Microaneurysms Detection from Retinal Image and Diabetic Retinopathy Grading

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Abstract

From the last few decades, diabetes has emerged as a fast growing disease. Diabetic retinopathy (DR) is the most common diabetic eye disease. Diabetic Retinopathy is a medical condition where the retina is damaged because fluid leaks from blood vessels into the retina. In extreme cases, the patient will become blind. So, early microaneurysms (MAs) detection and diabetic retinopathy (DR) is important in avoiding vision loss. Since the presence of micro aneurysms (MAs) is usually the first sign of DR and occurs due to blood vessel damage in the retina. Early MAs can help to reduce the incidence of blindness and it is the first step in automated screening of Diabetic retinopathy. The presences of MAs in the retina are the earliest symptoms of DR. The counts of MAs are used to indicate the severity of the DR disease and early microaneurysms (MAs) detection and diabetic retinopathy (DR) grading is important in avoiding vision loss.

Keywords: Diabetic Retinopathy (DR), microaneurysm (MA).

1. INTRODUCTION

The World Health Organization estimates that 135 million people have diabetes mellitus worldwide and that the number of people with diabetes will increase to 300 million by the year 2025. Medical image analysis is one of the research areas that is currently attracting intensive interests of scientists and physicians. It consists of the study of digital images with the objective of providing computational tools that assist quantification and visualisation of interesting pathology and anatomical structures [1]. The progress, which has been achieved in this area over recent years, has significantly improved the type of medical care that is available to patients. The severe progression of diabetes is one of the greatest immediate challenges to current health care. The number of people affected continues to grow at an alarming rate. According to recent survey, 4.4% of the country population has been diagnosed of diabetes disease alone and it have been recognized and accepted as one of the main cause of blindness in the country if not properly treated and managed [1]. Early detection and diagnosis have been identified as one of the way to achieve a reduction in the percentage of visual impairment caused by diabetes with more emphasis on routine medical check which the use of special facilities for detection and a lot of approaches have been suggested and identified as means of reducing the stress caused by this constant check up and screening related activities among which is the use medical digital image processing for diagnosis of diabetes related disease like diabetic retinopathy using images of the retina[4-6]. Diabetic retinopathy can be broadly classified as nonproliferative diabetic retinopathy diabetic patients retina is very important. And, automated or computer assisted analysis of diabetic patients retina can help eye care specialist to screen larger populations of patients[22-30]. With a large number of patients, the workload of local ophthalmologists is highly unsubstantial. So the automated detection systems should be able to limit the severity of the disease and pave assistance to the ophthalmologists in diagnosing and remedying the disease, effectively. To build such automated systems, different modules are needed for analyzing retinal anatomical features such as fovea, optic disc, blood vessels, and common diabetic pathologies, such as hemorrhages, micro aneurysms, and exudates.

In this paper section II presents our proposed method in detail. In Section III Results and efficiency of the proposed method is examined by comparing the experimental results obtained by the use of proposed method and the state of art technique. then conclusion and the acknowledgement of the proposed work.

2. METHOD OVERVIEW

The process of automatic diabetic retinopathy detection involves detection of the abnormal features from the input images and grading of the diabetic retinopathy stage. The basic system block diagram for automatic diabetic retinopathy detection and grading is as shown in figure 1 and Procedure for Retinal abnormalities such as (Microaneurysms, Hemorrhages and Exudates) detection shown in figure 2. The proposed method is made up of three fundamental stages:

1. Image Pre-Processing: The aim of pre-processing is to attenuate the noise to improve the contrast and to correct the non-uniform illumination. In the RGB images, the green channel exhibits the best contrast between the vessels and background while the red and blue ones tend to be more noise. Hence green channel is used for further processing. Resizing of the input RGB retinal image Firstly original Red, Green, blue (RGB) image is resized to the standard size (512*512) pixels, without changing its aspect ratio[7]. In this RGB images is transformed to gray scale image as shown in figure (3) because gray channel has a better contrast over RGB then DCT and blocks wise splitting and merge method is applied to check the homogeneity property for each region. If the homogeneity property fails, we split up the region into 4 quadrants. If the region satisfies the homogeneity property we merge it with the adjacent region.

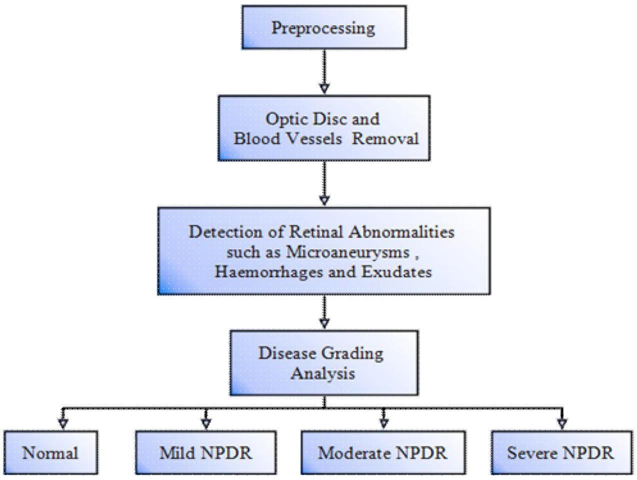

Fig. 1: Block diagram of proposed method.

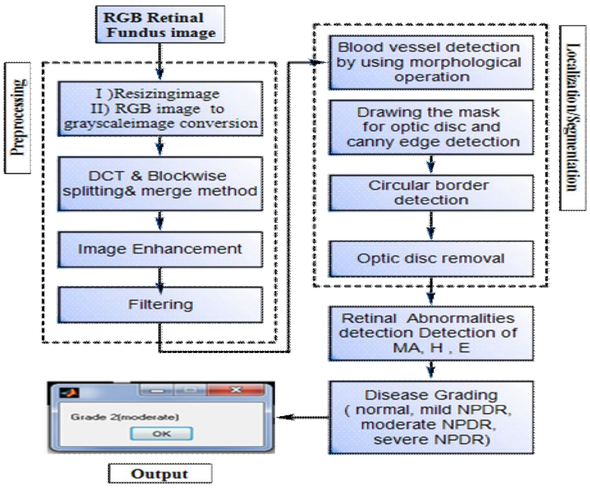

Fig. 2: Procedure for Retinal abnormalities such as (Microaneurysms, Hemorrhages and Exudates) detection

2. Localization/Segmentation: Image localization/ segmentation process consist various sub process are carried out on input image such as Image enhancement, Filtering, Blood vessel detection and removal, Drawing the mask for optics disc and Circular border formation etc. Image enhancement technique does not add any extra information to the original image. It merely improves the subjective quality of the image by working with the existing data. It convert blur image into quality image then filtering is used for removal of noise in proposed system wiener filtering method is used which performs 2D adaptive noise removal filtering on grayscale image. It is low pass filters a grayscale image that has been degraded by constant power additive noise. After applying filtering Blood vessels are detected by using simple threshoulding method and blood vessels are removed by morphological operations. For drawing the mask for optic disc, we should find out the circular part / radius of circle. So the mask is created using the circularhough transform. Relation for creating the circles R2 = (X - h)2+(Y - k)2 Canny edge detection. In drawing the mask for optics disc step all the edges of objects present in the input image are detected with canny threshold method. Then at last Circular border of the image can be detected by subtracting the morphological eroded image from dilated image. Results after Localization are shown in figure 4 and 5.

3. Microaneurysms, Haemorrhages and exudates detection: In detection of Microaneurysms, Haemorrhages and Exudates first Subtracting optic mask from binarization of eroded image to remove the optic disc. After this the circular and rectangular border is removed for ease of detection [16-19]. With the help of closing operation that is by Im close function to find out brightest region in retinal image. Non microaneurysms region detection purpose adaptive histogram equalization technique is used to enhance the contrast of intensity adjusted image. Output from this step is binarized by using IM2BW function with thresholding value of 0.85. Then the output from the expanding the region and non MA region is ended to get only the Micro aneurysms MAs part as

In this project our aim is to find MAs by its diameter and isolated pixels with a constant intensity value. for that purpose image size is 512x512 pixels, the size of Mas is about pixels. If MAs are increased then they tend to becomes

Hemorrhages which have any unpredicate large shape. After this exudates (E) create due to bursting of Hemorrhages (H). So according to the area of pixel by stat and bounding box function, MAs, H, E can be detected. After the detection of Microaneurysms, classification groups the eye images as either diseased or normal depending on the count of detected microaneurysms. Classification can be used to grade the DR into four stages as no DR, mild DR, moderate DR, and severe DR[8] as shown in Table 1.

3. PERFORMANCE RESULTS AND COMPARISON

In this project DRIVE purpose of evaluation three datasets were used namely, MESSIDOR database (total images taken= 36)[20], E-optha database datasets (total images taken= 20)[19]and real time database from H. V. Desai Eye Hospital, Hadpasar, Pune, which is 2nd ranked eye hospital of India with specifications (total images taken = 55) Real time image dimensions is : 2438*2112 pixels, Image size = 14.7 MB Type of image file : bitmap image file Camera used to take the image is FF450 Zeiss Fundus Camera Field of view = 30o; 45o; 120o; 180o: Total images from all three databases on which work is done =110 images. These images are tested using the MATLAB program. MATLAB stands for ”Matrix Laboratory”. It is developed by MathWorks. It is a high-level technical computing language and interactive environment for algorithm development, data visualization, data analysis, and numeric computation. Simulink (Simulation and Link) is a graphical extension to MATLAB for modeling and simulation of the systems. The image size considered here is 512 x 512 pixels with 24 bits per pixel. The proposed algorithm takes no time for execution. For experimentation, from the data set ten images are evaluated out of these 1 healthy images, 2 are mild images, 6 moderate images and 1 severe image. Table 2 shows the microaneurysms detected by the algorithm in grade verious parameters such as Ma, E, H etc. Figure 7 shows the selected output images of Diabetic Retinopathy for reference.

Other than the results of MA performance of proposed algorithm also tested with help of different parameters such as Accuracy, Precision, specificity and Sensitivity with the help of MATLAB and following equations

Sensitivity =TP =TP + FN.

Specificity =TN=TN + FP

Precision =TP =TP + FP

Accuracy= TP + TN = TP + FP + FN + TN obtained results from proposed algorithm in percentage shown in graphical form in figure 8 , on the basis of above mentioned parameters are listed below in table III. Proposed System is compared with previously reported algorithms. Table IV shows comparison of average Performance Metrics of the different Datasets. table IV shows that proposed system is best in respect to Sensitivity, Specificity that means proposed system best sense MA as compared to [9]. Graphical view of grading parameters such as Ma, E, H is shown in figure 7.

4. CONCLUSION

From above results and comparison we conclude that, proposed system satisfactorily detects the presence of abnormalities in the retina such as MA, E, H with Sensitivity of 94.28749%, Specificity of 93.66891% and Accuracy of 94.8144 % using mathematical morphological operation of the digital image processing. All online database images and real time database grade results are matched with the online database ground truth and ophthalmologists hand drawn ground truth. The results are encouraging and these methods contribute to overall goal of development of a system for the automated screening of diabetic retinopathy. Thus, the method can help the ophthalmologist to detect the microaneurysms in the screening process.

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