# An automated approach for detection of diabetic retinopathy in human Eye

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**Abstract:** *Diabetic Retinopathy is a typical complexity of diabetes that is created by changes in the veins of the retina. The symptoms can obscure or mutilate the patient's vision are a fundamental cause of sightlessness. The veins in the retina get altered. Exudates are emitted, microaneurysms and haemorrhages forms in the retina. The presence of these features represents the level of seriousness of the disease. Regular screening is vital all together distinguish the early phases of diabetic retinopathy for convenient treatment to avoid further deterioration of vision. But, a huge shortage of professional experts has incited computer assisted monitoring. This paper detects the presence of abnormalities in the retina and distinguishes the stage of diabetic retinopathy as mild diabetic retinopathy or severe diabetic retinopathy using image processing techniques. By applying morphological operations to the fundus images features such as blood vessels, microaneurysms, exudates are extractedand different edge detection techniques are performed. Then depending upon the area ofthe extracted features the severity of the disease is detected.*

**Key words:** diabetic retinopathy, retina, fundus image

## 1. INTRODUCTION

Human eye is the organ which provides us learn more about the surrounding world than we do with any of the other four senses. utilize our eyes in every action we perform, whether perusing, working, staring at the TV, driving an auto, and in endless sense they esteem more than all the rest.

### 1.1 Structure of human eye

In the human body eye is the most complex organ and is responsible for visualizationof objects. It lies inside the orbit, socket of bone and eyelids protects it from the dustparticles. The structure of human eye is shown in figure 1. It can be classified intothree parts:

Anatomy: Structure of an eye

Physiology: Function of the eye

Pathology: Disease and disorder of the eye

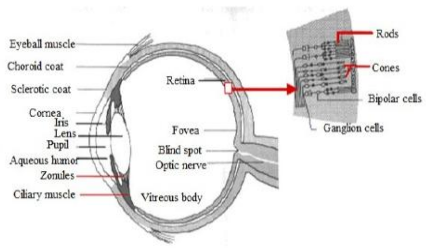



Figure:1 structure of human eye

The cornea is a clear transparent structure present in front of the eye that transmits and focuses light into eye. Below the cornea there exists a colored ring called the iris. It regulates the amount of light that enters adjustable circular dark aperture called the pupil, which determines the amount of lightthat can be let into the eye. Below the pupil, there is a colorless, transparent structure called the lens that focuses the light rays onto the muscles which holds the lens and plays the lens became flatten and allow the eye to see the far objects whereas the contraction of the ciliary muscles results in thickening of lens and helps to see closer objects.The nerve which connects the eye to the brain is called optic nerve.

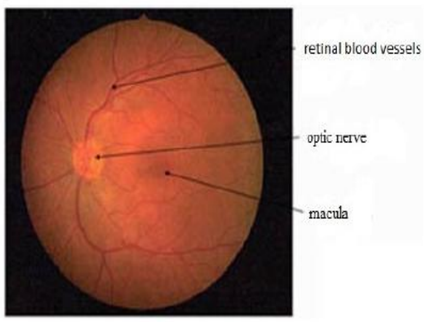



Figure 2: Retina

Interior portion of the eye is filled by a clear, jelly like substance called vitreous humour. After passingthrough the lens, light travels through this humour before striking the sensitive layer of cells called the retina. It is shown in the figure 2.Retina is the deepest layer of the eye. The furthest layer is known as the sclera, whichseems white in color. The cornea is additionally a piece of the external layer. The choroid is the centre layer between the retina and sclera. It contains veins which supply supplements to the retina furthermore it evacuates the waste item. At the focal point of the retina there is a little region of quite concentrated delicate tissue called macula. It is responsible for sharp vision.

### 1.2 Diabetic retinopathy:

Diabetic Retinopathy is a major complication of diabeties that is caused due to insufficient insulin in the body and leads to poor vision.It is the common cause of legal blindness in the working age population of developed countries.It is a progressive disease which occurs when the small vessels that provide the oxygen and nutrients to the retina are damaged by the high blood glucose present. These tinyblood vessels will leak blood and fluid on the retina that causes swelling of retinal tissueand clouding of vision. The fluid leak into the macula,which is the central part of the retina.The excess lipid and sugar comes out and form features such asmicroaneurysms, hard exudates, soft exudates, hemorrhages. An ordinary retina does not have any of these features and are shown in theFigure.3.

igns and symptoms of diabetic retinopathy:

- Blurred vision
- Fluctuating vision
- Distorted vision
- Dark areas in the vision
- Poor night vision
- Impaired color
- Partial or total loss of vision

## 2. METHODS OF WORKING

The proposed system of Automatic Diabetic Retinopathy detection involves detection and segmentation of the unusual features from the input images.

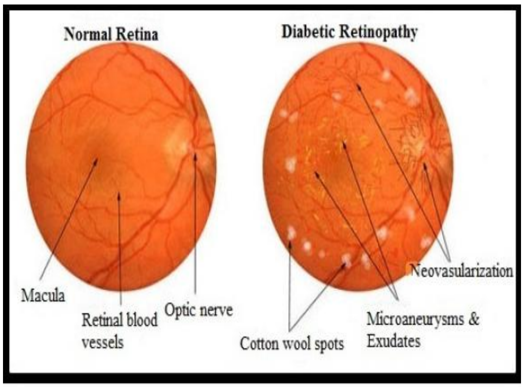



Figure.3: normal retina and diabetic retina

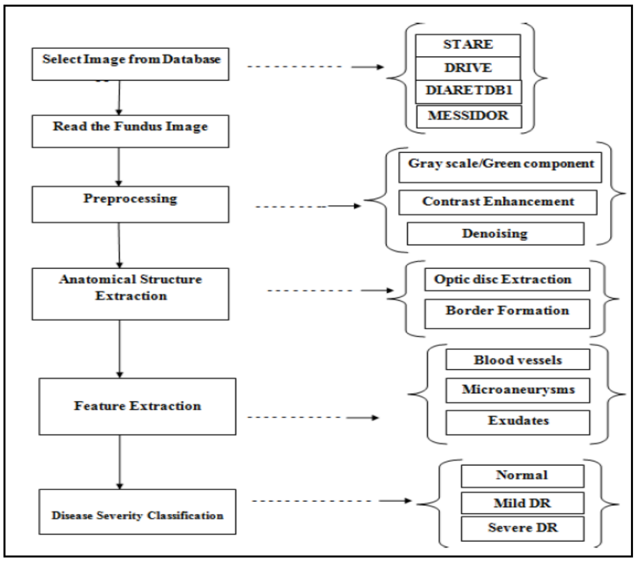
The input image from the retinal image database is pre processed to concentrate the gray scale or green component of the image, noise removal and to enhance the contrast of the image for further processing as shown in figure.4

The proposed system involves the following steps:

- Read the fundus image
- Image Pre-processing
- Anatomical Structure Extraction
- Feature Extraction
- Disease Severity Classification

### 2.1 Image pre-proccessing:

Color fundus picture is initially changed over into a green picture or a gray scale picture keeping in mind the end goal to implement the blood vessels segmentation. From visual perception, blood vessels typically show the best refinement within the green band.Gray scale picture gives brilliance information from color picture after removing hue and saturation. The command "imadjust" alters image intensity values and expands contrast the output by smothering darker pixels and also command




"bwareaopen" is used to reduce the noise.

Figure 4: block diagram of proposed method

### 2.2 Anatomical feature extraction:

The detection of optic disk is very challenging task because it is equal in brightness and contrast to the exudates. The optic disc is round fit as a fiddle and it is brighter than all other part in the retinal picture. So we make a round cover for the optic disc region by finding the brightest pixels in our picture that is being taken care of. The technique must be performed independently on the region of interest. However generally, In finding the circular border of the image two strategies are used. The circular border is separated once subtracting the swollen image from the worn image obtained by applying morphological dilate and erode.

## 2.3 detection of blood vessels:

The fundus picture is first preprocessed to standardize size 576*720 and then intensity of green channel is inversed before applying histogram equalisation as shown in figure.5and (b) The optical disc is then evacuated and then the image is converted to a binary image using the function "im2bw". The pixels of the input image are converted to binary 1 (white) for values greater than the selected threshold and else to binary 0 (black). converted binary image at this point may still have some noise and the function "bwareaopen" is applied to eliminate the noise. To the green component picture adaptive histogram equalization and image segmentation are applied to select the area
of blood vessels. Small noise pixels are additionally uprooted. After applying image segmentation at optical disk region some blood vessels are lost. Hence a mask is made to hold these blood vessels and it is merged with the mask and using AND logic it is compared with previous blood vessels. The practically identical pixels are outputed as binary 1(white) and represents the blood vessels as shown in figure.6

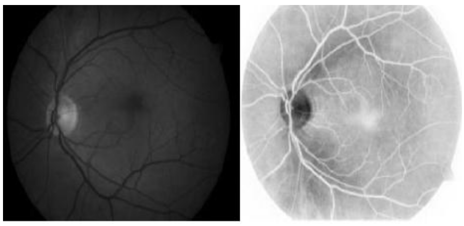


Figure.5(a) Green channel image (b) Intensity inversed image after histogram equalization

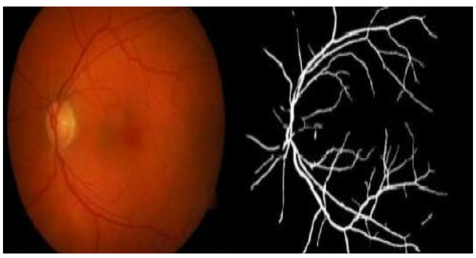


Figure 6:original fundus image and final blood vessels image

## 2.4 detection of microaneurysms:

Microaneurysms visible as small dark round dots around 15 to 60 microns indiameter on the fundus pictures. They are tiny dots emitted from the weak bloodvessels. The fundus picture is preprocessed and then the gray scale image intensity is balanced. The image's contrast is enhanced by applying histogram equalization as shown in figure.7 (a) and (b) The round border is then eliminated before applying the function "imfill" to fill upthe enclosed area as shown in figure.8. The holes image is gained by subtracting away the edges and eliminating the larger area using command "bwareaopen" and final image is obtained as shown in figure .9

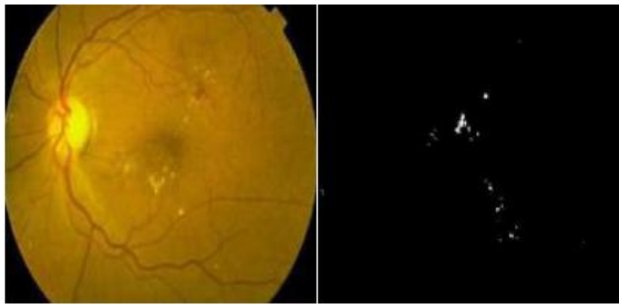


Figure.7(a) Image after histogram equalization, (b) Image after edge detection

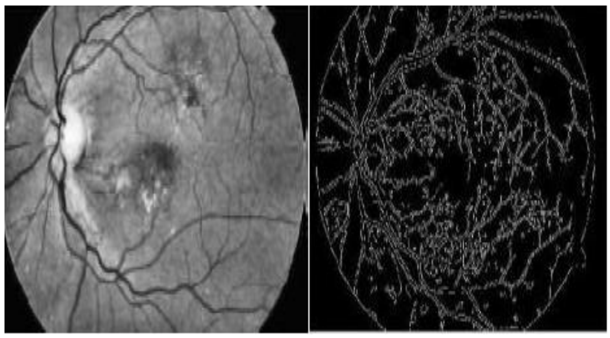


Figure.8(a) Image after function "imfill", (b) Image after removing the larger area

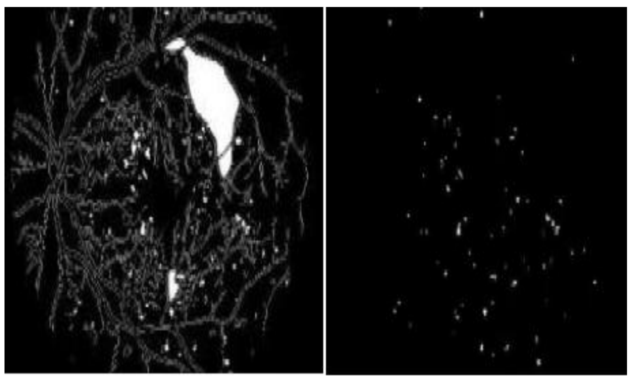


Figure.9: original fundus image and final microaneurysm image.

## 2.5 detection of exudates:

Exudates appear as brilliant yellowish patches on the retina because of the spillage of plasma containing lipids. The fundus picture is first pre processed and then the grayscale image intensity is adjusted. Morphological closing which comprises of enlarge took after by dissolve is connected to uproot the blood vessels converted to double precision value using function "colfilt" to check the exudates as shown in figure .10 (a) and (b). This picture is changed back to binary with a threshold value to filter out exudates utilizing the function "im2bw".Non-exudates are extracted from the grayscale image using function "im2bw" and are represented by binary 1 (white) after intensity inversion ,and final image of exudates looks like as in figure.11

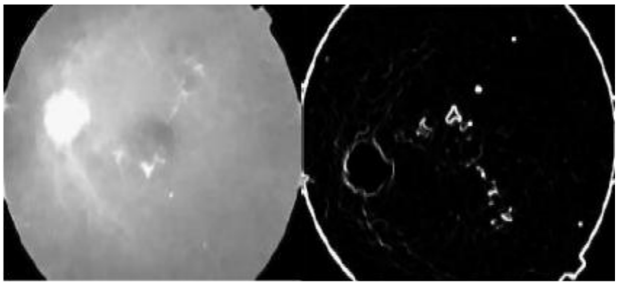


Figure.10 (a)Image after Morphological closing, (b) After column filtering

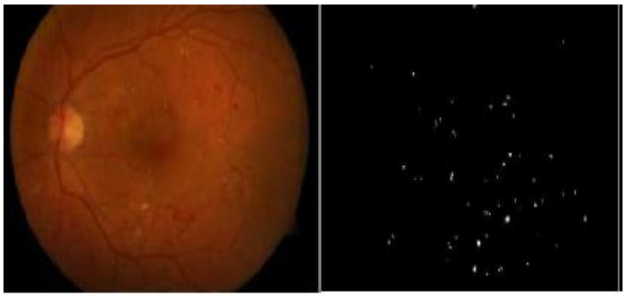


Figure .11 figure displaying original fundus image and exudates image

## 3 RESULTS:

In below Figure.12 displays the proposed framework.The input fundus image is preprocessed and new segmented images of blood vessels microaneurysms and exudates
are obtained. The areas of all the extracted features are calculated while processing the images. And depending on the area of the features severity of the disease is notified as shown in the figure.13.

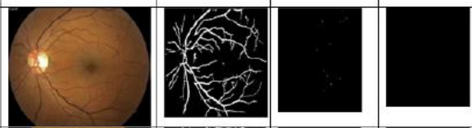
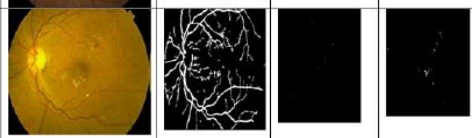
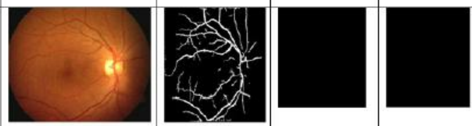
| SL NO | Input Fundus Image | Blood vessels | Microaneurysms | Exudates | Disease severity |
|---|---|---|---|---|---|
| 1 |  | | | | Mild |
| 2 |  | | | | Severe |
| 3 |  | | | | Normal |

Figure 12 : figure displaying the proposed framework

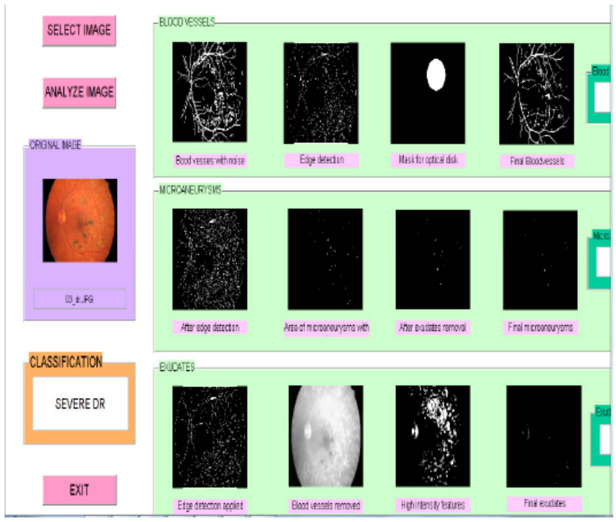



Figure .13: figure displaying the severity of disease

## 4. CONCLUSION:

An automated diagnosis system for the early signs of Diabetic Retinopathy have been developed by applying viable image processing techniques on the retinal color fundus got from the distinctive databases. The features like blood vessel, microaneurysms, exudates are extricated and recognized by utilizing MATLAB and applying the morphological operations. In view of the area of calculation, the framework utilizes the grouping as normal, mild, severe to recognize the phases of NPDR. Theframework groups the stages into normal, mild, severe of NPDR based on the area of features got from the results. This framework helps ophthalmologists in the mass screening procedure to distinguish manifestations of Diabetic Retinopathy rapidly and more effectively. The proposed system can be utilized as a preparatory conclusion device or decision supportive network for ophthalmologists. It doesn't require any client connection and the execution is reliable and proficient for both usual and unusual pictures

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