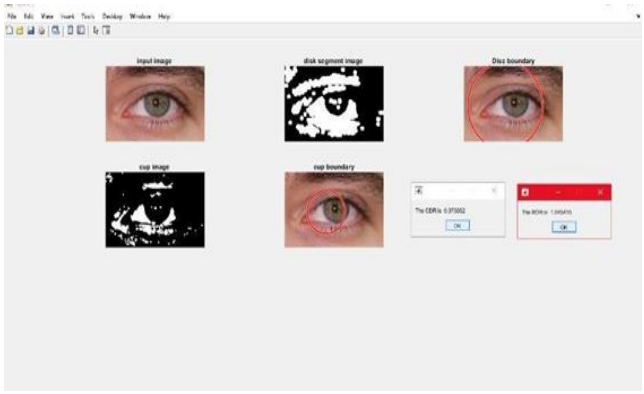

Fig 4.4: Normal Eye

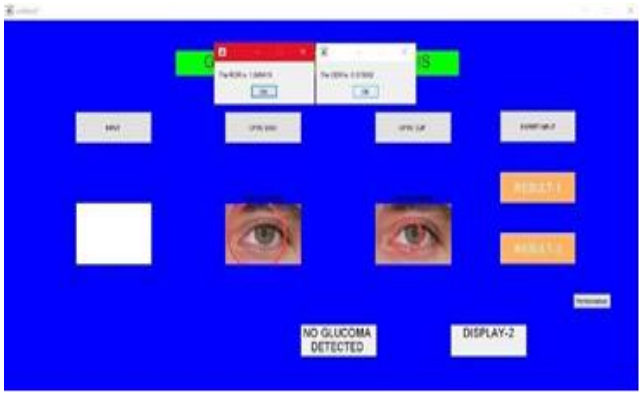

Fig 4.5: Absence of Glaucoma

4.3 Confusion Matrix:

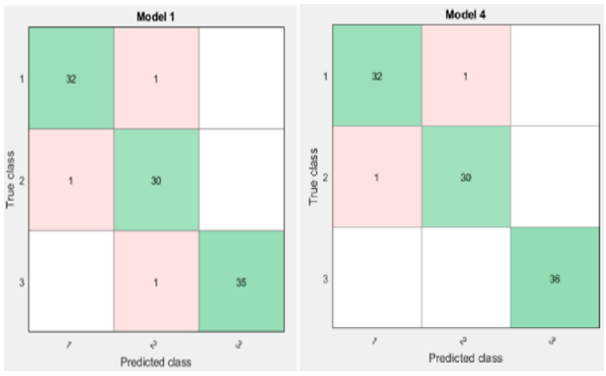

Fig 4.6 a. KNN b. SVM

Finally, accuracy of classifiers can be calculated as:

Accuracy (in percent) = (Sum of diagonal allocations/ Total allocation in matrix) * 100

Accuracy of SVM= (32+30+35)/100 = 0.97 * 100 = 97 % Accuracy of KNN= (30+32+36)/100= 0.98*100=98% Finally, accuracy of classifiers can be calculated as:

Accuracy (in percent) = (Sum of diagonal allocations/ Total allocation in matrix) * 100

Accuracy of SVM= (32+30+35)/100 = 0.97 * 100 = 97 % Accuracy of KNN= (30+32+36)/100= 0.98*100=98%

The output image for a normal eye is represented in Fig 4.4. The CDR value here is 0.266856. The CDR value being less than 0.4, there is no risk of Glaucoma. These details are depicted in Fig 4.6

Table 1: CDR Values

CDR	RESULT
0.501162	Glaucoma
0.373052	Normal
0.821629	Glaucoma
0.588591	Glaucoma
0.138271	Normal
0.362347	Normal
0.593860	Glaucoma
0.260040	Normal
0.379974	Normal
0.837794	Glaucoma

About 10 images were taken as input. And as per the CDR values the presence of Glaucoma is detected. When the CDR value falls in the range of 0.1 to 0.4, then there is no risk of Glaucoma. The eye is Normal. Whereas when the CDR value is above 0.4, then there is a risk of Glaucoma.

5. CONCLUSION

Glaucoma occurs as a result of neuro degeneration of eye's optic nerve. This may cause permanent vision loss. Hence, detection of this disease at the early stage helps in prevention of vision loss. In this paper, CDR is considered as the main parameter to detect the presence of Glaucoma. There are many features which contribute to the detection of Glaucoma. As we are using SVM we get classification more accurately compared to previous Existing method. When tested on a large data set of 10 images, the proposed method gives promising results over 98% accuracy, 98% sensitivity and 80% specificity.

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