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Comparison of Techniques for Diabetic Retinopathy Detection Using Image Processing

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Abstract: ***Diabetic retinopathy remains an alarming prospect to patients and disappoints doctors. Destruction of damaged retina by photocoagulation remains the primary treatment almost 50 years after its presentation. The diabetes pandemic requires new ways to deal with the pathophysiology and enhance the discovery, prevention, and treatment of retinopathy. This point of view considers how the exceptional life systems and physiology of the retina may incline it to the metabolic worries of diabetes. The parts of neural retinal modifications and debilitated retinal insulin activity in the pathogenesis of early retinopathy and the instruments of vision misfortune are accentuated. Potential intends to defeat confinements of current creature models and demonstrative testing is additionally given the objective of quickening treatments to oversee retinopathy even with continuous diabetes. Modified exudates disclosure and retina pictures gathering would be valuable for diminishing diabetic retinopathy screening costs and engaging standard examinations. We proposed the wonder that applies numerical showing which enables light drive levels highlight, exudates acknowledgment, capable and revise revelation of retina pictures.***

Keywords: Diabetic Retinopathy, Exudates.

I . INTRODUCTION

Diabetic retinopathy (DR) is a vascular ailment of the retina which influences patients with diabetes mellitus. This harms the retina of the eye and may prompt to visual impairment if the level of diabetes is exceptionally high. Diabetes happens when the pancreas neglects to discharge enough insulin, gradually influencing the retina of the human eye. As it advances, the vision of a patient begins breaking down, prompting to diabetic retinopathy.

Diabetic retinopathy falls into two rule classes: nonproliferative and proliferative. "Proliferative" recommends paying little regard to whether there is neovascularization (sporadic vein change) in the retina early defilement without neovascularization is called nonproliferative diabetic retinopathy (NPDR). As the illness moves, it might advance into proliferative diabetic retinopathy (PDR), which is portrayed by the closeness of neovascularization and has a more fundamental potential for real visual results.

NPDR Hyperglycemia acknowledges harm to retinal vessels. This handicapped people the thin dividers and results in insignificant out-pouching of the vessel lumens, known as microaneurysms. Microaneurysms as time goes on break to shape hemorrhages critical inside the retina, constrained by within obliging film (ILM). As an outcome of their spot like appearance, they are called "bit and spread" hemorrhages. The debilitated vessels likewise persuade the chance to be unmistakably broken, making liquid drench the retina. Liquid clarification under the macula, or macular edema, meddles with the macula's normal breaking point and is a common reason behind vision misfortune in those with DR. Confirmation of liquid lakes can leave dregs, like a fading away stream after a surge. This silt is made out of lipid repercussions and shows up as waxy, yellow stores called hard exudates. As NPDR advances, the influenced vessels finally persuade the chance to be especially avoided. This block may understand dead tissue of the nerve fiber layer, accomplishing cushioned, white patches called cotton wool spots (CWS).

II. LITERATURE SURVEY

The data mining technique decided in this paper places focus on the part significance and gathering methods to exactly sort the disorder associated with the retina in perspective of the components expelled from retinal pictures through picture taking care of procedures [1]. The result of the exudates recognizable proof is showed up as white pixel against the dull shaded establishment. The proposed computation focuses on intricacy redesign and the highlight of the force of the restricted exudates areas. The execution of the figuring is brisk and powerful in light of the associated numerical illustrating [4]. The SVM classifier is used to review the earnestness of this affliction whether the patient is respectably affected or greatly impacted [5]. To improve assessing execution, consider the proximity or nonattendance of more DR-specific bruises (e.g. exudates), which essential in a clinical are setting. In any case, our MA identifier can serve as an essential piece of such a structure [8].

III. METHOD

A .Image Acquisition

The database, DIARETDB0 consists of 130 color fundus images of which 20 are normal and 110 contain signs of the diabetic retinopathy (hard exudates, soft exudates, micronaneuyrysms, hemorrhages, and neovascularization). Images were captured with a 50-degree field-of-view digital fundus camera with unknown camera settings. The data correspond to practical situations and can be used to evaluate the general performance of diagnosis methods. This data set is referred to as "calibration level 0 fundus images".

B. Image Preprocessing

After the image acquisition binary mask of that image is created. The gradient image is calculated and a threshold is applied to obtain a binary mask that contains the segmented cell. For this purpose edge function with sobel operator is used. The threshold value is tuned as per our requirement.

C. Dilation of image

Lines of high contrast can be seen in resulting binary gradient mask. On comparison with original image gaps in lines are visible. These linear gaps are removed using dilation of sobel image using linear structuring element.

D. Removing the connected objects

Now that we have obtained a segmented region of interest, we have to remove unnecessary objects that have been found. These objects present on the border of the image are removed.

E. Output Image

To make the segmented image look natural, apply erosion using diamond structuring element. Hence, this segmented image gives detected exudates from the retinal image.

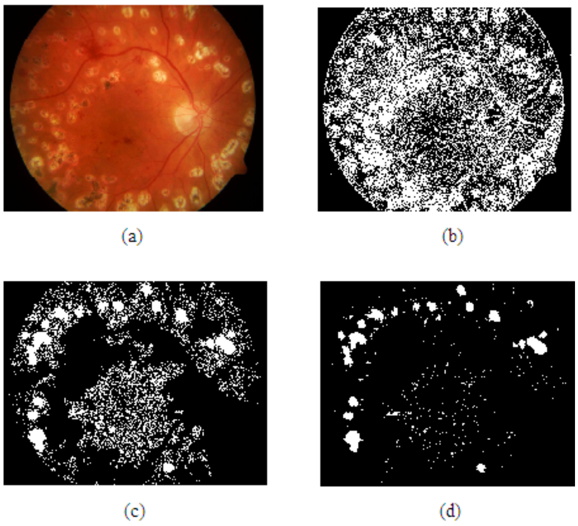


Fig.1. The method I outputs. (a) Original image (b) Dilated gradient image (c) Cleared border

Image (d) Segmented image.

IV. METHOD

A .Image Acquisition

The DIARETDB0 database consisting of 130 fundus images and STARE database consisting of 400 images are used. STARE database is Structured Analysis of the Retina Project initiated at University of California, San Diego. Images from STARE database were provided by Shiley Eye Center and Veterans Administration Medical Center in San Diego.

B. Image Preprocessing

For image processing of medical images, green channel images describe more features than that of red channel and green channel. So, initially, green channel extraction is performed.

Red Channel : $r = R/(R + G + B)$ (1)

Green Channel : $g = G/(R + G + B)$ (2)

Blue Channel : $b = B/(R + G + B)$ (3)

The histogram technique that is used to enhance the brightness and contrast of an image is histogram equalization. The target of histogram adjust is to course the lower levels inside a photo so that every dull level is correspondingly at risk to happen. Histogram equalization will increase the brightness and contrast of a dark and low contrast image, making features observable that were not visible in the original image.

C. Contrast Enhancement

A special case of contrast stretching is used to brighten the exudates called thresholding. Intensity transformation can be used for enhancement of exudates. The intensity transformation function is represented by T.

$s = T(r)$ (4)

where r and s are variables denoting gray levels of the image at any point.

D. Removing Optic Disc from the image

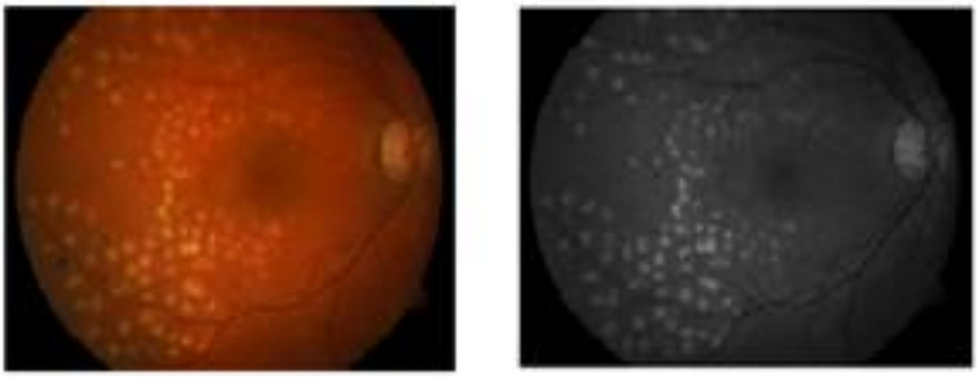
To obtain an image with removed optic disc subtraction operation of images is used. Image obtained after contrast enhancement is subtracted from the original image.

E. Thresholding

To make detection of exudates visible, adaptive thresholding is used. For adaptive thresholding, different threshold values for different local areas are calculated. The scale used for thresholding is 0:1.

F. Symlet Wavelet

After applying thresholding, we can observe that the detected exudates contain some noise. To nullify this noise, we apply symlet wavelet of level 1.



(a) (b)

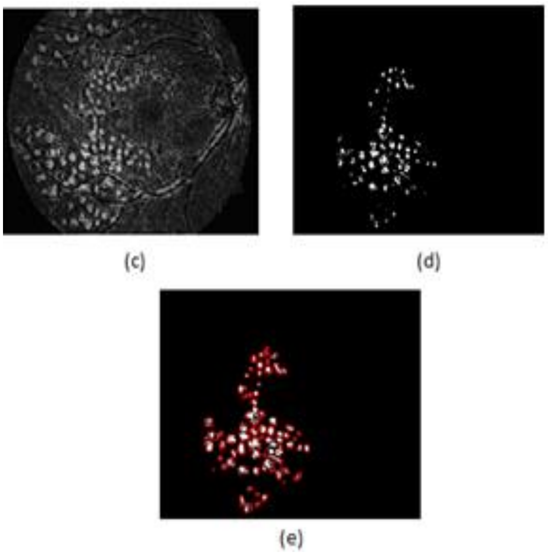


Fig.2. Method II outputs. (a) Original image
(b) Green Channel Image (c) Removed Optic Disc Image (d) Image after applying Wavelet Transform (e) Exudate Detected Output

RESULT

METHODOLOGY I

In this approach, we convert the image into binary and the apply sobel operator. Then using dilation we remove the linear gaps and then the borders are cleared by removing the connected objects. Then by applying erosion, we smoothen the segmented image and the exudates are detected. The segmented image is shown in Figure 3.

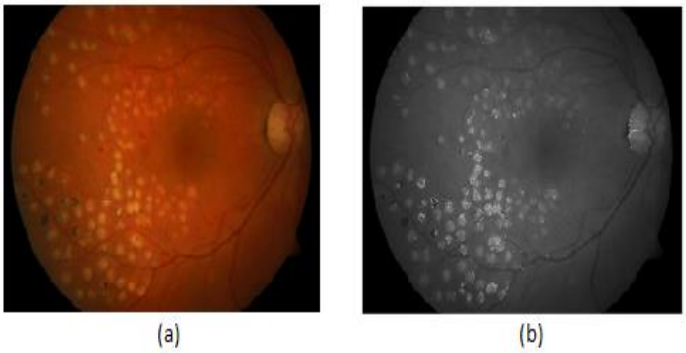


Fig.3. The method I output. (a) Original image
(b) Final Output

METHODOLOGY II

In this methodology, we extract the green channel as it displays maximum characteristics of the retinal image. Then we apply histogram equalization followed by thresholding to set the contrast of the image. We perform image subtraction to remove the optic disc and reapply thresholding to make the exudates visible. Symlet wavelet is applied to remove noise. The output is shown in Figure 4.

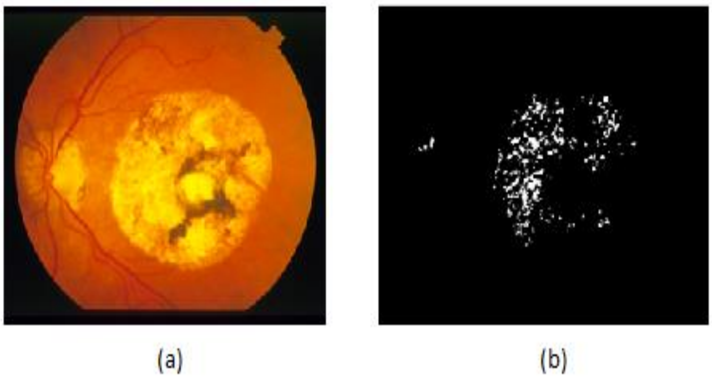


Fig.4. Method II outputs. (a) Original image
(b) Final Output

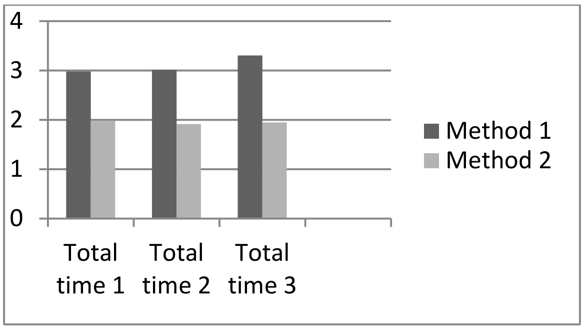


Fig.5.Bar graph showing response time (in seconds)

The above graph shows the comparison of the response time of the two methodologies. The time required for entire processing is depicted in the graph. Based on the readings of the graph, we can say that the extraction based on the green channel has faster response time than the former method.

CONCLUSION

We implemented two methodologies to detect diabetic retinopathy using retinal images. The main advantage of using this method is that blood does not need to be drawn from the human body. Instead, retinal images can be used to deduce to diabetes.

The first method used sobel operator and morphological operations like erosion and dilation. But the response of these operators is not efficient and hence needs post processing. Hence this methodology increases complexity.

The second method makes use of green channel which enhances the retinal properties. We apply histogram equalization and thresholding and remove the optic disc by image subtraction. The exudates are detected by thresholding and applying symlet wavelet. The output obtained by this approach are much efficient than the previous. The percentage of exudates detected is much more than the previous method.

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