Automatic Diabetic Retinopathy using Morphological Operations

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ABSTRACT
Diabetic Retinopathy (DR)is a main cause for blindness, detecting it as early by exudates that form in the retina. The old method followed by opthalmogists is the regular supervision of the retina. By way of this method takes time and energy of the opthalmogists, classification is done on the basis of new features for the detection of exudates in color fundus image is proposed in this paper. This method reduces work to examine on every fundus image rather than only on abnormal image. The exudates are extracted from the fundus image by applying thresholding and removal of optic disk and region of interest using morphological operation like closing, dilation, erosion. The features are extracted from processed image and used for classifying into exudates and non-exudates.

Keywords
Exudates, Fundus image, closing, dilation, Morphological operations

1. INTRODUCTION
Diabetic Retinopathy (DR) is the eye disease caused by the diabetes having more than 10 years. DR is the most common sight threatening disease when untreated leads to permanent vision loss and in many cases it cannot be reversed [1]. There are two types of DR: Non-Proliferative diabetic retinopathy (NPDR) and Proliferative diabetic retinopathy (PDR).In NPDR, the damaged blood vessels leaks fluid containing proteins and small amount of blood into the eye region. This condition leads to the formation of exudates in the area of inflammation or lesion. As the disease progresses the amount of exudates also get increases. In PDR case, the blood vessels in the retina close and prevents blood flow towards eye. Also blood vessel get weak and fragile. This condition leads to the emerge of new blood vessels called fragile in order to supply blood to the blocked area and this condition is called as neovascularization.

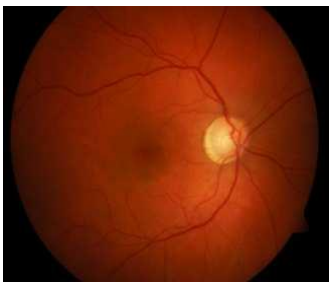


Fig.1: Normal Retina without DR

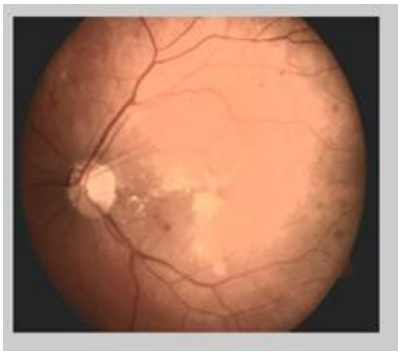


Fig 2 NPDR image

Fig 1 shows and Fig 2 shows the normal image and the retinal image with exudates. Exudates are manifested as spatially random yellowish or whitish covers of variable sizes, shapes and locations. These are the visible sign of DR and a major cause of visual loss in Non-Proliferative forms of DR. In this project, the retinal images are classified as exudates and non- exudates using statistical features extracted from the images. The detection of exudates in retinal images was investigated by many researchers.

Li Tanget. al. [2] proposed novel splat feature classification method to detect retinal hemorrhages based on extracting features like color, spatial location, interactions with neighboring splats, and shape and texture information.. Istvan Lazar and Andras Hajdu [3] used directional cross-section profiles for detecting the micro-aneurysms. Analysis was made on the features like size, height, and shape of each profile. The statistical measures of these feature set is used in a naïve Bayes classification to eliminate spurious candidates**.** Balint Antal and Andras Hajdu [4] suggested novel method by considering the output of multiple classifiers. Micro-aneurysms can be detected by improving pre-processed methods and candidate extractors. K. Sai Deepak and J. Sivaswamy [5] introduced motion pattern technique which is a preliminary technique for detecting the exudates in macula. Gaussian Data Description and Principal Component Analysis Data Description classifiers were used to extract the exudates. L. Giancardo et. al. [6] used multiple view retinal fundus images which are registered for detection and quantitative measurement of the disease. Finally, a dense pyramidal optical flow is calculated to build a naivec height map of the macula. K. Ram et. al. [7] proposed clutter rejection method to detect the Micro-aneurysms (MAs). This method has two clutter rejection stages in which MAs are discriminated from Non-MA by using similarity computation. C. Agurto et. al. [8]

developed the novel technique for lesion detection by using instantaneous amplitude and instantaneous frequency characteristics of an image. Keerthi Ram and Jayanthi Sivaswamy [9] proposed multi-space clustering technique to differentiate hard and soft exudates.

2. METHODOLOGY

2.1 Methodology

The main objective of this project work is to detect the exudate and classify the retinal image into exudates and normal. The retinal image is exposed to the preprocessing steps, color conversion problem, filtering and morphological operations are performed by using structuring element. The optic disk and blood vessel is removed by morphological operations like dilation, erosion and closing operations. Features are extracted like exudates area, homogeneity and texture properties are extracted. The flowchart of the proposed method is shown in Fig 3.

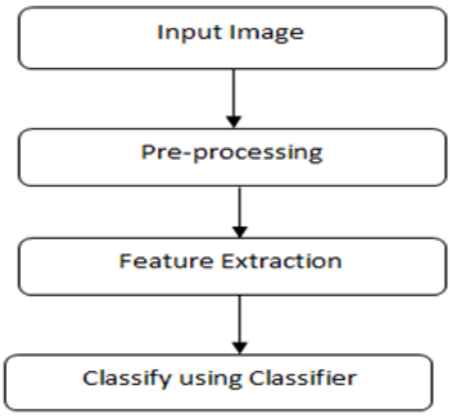


Fig 3: Flowchart of the proposed system

2.2 Image acquisition

The retinal images for this work are taken from MESSIDOR dataset. This database consists of color fundus images of which are normal and contain various signs of the diabetic retinopathy includes cotton wool spots ,red lesions, haemorrhages, hard exudates, soft exudates (microaneurysms).

2.3 Preprocessing

Pre-processing is the basic step in all the case of image related diagnosis system. In case of DR the retinal images in the dataset are often noisy and poorly illuminated because of noise like paper and salt and camera settings. To remove noise in the image use median filter for remove noise and for better corner preservation. Thus to remove noise and undesired region the images are subjected to preprocessing steps, which include green plane. Because of the similar attributes of exudates and optic disk, the morphologically operated image has both exudates and optic disk. Since the optic disk occupies channel extraction, histogram equalization and contrast enhancement.

The exudates appear bright in the green channel as compared to red and blue channels in RGB image. Green channel is subjected as intensity through which exudates can easily extracted. Hence green channel is used for further processing by avoiding other two channels. Adaptive Histogram equalization and contrast enhancement are used to increase the contrast between the exudates and the image.

2.4 Optic disk elimination

The enhanced retinal image is converted into binary image by u s i n g proper thresholding value. This binary image is then treated to morphological operations like opening and closing. Closing operation is distinct as dilation followed by erosion and opening is the converse of closing operation. Dilation is an operation that grows or thickens objects in a binary image. The process of thickening and thinning is controlled by a SE. As the optic disk and exudates are circular in shape, a disk shape structuring element is used in this work.

The mathematical equations governing morphological operations are:

Dilation is given by,

$$A \oplus B = \{Z | B_z \cap A \neq \Phi\}$$

Erosion is given by,

$$A \odot B = \{Z | B_z \subseteq A\}$$

Closing Operation is given by,

$$A.B = (A \oplus B) \odot B$$

With the help of structure element(SE). Erosion shrinks or thins the objects in the maximum area in the image, by using connected component properties the maximum area is eliminated.

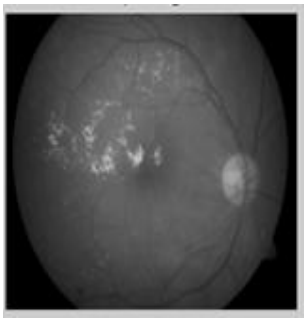
2.5 Feature extraction

The processed image after the removal of maximum area (optic disk) has only exudates. This image is used for feature extraction. The statistical features like exudates area, entropy, correlation, energy, contrast, homogeneity, standard deviation, mean, skewness and kurtosis are extracted from the image. From this features, the most effective features are used for classification.

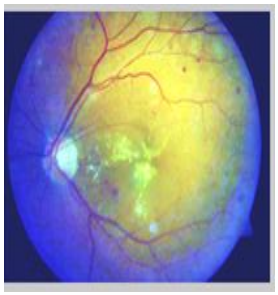
3. RESULTS AND DISCUSSION

The retinal image database contains images of various diabetic retinopathy signs (cotton wool spot, red lesion, hemorrhages, hard exudates, soft exudates). Thus a set of images (16 normal and 20 abnormal) were chosen and analyzed for the Classification purposed. The Images show in figure gives different output and exudate is detected by removing optical disk and blood vessel.

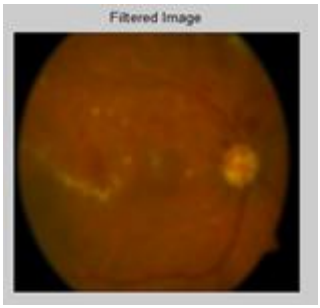
a)Input Image



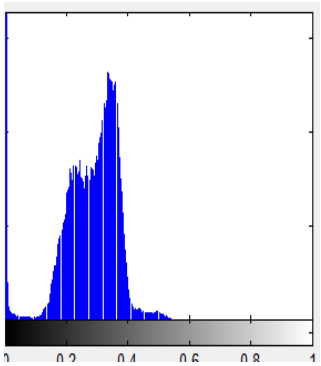
b)Gray Scale Image



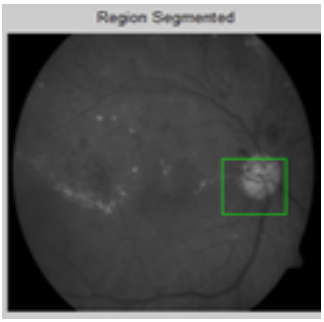
c)Green Channel Image with high intensity



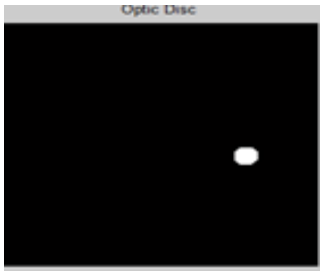
d) Image without noise (Filtered)



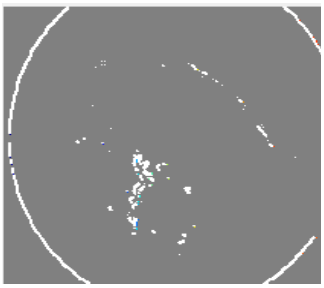
e)Adaptive Histogram Equalization



f)Optical disk Detected Image



g)Optical disk removed Image



h)Exudate Detected Image

The comparative difference in the feature value for the normal and Diabetic Retinopathy images is shown in the Table 1.

Category	Normal Image	DR image
Number of images	20	16
Exudate Area	>100	<200
Energy	0.05453	0.0074356
Homogeneity	1	.998
Contrast	1.3e-4	1.5e-5
Symmetry	1	1

4. CONCLUSION

The main aim of this project is to classify retinal images into exudates and normal using statistical features. The retinal image is subjected to various operations and features are get extracted for the image. Then the calculated feature values of a retinal images can be classified under the category the image falls on either exudates or normal manually.

5. ACKNOWLEDGEMENT

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6. REFERENCE

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