"DETECTION AND CLASSIFICATION OF DIBETIC RETINOPATHY IN COLOR FUNDUS IMAGE"

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Abstract: *Diabetic Retinopathy (DR) is an eye syndrome due to diabetes which causes optical loss. So it is sensible to offer treatment for DR at primary stages of disease. Haemorrhages are the initial symptoms that indicate person have diabetic retinopathy. Therefore, their acknowledgment is very crucial. In this paper image contrast is enhanced by pre-processing and then blood vessels are detected as the margins of haemorrhages are not discriminate when they are in contact with blood vessels. then classified the image on the basis of quality characteristic such as area in three stages as normal, moderate or Severe DR. classified images are classified with 99% accuracy. we tested set of images and obtained Precision= 0.99974, Recall=1, F1Score=0.99987.our approach has potential to be used as too in clinic for haemorrhages detection.*

Keyword: Blood vessel, Diabetic retinopathy, Diabetes, Haemorrhages

I. INTRODUCTION

Diabetes is the major rationale for visual loss. Diabetes is nothing but a disorder of metabolism. A hormone called "insulin" is created by the pancreas. During eating, the pancreas produces the precise quantity of insulin. In persons with diabetes, pancreas either produces less or no insulin or the cells do not react properly to the insulin that is formed. The quantity of glucose in the blood flows through the urine and then passes out of the body. Therefore, the body doesn't have its important source of fuel even though the blood contains massive amounts of glucose. In earlier days, retina experts recognize the symptoms of diabetic retinopathy in the digital color fundus images of retina which taken with the help of ophthalmoscope or fundus photography physically. So it requires highly practiced and talented experts to carry out analysis. But as the quantity of people with diabetes increases it gets problematical to detect DR symptoms from fundus images.

The objectives of this approach are to simply detect blood vessel, then identify haemorrhages and finally classify different stages of diabetic retinopathy into normal, moderate and severe diabetic retinopathy. The source of the categorization of different stages of diabetic retinopathy is based on the quality feature such as area, standard deviation etc.

This paper gives brief discussion on proposed plan of work in Section III then in section IV result and performance analysis of given approach is shown while section V gives conclusion.

Diabetic retinopathy is a retinal disorder that occurs in people having diabetes. Diabetic retinopathy, also famous as diabetic eye disorder, is when blood sugar level in the blood increases which can lead to hammering of vision. Blood sugar causes the retinal tissue to bloat, resulting in fuzzy vision. Sometimes new blood vessel grows in the eyes which are delicate and can bleed cause sightlessness. DR frequently affects both eyes. If a person has diabetes for longer time, then have additional chances of diabetic retinopathy. If this is not treated, diabetic retinopathy can cause everlasting visual loss.

The menace of diabetic retinopathy is minimizes with prohibited blood sugar and blood pressure level. Hemorrhages are one of the diabetic retinopathy diseases which affect the retinal part of the eye. Hemorrhages occur in the deeper part of the retina. Hemorrhages are also called 'blot' hemorrhage because of their round shape. unusual new blood vessels forms at the rear of the eyes which can burst and lose blood causes blur vision. The occurrence of hemorrhages in the retina is the major signal of diabetic retinopathy. The thoroughness of the diabetic retinopathy depends on numeral and form of hemorrhages.

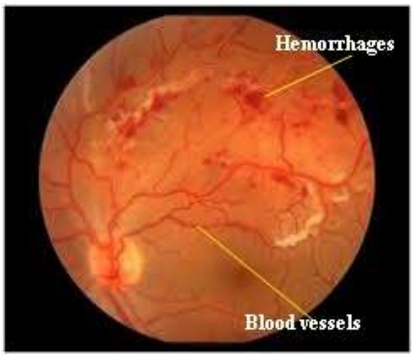

Figure 1: Diabetic retinopathy affected fundus image

Two kinds of DR are shown in Fig .The two stages of Retinopathy are Non-Proliferative and Proliferative diabetic retinopathy. First stage is Non- Proliferative Diabetic Retinopathy (NPDR) in which symptoms will be mild and hardly shown. Retinal hemorrhage is useful to find NPDR. So, earlier detection of NPDR is helpful to improve vision of patients.

Second, advanced or severe stage is Proliferative Diabetic Retinopathy (PDR) occurs due to new blood vessel starting to grow in the eye that are fragile and can bleed which causes Blindness. At first, the people suffering with DR may notice no changes in their vision. But It could get worse over the years and decreases their good vision. Treatment for diabetic retinopathy depends on the stages of the disease.

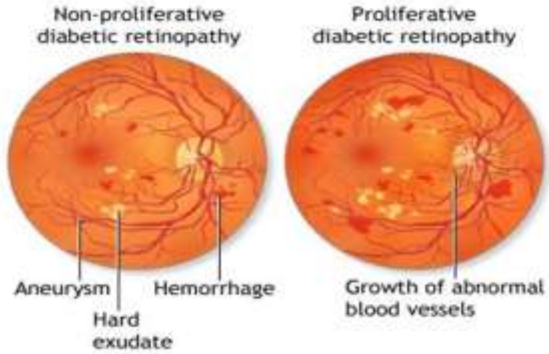

Figure 2: kinds of Diabetic Retinopathy (a) Proliferative DR.(b) Non-proliferative DR

II. PROPOSED PLAN OF WORK

The main objective of the planned system is to automatically categorize hemorrhages from other symptoms of DR. The input retinal images are taken from Internet (STARE database) which is given as input to the pre-processing. After pre-processing, the blood vessels are detected. After discovery of blood vessels removes from the abnormal images and then classify these retinal images does contain hemorrhages problem on the basis of feature extracted. Block diagram of the proposed system is shown in Figure 3.

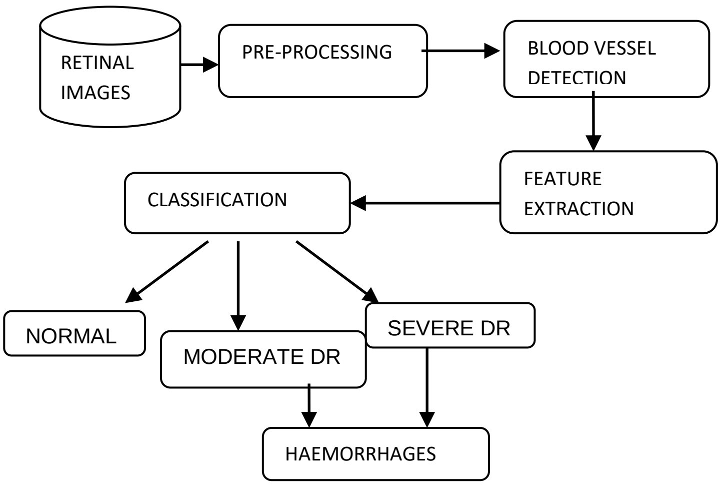

Figure 3: Block Diagram of the Proposed System

Proposed system consists of four modules which are A) Pre-processing the retinal image, B) Blood Vessel Detection C) Feature Extraction and D) Classify the output

A. *Pre-processing*

Pre-processing is the initial step in all the case of image related diagnosis system and it helps in accurate feature extraction The input of the automated system is color fundus retinal image which is taken from internet. This stage corrects the problem of illumination variation of the picture taken. The pre-processing steps consist of :

1) Resizing the retinal gray images

The input retinal images are resized into small images. It is mainly to avoid overloading and time consumption.

2) Color to green channel extraction

To convert RGB color fundus images into green channel conversion.

3) Adaptive histogram technique

Histogram equalization is defined as the process of adjusting intensity values of the image. Adaptive histogram is used to increase the "contrast" and to enhance the quality of retinal image. Adaptive Histogram Equalization Method (AHEM) gives improved performance, increase processing speed and work for all images are of variant sizes, hence it is used as method of correcting variant intensities. Here contrast-limited adaptive histogram equalization (CLAHE) is performed. it operates on small data regions rather than the entire image at a time. Contrast of each region is enhanced so that the histogram of each output region approximately matches the specified histogram. The contrast enhancement can be limited in order to avoid the enhancement of noise which might be present in the image

4) Morphological Operation

Morphological processing is used for operations on sets of pixels. Binary morphology uses only set membership and is similar to the value, such as gray level or color of a pixel.

The basic morphological operators :

Binary dilation and erosion: The set of black and white pixels describes a binary image. Only black pixels are measured and the others are treated as a background. The primary morphological operations are dilation and erosion, and from these two operations such as opening, closing, and shape decomposition are formed.

Dilation: The dilation operation thickens the image. The extent of how much it should be thicken is based on the structuring element.

Erosion: The erosion operation performs either shrinking or thinning of the object. The extent of this operation is decided by the structuring element.

B. Blood Vessel Detection

After enhancing the contrast of the image, The designed matched filter is applied on the image to detect the blood vessels. A binarised image is obtained by thresholding. A matrix was generated to store the number of matched filter which was responsible for detecting that particular pixel of the blood vessel. The gray level value of the pixels in a particular direction of detection was multiplied by a factor. The value was then checked against threshold level. For 0°, 15° and 180° pixels in the horizontal direction were checked; for 30°, 45° and 60°, pixels in the 45 degree and 225 degree directions were checked; for 75°, 90° and 105°, pixels in vertical direction and for 120°, 135° and 150°, pixels in 135 degree directions were checked. If gray value multiplied by a factor was greater than the threshold, then that pixel was counted as blood vessel. Finally, the blood vessels are extracted pixel by pixel.

C. Feature Extraction

In feature extraction, Texture analysis used to take out feature values from the input images. These features are used to calculate behavior that is described in terms of rough, smooth and silky. Texture analysis can be supportive when objects in an image are more characterized by surface than by intensity.

1) Range Filter

Range Filter is used to find the local range of the gray scale images. Matlab function of range filter is used to generate ranges for the input images. It returns each output pixel that contains the range value which is greater value – smaller value find for every 3-by-3 matrix for the corresponding pixel in the input image.

D. Classification

This defines a consortium of all the categories in disjoint teams. We prefer categorization of hemorrhages on the basis of area and size of the pixels of image which is extracted during feature extraction of an image, since it provides more correctness on a larger dataset.

III. RESULT AND ANALYSIS

The color fundus images were used in this experiment to detect the retinal images having Diabetic Retinopathy problem or not. We take sample retinal images from STARE database for evaluating the proposed approach. In first step pre-processing is done for removing noise and other factor, then blood vessels are detected as the boundaries of hemorrhage does not preserved when they are in contact with blood vessels. After that feature are extracted and classify retinal images whether it is normal, moderate or severe DR. and finally as hemorrhages. The experimental results are shown in Figures.

Performance Analysis:

We have taken sample images from STARE database then preprocessed this images and found hemorrhages as described in section II. then we calculated time required for processing.

For performance analysis we calculated Accuracy ,Precision, Recall, Specificity, F1Score.for this calculation four parameters needed which are True Positive [the number of hemorrhages pixels that are correctly detected] ,False Positive [the number of non hemorrhage pixel that are wrongly detected as hemorrhage pixels] , False (invalid) Negative [the number of hemorrhage pixels that are not detected. True (accurate) Negative [the number of non hemorrhage pixel that are not detected] .finally on the basis of this we calculated

Precision = TP/ (TP + FP)

Sensitivity = Recall = TP / (TP + FN)

Specificity = TN / (TN + FP)

F1Score=2TP/ (2TP+FP+FN)

Table I: PERFORMANCE ANALYSIS

Image	Accuracy	Precision	Recall	F1Score
1	99.9741	0.99974	1	0.99987
2	99.7662	1	0.99766	0.99883
3	99.8109	1	0.99811	0.99905
4	99.9937	0.99994	1	0.99997
5	99.9766	0.99977	1	0.99988
6	99.9905	0.9999	1	0.99995
7	99.9944	0.99994	1	0.99997
8	99.025	0.99764	1	0.99882
9	99.738	0.99974	1	0.99987
10	99.8109	1	0.99895	0.99538

IV. CONCLUSION

The proposed automated system use to identify patients having diabetic retinopathy using fundus images efficiently. Our algorithm didn't require any pre-training to classify the given images. We have preprocessed images to remove noise and enhance intensity of images. after tracking blood vessels we omit that and concentrated on hemorrhages. Finally texture feature area is used to classify images into normal, moderate and severe DR. we tested this approach against STARE database. It shows accuracy of 99%. So this approach has potential to be used in clinic as a tool for detection of hemorrhages.

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