MICROANEURYSM DETECTION USING ACTIVE CONTOUR MODEL WITH DIABETIC RETINOPATHY SCREENING

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ABSTRACT

Diabetic retinopathy is most leading disabling diseases effected in retina, it will be the leading causes of preventable blindness in the world. For automated screening programs of diabetic retinopathy, image processing and analysis algorithms have to be developed. Microaneurysms are the first sign of diabetic retinopathy for automatic screening. The number of microaneurysms are used to indicate the severity of the disease like diabetic retinopathy mild, diabetic retinopathy moderate etc. Early microaneurysm detection can help to reduce the occurrence of blindness. Candidate objects are first located by applying a dark object filtering process, active contour model for detect the vasculature and neural network for classification. Contour model segmentation in fundus images is a nontrivial task due to variable size of vessels, relatively low contrast, and potential presence of pathologies like microaneurysms and other diabetic retinopathy signs. This model can also find out different stages of diabetic retinopathy like diabetic retinopathy mild, diabetic retinopathy moderate, diabetic retinopathy severe etc with high accuracy using neural network classifier. Diabetic retinopathy pathologies were further categorized into several groups. In this paper several different databases are presented. The proposed method is performed on the green channel of retinal fundus image. the MAs, hemorrhages and vessels normally present the highest contrast against the surrounding background in green channel, so microaneurysm appear as bright structure and get finer details [6]. MA detection process is divided into mainly 4 steps, there are preprocessing, candidate extraction through multilayered dark object filtering, vasculature detection based on active contour model and classification.

Keyword: - *Diabetic retinopathy, Image processing, Microaneurysms, Multilayered dark object filtering, Contour model.*

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1. INTRODUCTION

DIABETIC retinopathy (DR) is a major retinal issue since it can lead to blindness in patients with diabetes. Microaneurysms (MAs) are usually the first symptom of DR[1].One possible complication of the disease is diabetic retinopathy, diabetic retinopathy occurs inside the retina when diabetes damages the tiny blood vessels[2]. There are mainly two types of diabetic retinopathy, they are non-proliferate diabetes retinopathy (NPDR) and proliferate diabetes retinopathy (PDR). Non proliferative retinopathy is the early stage of diabetic retinopathy and can be viewed only by high resolution fundus photography. The effective treatment of diabetic retinopathy can inhibit the Progression of the diseases. Many patients are not aware of this disease. Proliferative retinopathy is the later stage of diabetic retinopathy. Here dark red blood spots appear in the eye due to the bursting of fragile blood vessels of the retina. If the symptoms are identified in earlier stage, it will prevent the burden of the disease [3]. The first significant symptoms of diabetic retinopathy is small reddish dot in the retina, this is called microaneurysms. Neural Networks help to detect the symptom by trying to mimic the structure and function of our nervous system. Recognition of microaneurysms is an essential task when developing an automated analysis system for diabetic retinopathy detection. The manual microaneurysm detection is a lengthy task for professionals and researches, and it requires a number of resources. Our goal is the detection of microaneurysms and stage of diabetic retinopathy by size and shape.

2. DIABETIC RETINOPATHY

Diabetes is a well known disease that may cause abnormalities in the retina (diabetic retinopathy) and nervous system (diabetic neuropathy). Also diabetes can make a major risk for cardiovascular diseases. Diabetic retinopathy is a microvascular complication caused by diabetes which can lead to blindness in the working age population[4].blood vessels providing blood supply to the retina when blood vessels gradually weakens due to diabetes, it can be swelled and blocked. The disordered and weak small blood vessels are not able to maintain the right blood supply, they can be burst, and thereby exudates and blood can leak out to the vitreous part. The blood flown to vitreous part obstructs the path of light to the retina, thereby worsens vision.

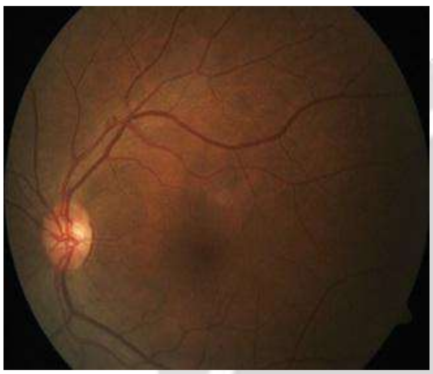

Fig- 1: Image of normal retina

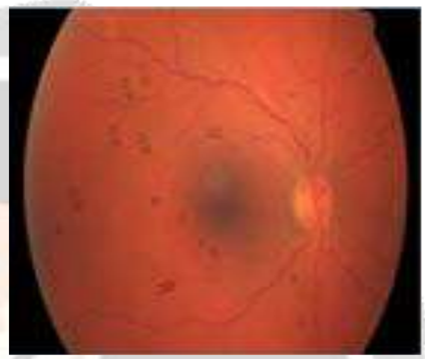

Fig- 2: Image of Diabetic Retinopathy

In Some times fluid is flows below the retina, then it can move from back wall of the eye, such condition distorts vision. In serious cases the retina and blood vessels are detach, which causes blindness. In early stages of diabetic retinopathy like microaneurysms (MA) have typically no visible signs, but the severity and number of abnormalities increase during that time. The early stage of Diabetic retinopathy typically starts with small changes in retinal capillaries. The first detectable abnormality is microaneurysms, which results local enlargements of the retinal capillaries. The ruptured microaneurysms can cause hemorrhages that appear as flame or blot like structure. The small circle shaped swelled vessels are called microaneurysms (MA)[5.], which can be detected in early stages of the diabetic retinopathy.

3. PROPOSED METHOD

The proposed method is performed on the green channel of retinal fundus image. the MAs, hemorrhages and vessels normally present the highest contrast against the surrounding background in green channel, so microaneurysm appear as bright structure and get finer details [6]. MA detection process is divided into mainly 4 steps, there are preprocessing, candidate extraction through multilayered dark object filtering, vasculature detection based on active contour model and classification. The details of these 4 stages are described in the following sections.

3.1 Image Preprocessing

Preprocessing is the common stage which attenuates the effect of the noise and retains the true information of MAs. The techniques performed on the green channel of RGB color image, the filtered image Igg is catch by Gaussian filter is applied to the green channel Ig. It enhances the small and dark structures as shown in Figure. 3 (b). Due to the noise many tiny structures preserving those corresponding to MAs or vessels. The Gaussian filter with particular size of width and variance removes this tiny structure. In his project apply width = 3; variance = 1 for best result.

Also it can identify, when bright regions or lesions are close together form a small gaps between them to be consider as MAs in the later stages of the processing [7]. In order to prevent these false positives (FPs), a shade correction method [8] is extended to remove any bright region from image Igg.

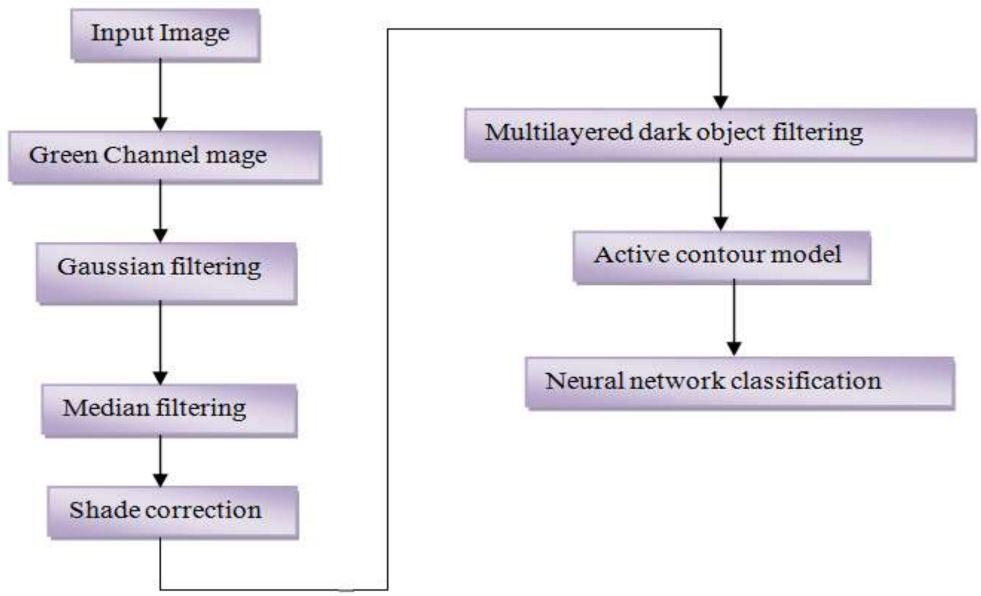

Fig-3: Block diagram of proposed method

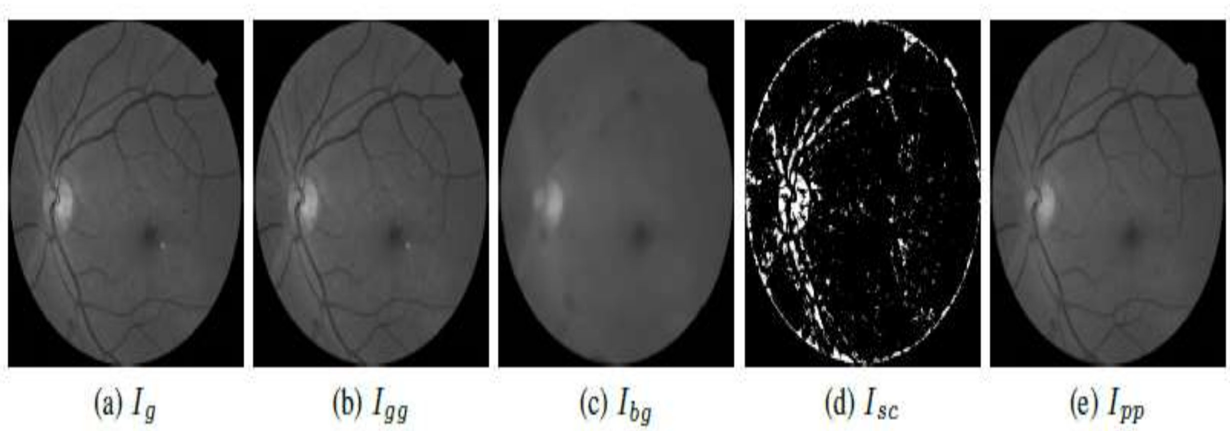

Fig-4: (a)The green channel of the fundus image. (b) The Gaussian filtered image of (a). (c) The estimated background image Ibg. (d) Shade correction image Isc was accomplished by subtracting the median filtered image Ibg from Igg. The white parts indicate bright regions (including bright lesions). (e) The preprocessed image Ipp (the bright pixels in Igg indicated in Isc are replaced by the values of corresponding pixels in Ibg).

1) First, estimate a background image Ibg (Figure. 3 (c)) by applying a median filter with particular background estimation range (35 x 35) to Igg.

2) Obtain shade correction image Isc by Subtract Ibg from Igg (Figure. 3 (d)). Any pixel in Isc that has a positive value means, in Igg, the corresponding pixel has higher intensity value than its neighbouring retinal background intensity These pixels are used to locate bright regions in Igg.

3) All bright pixels in Gaussian filtered image (Igg) indicated by shade correction image (Isc) are replaced by corresponding pixels value in Ibg resulting in an image Ipp (Figure. 3 (e)). this process removes all the bright regions (including brightlesions) from the image Igg, it also removes the gaps among the bright lesions or regions cluster together causing to be considered as MAs. the pixels in Isc with a zero or negative value are processed for candidate extraction in the next stage.

3.2 Multilayered Dark Object Filtering for Extraction

any object in the image showing MA-like characteristics then Candidate extraction process identify such characteristic. These candidates will then be further analyzed or classified into MAs and non-MAs using filtering process. The methods is able to extract isolated MAs away from other dark objects including vessels. However, when an MA is next to other dark objects, it was often not detected but considered as part of the neighboring objects. Calculate its eight neighboring pixels have lower or the same intensity. Here the pixel regarded to be a local maximum (in an inverted image), if The use of these local maxima made it easier to find out more MAs.

First histogram is applied, Histogram equalization automatically determines a transformation function that seeks to produce an image with uniform histogram. If background and image pixels have gray levels, they can be separated with a threshold value. The value 0 represent background and 1 represent object or aneurysm. Then This image is converted to binary. Binary image also have two values: 0 and 1. For segmentation of image, Binarisation is one of the important approaches. The gray scale image is converted into black (background) and white (aneurysm) image after binarisation. Lighter region is converted to white and the darker area will be transformed to black pixel, so only black and white pixel will be present. Then compare each pixel with its eight neighboring pixels. In the final step we get the image after vessel removal. This image has no boundary so in next step detect the outer side using edge detection method.

Then calculate the area based on threshold value. Connected components that are less than threshold value, which produce another binary image BW3. This operation is known as an area opening operation, used to attain detection of microaneurysm. multilayered dark object filtering method reduce common interfering structures as MA candidates such as vessel crossings as well as many small background regions due to high local intensity variation. After preprocessing, all pixels with negative values or zero value in Isc are regarded as initial positions to examine dark objects like vessels, dark lesions and noise in image Ipp. threshold (Δ)is denoted as $\Delta = \mu + k\sigma$, where μ and σ are the mean and the standard deviation of the connected neighborhood strengths of shade correction image Isc. if a pixel O has N neighboring pixels that have strength greater than Δ, it will appear in candidate layers 1 through N. If all of its neighboring pixels' strengths have higher values than Δ , the current pixel will appear in all layers. On the contrary, if none its neighbors' strengths are higher than Δ, this pixel cannot appear in any layer.

- A higher neighboring pixels value means pixel O has more darker neighbors(N), the dark pixel itself is more likely in the middle of a dark object.
- A lower N means pixel O is more likely to be on the edge of a dark object.

Any candidate object which have threshold value is greater than already mentioned threshold value is removed. To determine a threshold Δ = 100.This means any candidate object have threshold value greater than 100,remove that object and select only the object which have threshold value less than or equal to 100.

3.3 Extraction Based on Active Contour Model

Vasculature is segmented out from the given retinal image using contour and morphological techniques. Contour model is better suited to find out vasculature structure of the retina. the active contour model is a natural choice of taking geometry information of the object. This model is applied to datasets of grouped retina image and performs most of the existing method in terms of segmentation. First select the threshold value from the binary image. take the vasculature from input image by applying kernel mask. then select the portion of the matrix from total matrix of the input image and multiply each matrix pixel value, then sum together. next create the empty matrix for find out the vasculature. After summation store the value in an array.

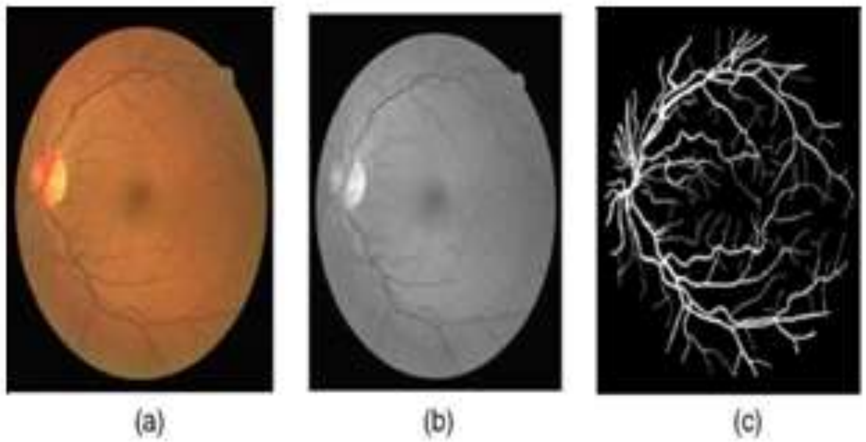

Fig-5: (a) input image, (b) gray image, (c) vasculature structure.

The mask creation is forming one side, at a time the threshold value also set.based on these values the output is formed.Contour tracing is one of the techniques performed on digital images in order to extract information about their general shape. Hence, correct extraction of the image using contour will produce more accurate features which will increase the chances of correctly classifying a given pattern.

3.4 Classification Based on Neural Network

A neural network is a computer program that can help to recognize patterns in datasets check and learn from this and make forecasts of future patterns. There are now over 20 neural network programs are available, these are designed now commonly because of some notable reports of their successful application. Neural network is done to classify the diabetic retinopathy condition, by using trained datasets. There are many different types of neural networks and techniques for training them Accuracy are calculated using neural network. The candidates are classified as diabetic retinopathy mild, diabetic retinopathy moderate ,diabetic retinopathy severe etc. using neural network the accuracy improved than other classifiers. Proper use of a neural network involves less spending time, understanding and cleaning the data, preprocessing and post processing, removing errors.

4. CONCLUSION

Proposed MA detection achieved a good sensitivity and specificity on a per image basis. This is especially meaningful when this method is integrated into a reliable automated system for detecting abnormality in digital fundus images. The proposed candidate filtering process is able to significantly reduce the number of non-MA candidates and sufficiently extract more candidates located close to the vasculature. We take the advantage of a basic active contour method to detect the stage of diabetic retinopathy.

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