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Microaneurysms Detection of Retinal Image by Image Quality Enhancement

T.Thivya
Assistant professor
Department of Information technology
Sri Vidya College of Engineering and Technology

K. Karthigai Lakshmi
Final Year student
Department of Information technology
Sri Vidya College of Engineering and Technology

***Abstract*--Earlier identification of Micro aneurysm (MA) reduces blindness. Presence of MA is the way to recognize the Diabetic Retinopathy (DR) disease. The affected people have a small gloomy dot in their Retina. Eye specialist has a lot of trouble in the identification of this small dot in the retinal image. The image is poor in contrast and is noisy. Hence we use Contrast Limited Adaptive Histogram Equalization (CLAHE) which is the contrast enhancement process for the detection of MA. The main aim of using image enhancement is to extract the advanced details of the retinal image with detailed description. Here, Median Filter is used to make the retinal image smoother and maintains it for further processing. In the proposed system, three steps are used. They are Extraction of Green layer, Identification and Removal of large and dark objects and finally categorize Normal Eye or Diabetic Eye.**

IndexTerms: ***Diabetic Retinopathy, Microaneurysm, image enhancement, Retinal image.***

I. INTRODUCTION

Diabetic Retinopathy (DR) is the problem in the persons with diabetes which causes progressive damage to the retina. Normally, diabetes is a disease that interferes with the body's ability to use and store sugar which can cause many healthy problems. Too much sugar in the blood can cause damage throughout the body, including eyes. The longer a person has diabetes they will develop DR. It is the most common diabetic eye disease occurs when blood vessels in the retina change. In the beginning, it may cause no symptoms or only mild vision problems. Retina is a light-sensitive layer of tissue, facing the inner surface of the eye. Sometimes the vessels in retina are swelling and leak fluid or close off completely. It affects both the eyes and causes vision loss. However, it can result in blindness. The symptoms are spots or dark strings floating in your vision, blurred vision, irregular vision, dark or empty areas in your vision, fluctuating vision, vision loss, and difficulty with color insight.

For the detection of MA in the Retinal fundus image, morphological operators are used. To improve the performance some other measures can be used [1]. In Circular Hough Transformation (CHT), only the central part of the Micro aneurysm is identified. The process of finding the circles in the image using CHT has more number of steps. Here the classification is based on the Neural Network [2]. Localization and segmentation is used for the identification of DR disease. They alternatively use Histogram specification for color normalization [3]. Mathematical morphology provides a systematic approach to analyze the geometric characteristics of images and also image segmentation is applies for further processing [4].

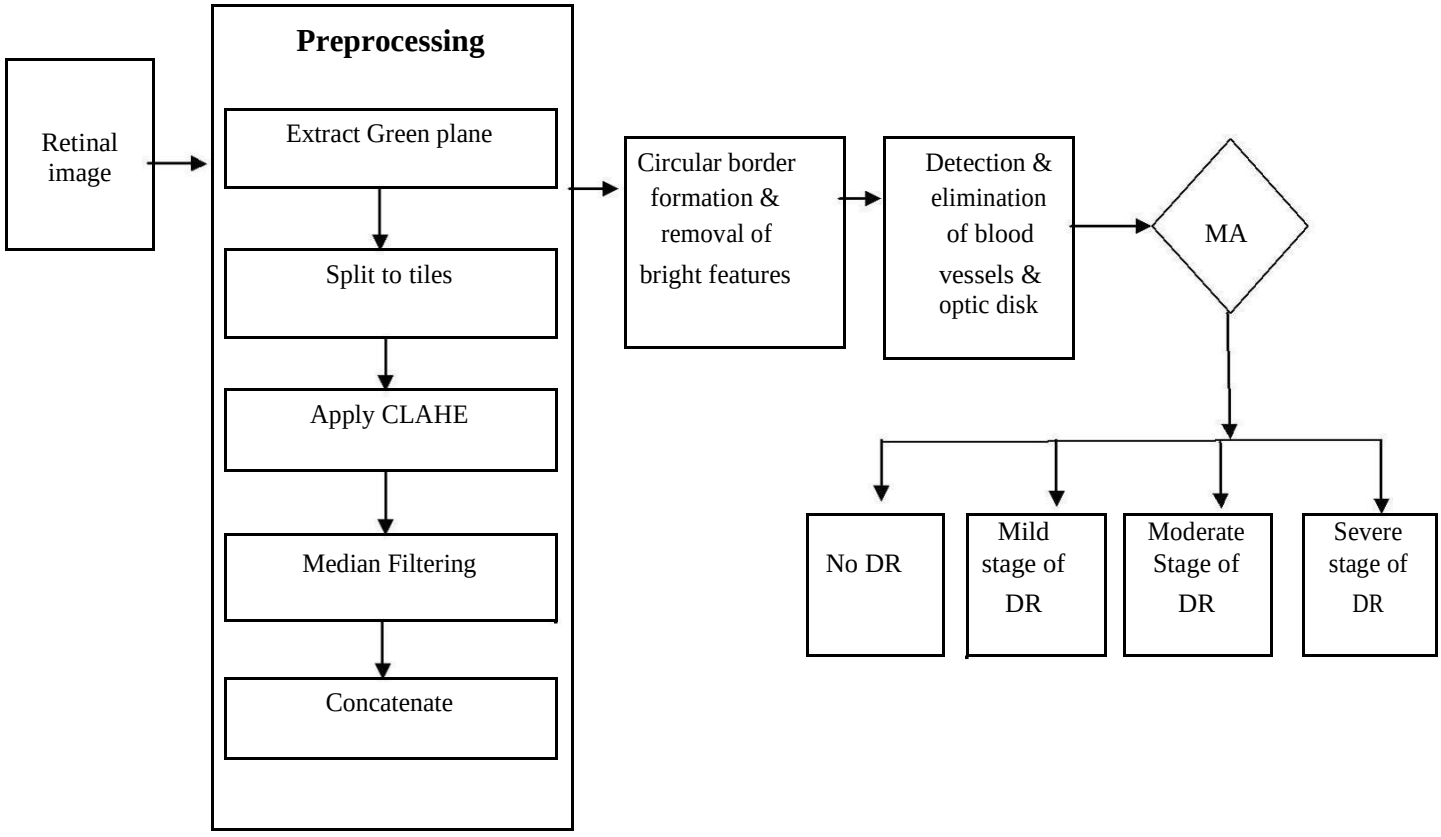

Figure 1. Block Diagram of the proposed system

II. PROPOSED SYSTEM

In the proposed system Image enhancement technique is used which increases the quality of an image. The diagram will help us to know about the features that are used in the proposed system is shown in Figure 1. Next, the upcoming steps will explain about the intermediary steps used for the detection of MAs.

A. Preprocessing steps

In general, Histogram Equalization plays an important role in image processing. The contrast of the retinal image is intense at the center and weakens at the side. In order to equalize the intensity level in the proposed system Contrast Limited Adaptive Histogram Equalization (CLAHE) is used. It improves contrast of the original image and is used to limit the amplification of noise in an image. It was proved that CLAHE was successful concept in biomedical image analysis.

The proposed system consists of six steps in preprocessing stage and they are as follows. In first step, Image of retina was selected as input, at first original image was often very noisy and low in contrast, so the detection of MA is very difficult for the ophthalmologist. Hence in step two, extraction of Green layer from the original image is done. It is selected to see the features of images more clearly. In step three, the image is divided into two by two regions also called Tiles. see the image clearer and visible. Then CLAHE is applied separately on each tiles, which improves the contrast of the image and also used for the detection of retinal changes in DR images. The results of pre-processing are shown in figure 2. In fifth step, median filter is applied on each tile. It is used after CLAHE which helps to suppress the background noise and smoothen the image. Finally Catenation is applied on four tiles to form a single image. This concatenation is applied on each

tile will help to find the circular border and also the blood vessels in the image after the initial steps.

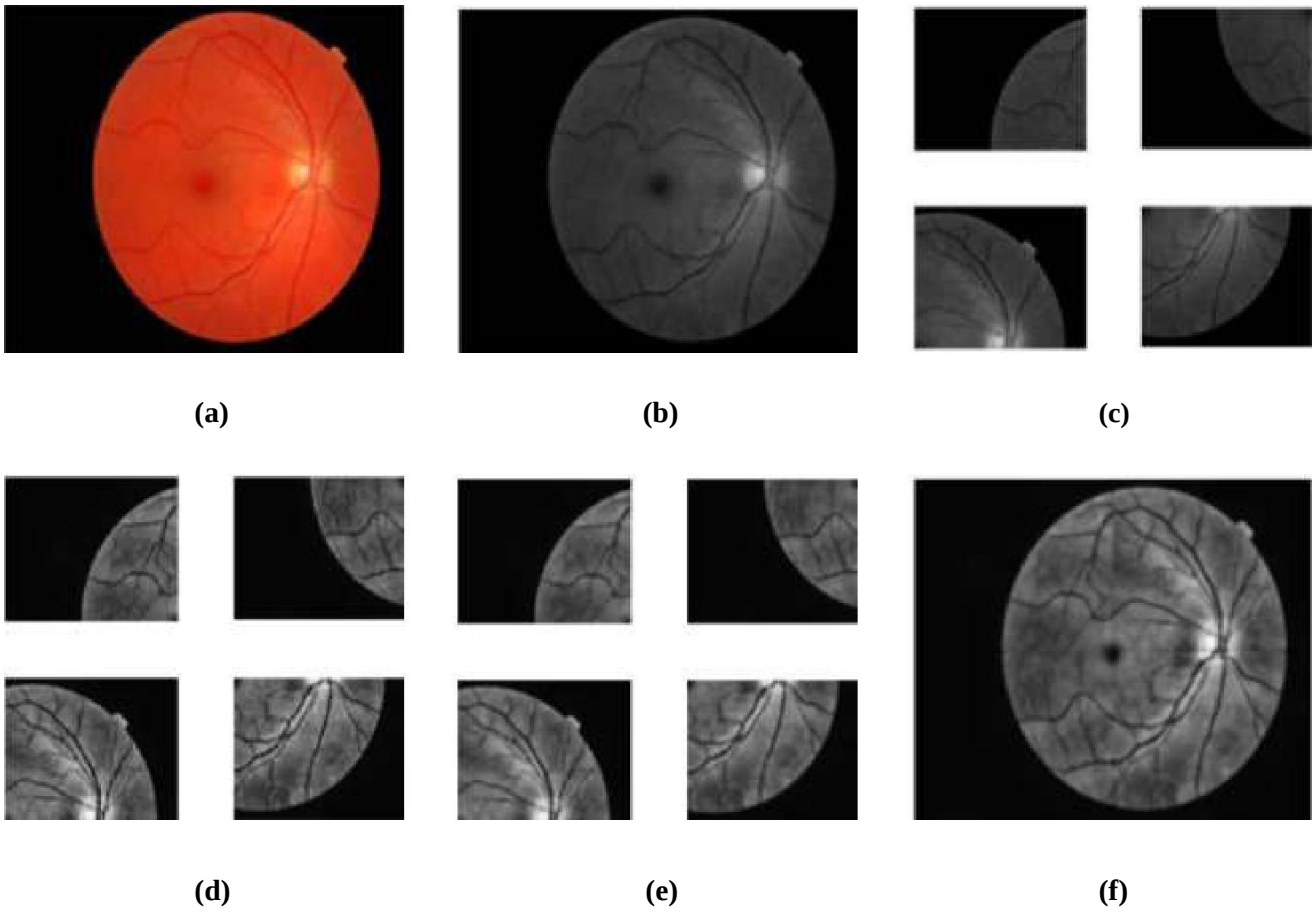

Figure 2. Results of pre-processing. (a) Original retinal image (b) Green layer of the image (c) Image split into tiles (d) Image after applying CLAHE (e) Image after applying Median filter (f) Concatenated image

B. Circular Border formation & removal of bright features

After the pre-processing steps, the image formed is free from noise but having large number of blood vessels and other bright features. Removal of circular border and bright features that helps for the detection of MA in the retinal fundus image. CANNY edge detection method is used for the discovery of edges in the retinal image. This technique is used to extract the useful structural information from different vision objects and reduces the amount of data to be processed. The detected edges should be as close as possible to the real edges of the retinal image. And hence circular border of the retinal image is formed by the application of canny edge detection method. Finally circular border is obtained after the subtraction with eroded image.

Removal of bright features and elimination of large objects are done by using mathematical morphological operators or methods. It also helps to remove the exudates, bright vessels, veins, and lesions. Even after the above process, resultant image is obtained with noise. This type of noise and exudates are removed by applying AND logic on the retinal image.

C. Detection and elimination of Blood vessels and optic disk

Blood vessels are the part of the circulatory system that circulates the blood to the entire organisms of the body. Normally detection of MA includes detection and elimination of optic disk and blood vessels as its basic steps because these are the normal features of the retinal fundus image. In this proposed system, for detection of Microaneurysm includes the detection and elimination of blood vessels and optic disk. Then the blood vessels in retinal image are detected and extracted by applying the morphological operators. After this process even the small area of noise can be eliminated. By using the AND logic this image is compared with the previous AND logic and blood vessels are removed.

Centre of Optic disk is the origination of retinal blood vessels and spreads over the region of retina. Collection of bright pixels are optic disk and it is developed in anywhere in the retinal image. To enclose the optic disk, mask is created. The relation used for creating the circle is

where h and k are coordinates (row and column) and R is the radius. The image without optic disk is obtained after the created mask is subtracted from the existing retinal image.

D. Microaneurysm Detection

Detection of MA in the retinal image is very difficult for the eye specialist. By improving the Quality of image, it was easily getting identified. In this overall process, green layer of retinal image is selected as input where red and blue layer are not clear. And then to increase the quality and make the image more clearer, image enhancement is used. CLAHE improves the contrast of the image and helps for further identification process. It was developed to prevent the over amplification of noise in the retinal image. Median filtering is one of the best filtering techniques, used to suppress the noise in the retinal image. Canny algorithm is adaptable to various environments. It is used to find the circular border of the retinal image and also the large objects. Blood vessels and optic disk is also detected and eliminated by the use of some morphological operators. Finally MA is detected.

Presence of MA is varied according to the people and their disease level. Person severely gets affected by the diabetes, have large number of MA will be present in the retinal image. Hence to identification of the level of MA in the retinal image will help for the treatment of patient and also for the ophthalmologist. Hence in the proposed system, detecting the levels of MA is implemented. In the severe stage of DR number of small dots in the retinal image is more where patient get highly affected. The second stage is Moderate stage of DR, where the number of MA in the image is second prior to the first stage i.e. the counts of small dots are less when compared to the first stage. Third stage is earlier stage for the disease. They can get easily identified and cured and this is the mild stage of DR and the final stage is no DR stage where no MA is present in the retinal image. In this stage the people are not affected by the DR**.** This categorization will help for taking different types of treatment. It will also help for the doctors to differentiate the levels of people according to their level of MA in the retinal image.

This categorization of levels is one of the best way to reduce the trouble for the eye specialist. This will also be useful for the patient to know well about their level and help for them to improve their life style and the food habits.

III. RESULTS AND DISCUSSION

The proposed method is applied for more number of retinal images of different people. It is used for checking the normality and abnormality of the eye. The performance of the proposed method will be evaluated after the completion of the experiments. Results of the further process will be completed at the time of conference.

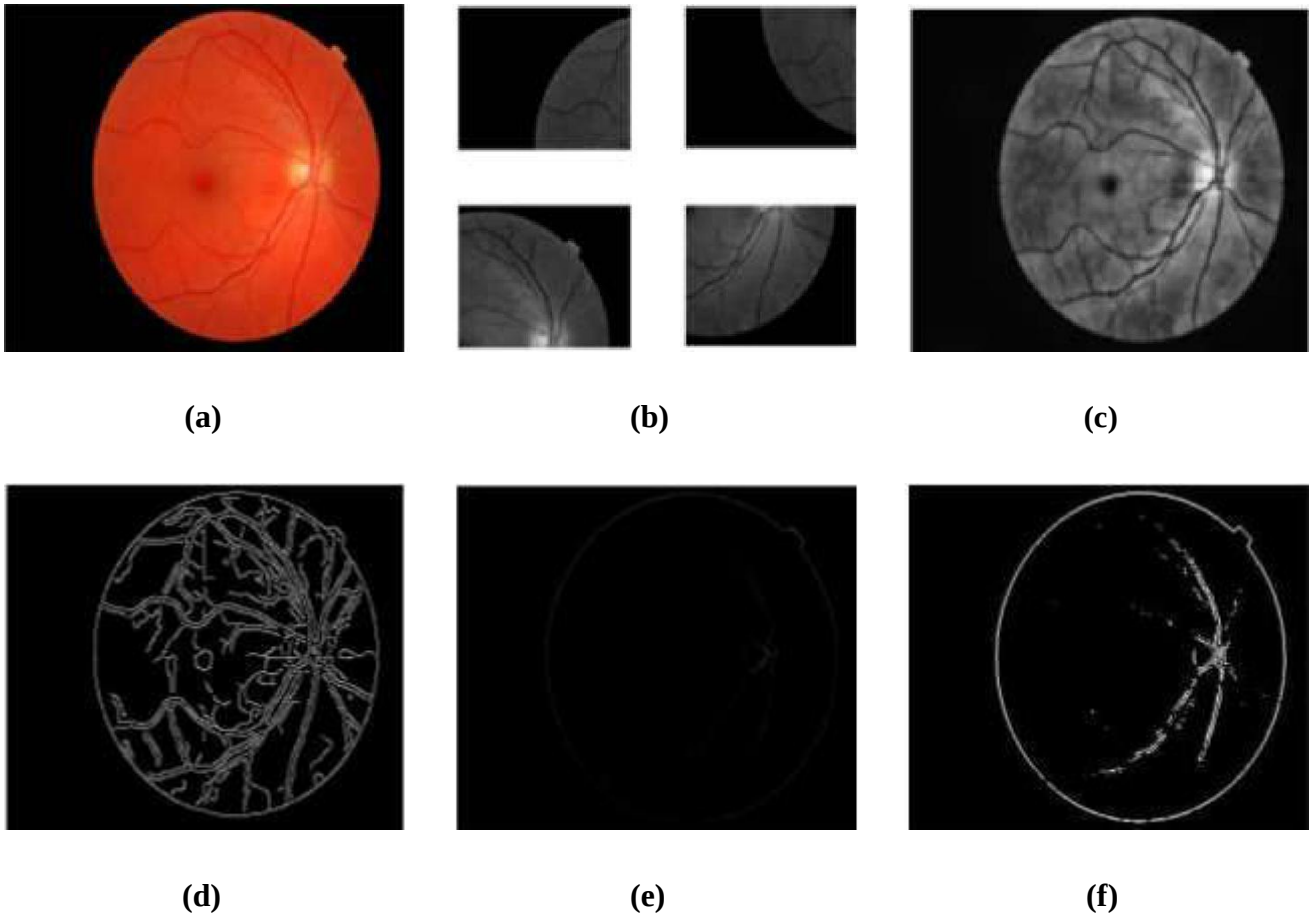

Figure 3. Results after all experiments. (a) Original retinal image (b) splitting up into tiles

(c) resultant image after pre-processing steps (d) Image formed after CANNY edge detection (e)circular border of retinal image (f) Bright features of the retinal image

IV. CONCLUSION

The automated Diabetic Retinopathy screening process is used to notice the symptoms faster and easier for the ophthalmologist. Image enhancement that used in the proposed method improves the quality of the image even the small details. Grading the DR stage by calculating the number of MAs in the retinal image. It helps for the further treatment of the affected people and eye specialist. It also helps to analyse the Identification of MAs and mention them in grades according to the harshness of the DR disease level.