Severity Detection of Red lesion in Diabetic Retinopathy using GUI

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Abstract: In modern world, Diabetic Retinopathy (DR) is the leading cause of blindness. DR is a common reason for blindness in the age group of 20-74 years. The main reason for red lesion in working age population is micro aneurysms (MA) and hemorrhages(HE).The first clinical observable lesion indication of diabetic retinopathy are red lesions. So that the detection of red lesions are the main problem for the prescreening system. Here the proposed work gives the automatic detection of red lesion using the new set of shape features, known as dynamic shape features (DSF). DSF parameter gives shape of flooding blood in images and by using this the severity can be analyzed. Another aim of this paper is developing a MATLAB based Graphical User Interface (GUI) which helps to find out the abnormality and severity by the ophthalmologist easily and accurately.

Keywords: Fundus image, MA, HE, Graphical User Interface, Support Vector Machine.

I. INTRODUCTION

Diabetic retinopathy is an eye disease due to diabetes. It is a complication of diabetic mellitus which may leads to blindness in work age population. Diabetic retinopathy are of two types they are:-Non Proliferative Diabetic Retinopathy(NPDR) and Proliferative Diabetic Retinopathy(PDR).In NPDR the damaged blood vessels leaks extra fluid and small amount of blood , but in PDR the blood vessels in the retina will close and it will prevent the blood flow in eye. It may leads to the formation of new blood vessels.

The main symptoms of DR are red lesions, which are mainly due to the swelling in the retinal blood vessels and the damages of retinal blood vessels through injury or diseases. These conditions can be termed as Micro aneurysms and Hemorrhages respectively. Here MA s are uniformly circular in shape and limited in size. It can be detected by using morphological operations like diameter closing and top hat transformation using linear structuring. To differentiate micro aneurysms from blood vessels are by the elongated structure of red lesions. These are the primary symptoms of DR. Retinal Hemorrhages are the severe level of DR. These different types of hemorrhages like dot, blot and flame .Dot HE and Ma are similar in shape so that they are difficult to differentiate from one another on the fundus images. In flame HE the blood leaks into the nerve fiber .Its shape is more elongated like nerve fibers. In blot hemorrhages more blood leaks into retina .Its shape is larger than dot HE. These are various in shape and having the irregular boarders.
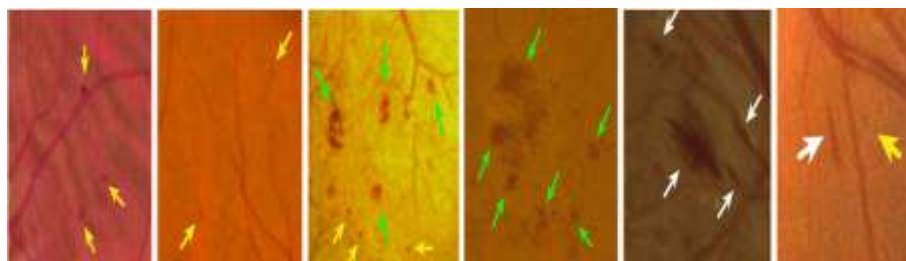

Figure 1: Different images of portions of red lesions. The yellow, green, white arrows represents Mas/dot HEs, blot HEs and flame HEs respectively [1].

In this paper MA and HE are detected by different steps such as image preprocessing, segmentation of preprocessing feature extraction, classification of lesion using SVM classifier and finally detecting the disorder. The final detection of disease is based on the DSF parameters like relative area, perimeter, eccentricity, solidity, circularity, rectangularity and elongation. An user interactive Graphical User Interface is implemented in this paper for finding the severity of the red lesions affected in the retina of patients.

II. PROPOSED METHOD

The proposed system of this paper is differentiate the retinal disorders like HE and MA and its severity levels. The major steps for the detection carried out are image preprocessing, segmentation of lesions feature extraction ,classification of lesions using SVM classifiers and detecting the disorder.
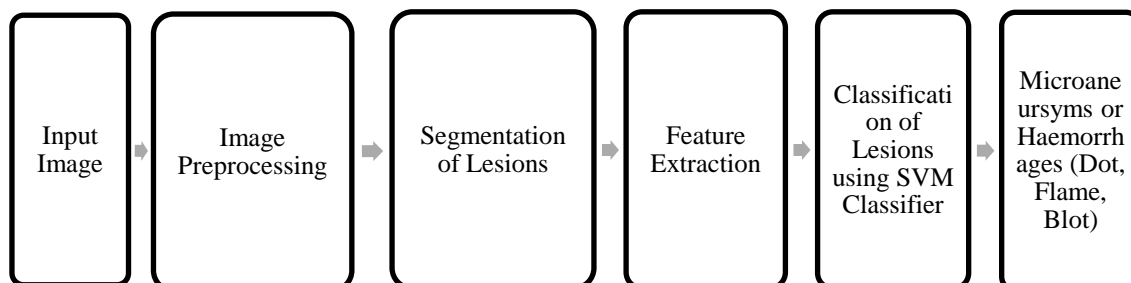
Block Diagram 3. 1:- Basis steps for red lesion detection

Image preprocessing techniques includes illumination equalization, denoising, RGB to gray conversion, adaptive thersholding and colour normalization. Segmentation of lesions includes two steps they are detection of blood vessels and detection of HE and MA .Detection of blood vessels helps the enhancement of the fundus image. Feature extraction is used for the classification of features obtained from the segmented retinal structures. Finally classifying the disorder based on the DSF parameters. The classification red lesion is used by support vector machine (SVM).SVM is based on structural risk minimization ,which is statistical learning method. SVM is used to map the input image vector into a high dimensional feature space by using a non linear mapping kernel. The feature shape is given by Burges equation[2].

$$f(x) = sgm \left[\sum_{i=1}^{l} yi\alpha ik(xi, x) + b \right]$$

here k is the kernel function ,b is the bias vector ,αi is the lagrange multiple and yi is the label..

In this paper SVM is used to classify the red lesion affected and not affected regions in the fundus images. For this purpose we can consider Niemeijer et al [3] features. The performance can be improved by considering the factors like angular second moment, contrast, correlation, sum of squares, inverse difference moment, sum average, sum variance, sum entropy, entropy, difference variance, different entropy and information measurements for correlation. All these features are obtained by co-occurrence matrix.

Severity of the red lesions are detected by the DSF parameters. Relative area is the one of the DSF parameters, in this the number of pixels is divided by the total number of pixels in the image. Elongation is obtained by 1-W/L ,where W and L are width and length of the images. Eccentricity is an another DSF parameter can be obtained from the width and length of the image by using the formulae $\sqrt{(L-W)/L}$.

Finally classified disorder is detected on the GUI based system. GUI is an user interactive MATLAB tool so that even the patient can understand the severity of the disorder.
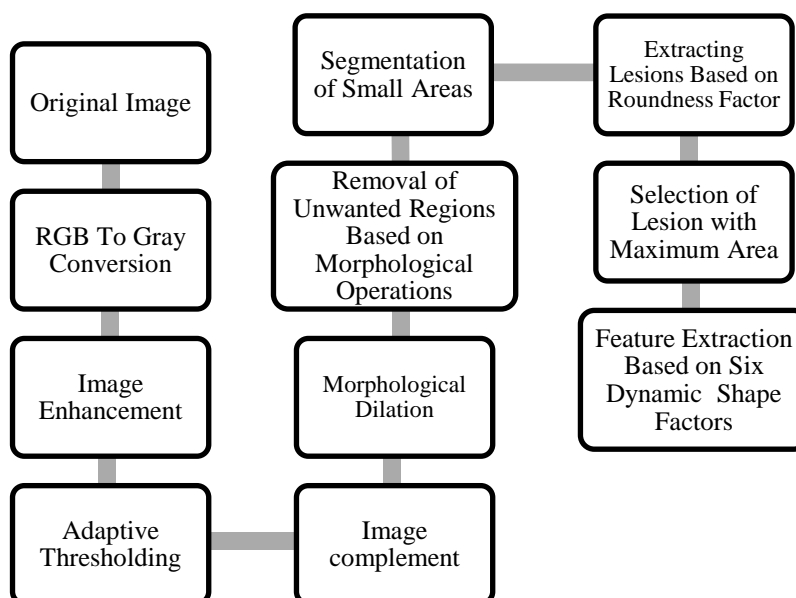
Block Diagram 3.2:- Detection steps for micro aneurysm
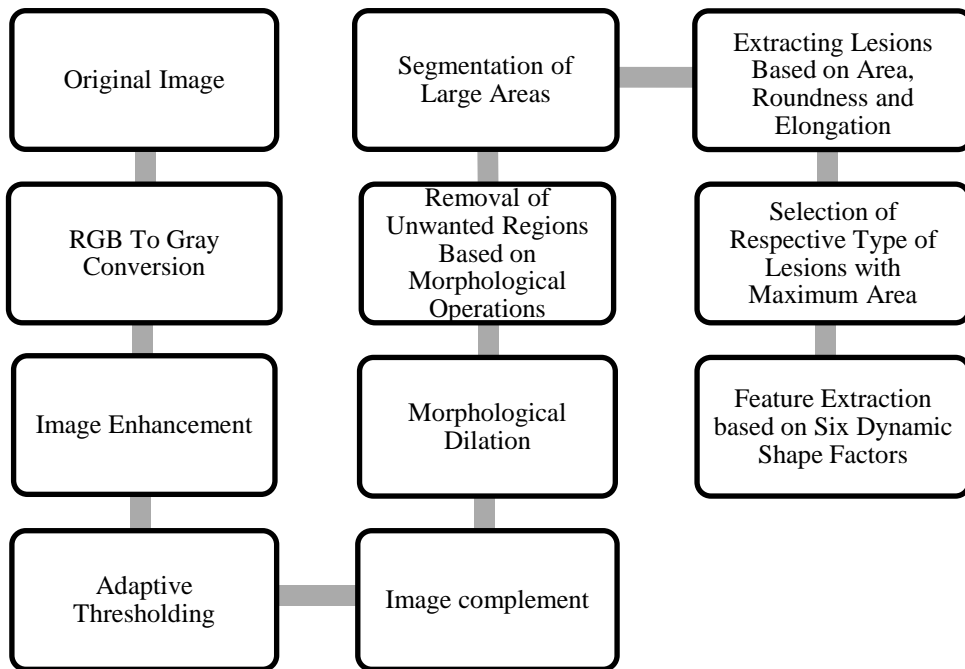
Block Diagram 3.3:- Detection steps for Hemrrohage

III. EXPERIMENTAL RESULTS

To analyze the effectiveness of the proposed method, algorithm is run on all the datasets and results for detection of red lesion and Blood Vessels were collected. Figure shows the resulting images of various stages in led lesion detection on a GUI screen and finally analyzing the severity of the fundus images by giving different threshold values for the various threshold values for different DSF parameters.

Fig 4.1: Generated GUI window

Fig 4.2: Loaded image

Fig 4.3 :RGB to Gray converted image

Fig 4.4: Adaptive Thersholding

Fig 4.5 :Image Complement

Fig 4.6: Removal of Small Regions

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Fig 4.7: Segmentation of lesion like structures

Fig 4.8: Detection of flame hemorrhage

Fig 4.9: Detection of Micro aneurysm

Fig 4.10: Detection of severe micro aneurysm

Various diabetic retinopathy grading schemes are tabulated below:-

Table 4. 1 : Summary of the Diabetic Retinopathy Grading Scheme

Grading	Description
R0 (No visible retinopathy)	No visible diabetic retinopathy anywhere
R1(Mild)	At least one dot or flame hemorrhage, micro aneurysms, exudate or cotton wool spot anywhere.
R2(Observable background)	Four or more blot hemorrhage in one hemi field only.
R3(Referable background)	Any of the following features i) four or more blot hemorrhage in the inferior and superior hemi fields ii)venous beading iii) intra retinal micro vascular anomalies.
R4(Proliferative)	Any of the following features: i)active new vessels ii) vitreous hemorrhage
R6(Inadequate)	Insufficient clarity or field of view

Different severity levels and its dilated ophthalmoscopy findings.

Table 4. 2: Severity level

Disease severity level	Dilated ophthalmoscopy findings
No apparent retinopathy	No abnormalities
Mild NPDR	Micro aneurysms only
Moderate NPDR	More than just micro aneurysms, but less than severe NPDR.
Severe NPDR	No signs of PDR, with any of the following: Intra retinal hemorrhage Definite venous beading Prominent intra retinal micro vascular anomalies.
PDR	Neovascularization, Vitreous or pre retinal hemorrhage.

IV.CONCLUSION

In this paper a novel red lesion detection based on the new set of dynamic shape features are carried out. The fundus image is processed in different steps for finding the severity of red lesion affected in diabetic patients. The Graphical Use Interface (GUI) is an user friendly tool used to identify severity levels of red lesion and it allows appropriate consistent referral to treatment center. The system can helps to reduce specialist's burden and examination time with the additional advantages of objectivity and reproducibility so that the implementation of this paper will be a succor to the patient as well to the ophthalmologist.

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