Automatic Detection of Red Lesions using Shape Based Extraction technique in Fundus Images

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Abstract

The paper proposes an automatic image processing algorithm based on shape features for the detection of red lesions. In Diabetic Retinopathy Micro-aneurysms and hemorrhages comes under the category of red lesions, which is the most common eye disease caused in diabetic patients and also leads to blindness. This paper describes an effective methodology to study any computer-aided fundus image that can be utilized as a tool for diagnosis and detection of red lesions. A Shape based extraction technique using three parameters i.e. Perimeter Area and Eccentricity is used to segment out the red lesions from rest of the image. Since the algorithm consider shape features for detection of red lesion which makes it efficient and independent of image quality. The results that are experimentally obtained by applying this algorithm has been compared with those of the ophthalmologist and the comparison of these results have been highly accurate. In addition to the accuracy of the obtained results, the proposed method is fast and having very low computational time.

Proposed Algorithm

In this proposed method the input is a RGB scale retinal image. In Fig.1 The various steps involved in the method are shown in the form of a flow chart later on each block of the flow chart is subsequently explained in this section.

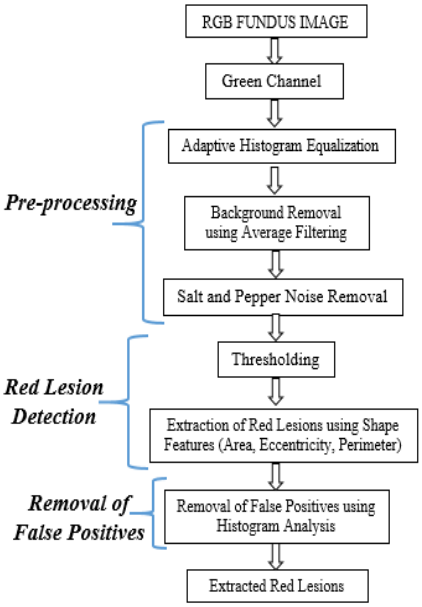

Fig.1. Flow Diagram of Proposed Algorithm

A. Adaptive Histogram Analysis

Histogram equalization increases the contrast of the image by remapping the intensity values. The basic idea behind histogram equalization is that the probability of occurrence of every pixel in the output image is equal to 1/(L-1), where'L-1' are total intensity levels in an image as shown in fig.2.

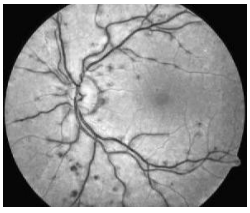

Fig.2 Histogram Equalized green channel

B. Average Filtering

The basic idea behind mean filtering is to replace each and every pixel value in an image with the average pixel value of its neighbors including itself. Thus average filter as shown in fig.3. is a kind of smoothening filter which has the effect of eliminating pixel values which are unrepresentative of their surroundings

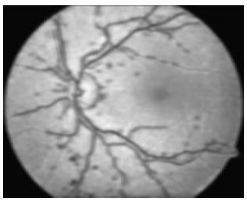

Fig.3 Mean Filtered image

C. Extraction of Blood vessels and Red Lesions

The blood vessels and the red lesions are extracted from the rest of the image by subtracting the histogram equalized image and the averaged image.

D. Noise Removal

The noise in the image obtained after subtraction is mainly salt and pepper noise, therefore median filter was applied on the obtained image to remove the salt and pepper noise.

Fig.4 Extracted Artefacts

E. Image Thresholding

The thresholding method helps in segmenting out objects from the rest of the image by the selection of proper threshold value.

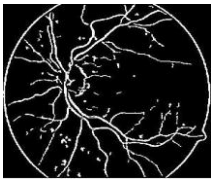

Fig.5 Output image of thresholding operation

F. Extraction of Red Lesions

In the proposed method the red lesions are extracted from the binary image using area, perimeter and eccentricity, the area and perimeter of the red lesion is much smaller to the area of the blood vessels, therefore the red lesions are separated from the blood vessels using the area and perimeter as parameters. The eccentricity is the measure of circularity and lies between 0 to 1 Red lesions are generally more circular in shape as compared to other artifacts and thus these artifacts are removed from the image using eccentricity.

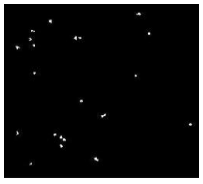

Fig.6 Extracted Red lesions

Experimental Results

The shape based algorithm for automatic detection of red lesion proposed in this paper was tested over a large database containing 120 images in which 89 images were taken from DIARETDB1[12] database andthe rest of the images were taken from the database of a local hospital. For betterunderstanding and evaluation Fig.2displays theresult of the intermediate steps including the final segmented out red lesions.The proposed method was successfully tested over a large no of images as revealed by Table 1 the sensitivity, specificity and the computational time of the proposed method is excellent.

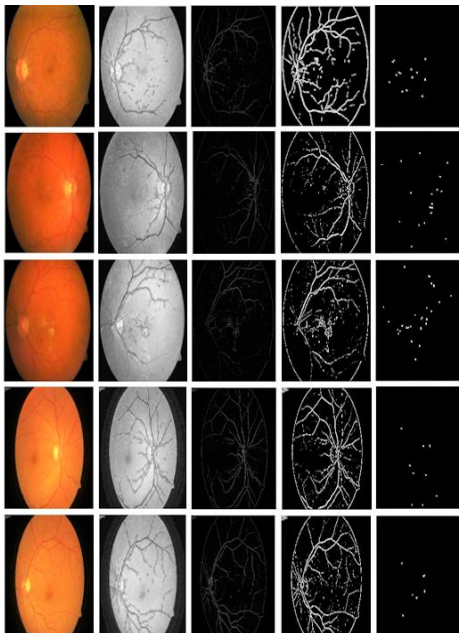

Fig.2: Results of Optic Disc segmentation (a) fundus image (b) adaptive histogram equalized image (c) background removed gray image (d) binary image (e) detected red lesions

TABLE 1. Sensitivity, specificity and computational time

Hardware:CPU@2.60 GHZ, 4GB RAM, 64-Bit Operating System			
Image	SENSITIVITY (in%)	SPECIFICITY (in%)	COMPUTATIONAL TIME (in seconds)
Image 1	100	99.999	1.075679
Image 2	94.742	100	1.032058
Image 3	88.69	99.998	0.914983
Image 4	85.9	99.968	0.903711
Image 5	100	99.989	0.982117
Image 6	100	99.979	0.969952
Image 7	100	99.996	1.015184
Image 8	98.87	100	0.891152
Image 9	99.94	100	1.031511
Image 10	100	99.998	0.908094

Conclusions

The shape based algorithm used in this proposed paper for detection of red lesions is more accurate, independent of image quality, fast and efficient. The average sensitivity is around 95.144% and average specificity of the proposed method is around 91.6122%. The proposed method is computationally very fast and requires less processing power. The average computational time is around 0.933105 seconds.

Acknowledgement

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