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Detection and Counting of Microaneurysms Using Digital Image Processing Techniques

Sonali S. Gaikwad1[1], Ramesh R. Manza[2]

[1,2]*Department of Computer Science and Information Technology,*
Dr. Babasaheb Ambedkar Marathwada University, Aurangabad

Abstract: - *In this research article, we proposedannew algorithm for the detection and counting of microaneurysms from retinal images. Two fundus image database were used. DIARECT DB0 and DIARECT DB1, total 219 fundus images. For detection and counting of microaneurysms we were used digital image processing techniques, such as green channel separation, image complement function, histogram and histogram equalization functions etc. This algorithm is achieved 92.69% accuracy. Means 203 images are correctly identified whereas 16 images were wrongly classified.*

Keywords: *Microaneurysms, Diabetic Retinopathy, DIARECT DB 0, DIARECT DB1, Threshold.*

I. INTRODUCTION

The microaneurysms are the leading clinically noticeable lesions in the Diabetic Retinopathy (DR). Early detection of microaneurysms can stop the diabetic retinopathy. For detection of microaneurysms author have used the computer vision and morphological image processing techniques [1].Diabetic retinopathy is a complication of diabetes and a leading cause of blindness in the world. Diabetic retinopathyarises when diabetes damages the tiny blood vessels inside the retina. The author proposed methodology, using DIARETDB1 in which have total 89 images, achieves an accuracy of 95.38%, sensitivity of 94 % and a specificity of 94.7% [2]. The first indication of the disease in the fundus images are Microaneurysms. Author uses the digital image processing techniques for the extraction of microaneurysms [3].Diabetes attacks when the pancreas stops to produce enough insulin, progressively disturbing the retina of the human eye is a diabetic retinopathy. The blood vessels in the retina become changed and have abnormality. Exudates are concealed, micro-aneurysms and haemorrhages occur in the retina of eye, which intern leads to blindness [4].The occurrence of microaneurysms in retinal images is a pathognomonic sign of diabetic retinopathy. Author introduces a novel algorithm that association's information from spatial views of the retina for the purpose of microaneurysms detection. The algorithm is tested using 160 images from 40 patients seen as part of a UK diabetic eye screening programme which contained 207 microaneurysms[5].There are two levels of Diabetic Retinopathy which are non-proliferative diabetic retinopathy and proliferative diabetic retinopathy. For detection of microaneurysms, author uses the digital image processing techniques [6]. Our proposed algorithm is tested on two standard database. Following table shows the detail of fundus image database.

Table 1. Fundus Image Database

Sr. No.	Name of Database	Total Images	Reference No.
1	DIARETDB0	130	[7]
2	DIARETDB1	89	[8]
Total: 219			

II. METHODOLOGY

For detection and counting of microaneurysms, we used digital image processing techniques as shown in figure 1. Following are the mathematical formulas.

1. **Green Channel: -**

$$g = \frac{G}{(R + G + B)} \qquad (1)$$

Here g is a Green channel and R, G and B are Red, Green and Blue respectively. Because green channel shows the high intensity as compare to red and blue respectively.

2.

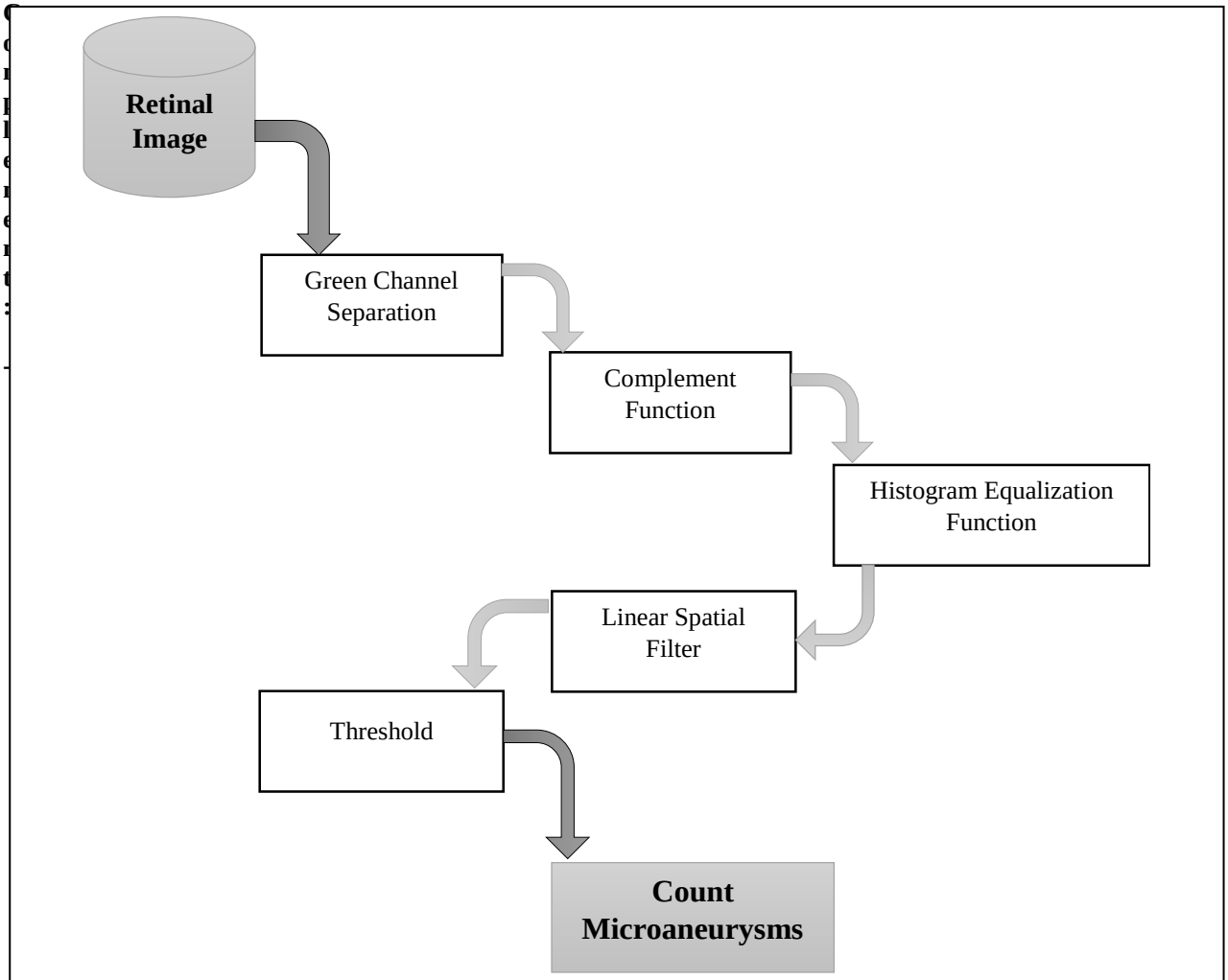


Fig. 1 Flow for detection and counting of microaneurysms

$$A^c = \{\omega \mid \omega \notin A\} \qquad (2)$$

Here A^c is a complement ω is the element of A, ∉ stands for not an element of A and A is set. Complement function is used on histogram equalization for enhancement.

3. Histogram Equalization:

$$h(v) = \text{round}\left(\frac{cdf(v) - cdf_{min}}{(M \times N) - cdf_{min}} \times (L-1)\right) \qquad (3)$$

Here cdf_{min} is the minimum value of the cumulative distribution function, M × N gives the image's number of pixels and L is the number of grey levels. Histogram equalization is used for enhancement of a green channeled image for extracting more fine details of fundus image.

4. Linear Spatial Filter:

A spatial filter is an image operation where each pixel value *I(u,v)* is changed by a function of the intensities of pixels in a neighborhood of *(u,v)*.

$$H: R_H \rightarrow [0, K-1]$$

$$I'(u,v) = \sum_{(i,j)\in R_H} I(u+i, v+i).H(i,j) \qquad (4)$$

This is also known as a correlation of *I* and *H*. Where H is just image.

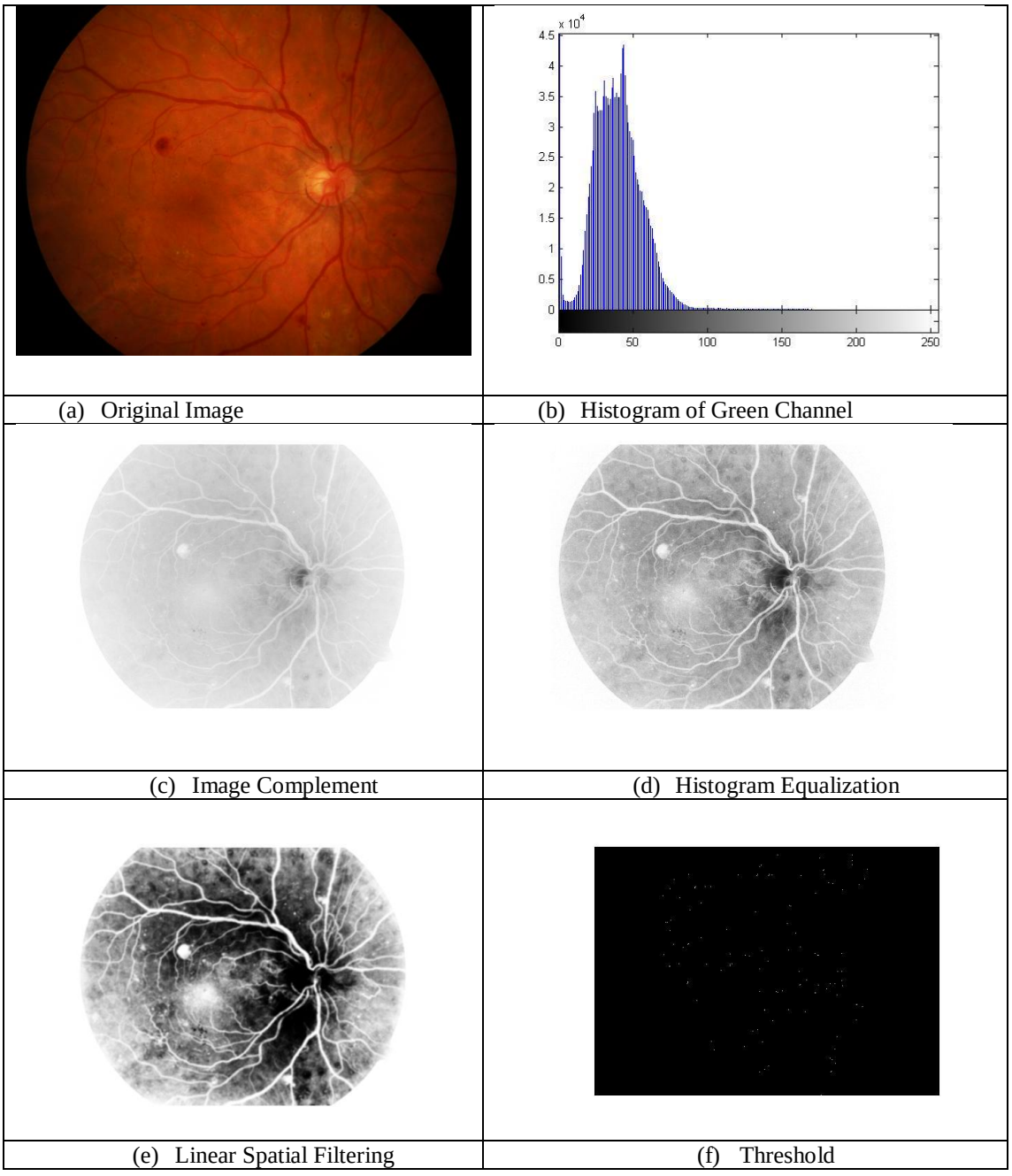
5. Threshold: -

$$T = \frac{1}{2}(m1 + m2) \qquad (5)$$

Here m1 & m2 are the Intensity Values. Threshold function is used for feature extraction of the fundus image.

III. RESULT

Detection and counting of microaneurysms is done with the help of digital image processing techniques and MATLAB 2012 software. For the extraction of the retinal feature, we have taken fundus image from DIARECT DB0 and DIARECT DB1 database.



(a) Original Image

(b) Histogram of Green Channel

(c) Image Complement

(d) Histogram Equalization

(e) Linear Spatial Filtering

(f) Threshold

Fig. 2Detection of Microaneurysms

First of all we have taken original fundus image, afterwards extract histogram of green channel image. Then after, perform image complement function and histogram equalization. For the enhancement of retinal image, linear spatial filtering techniques were used and at last for detection of microaneurysms, threshold technique is used. Above figure 2 shows the stepwise output for detection of microaneurysms. After detection of microaneurysms, we count the microaneurysms. Following table shows the count of microaneurysms.

Table 2. Counting Microaneurysms

Sr. No.	Image Name	Total Microaneurysms
1	image001.png	192
2	image002.png	100
3	image003.png	30
4	image004.png	197
5	image005.png	200
6	image006.png	122
7	image007.png	132
8	image008.png	154
9	image009.png	124
10	image010.png	120
11	image011.png	187
12	image012.png	208
13	image013.png	302
14	image014.png	196
15	image015.png	127
16	image016.png	112
17	image017.png	139
18	image018.png	265
19	image019.png	236
20	image020.png	121

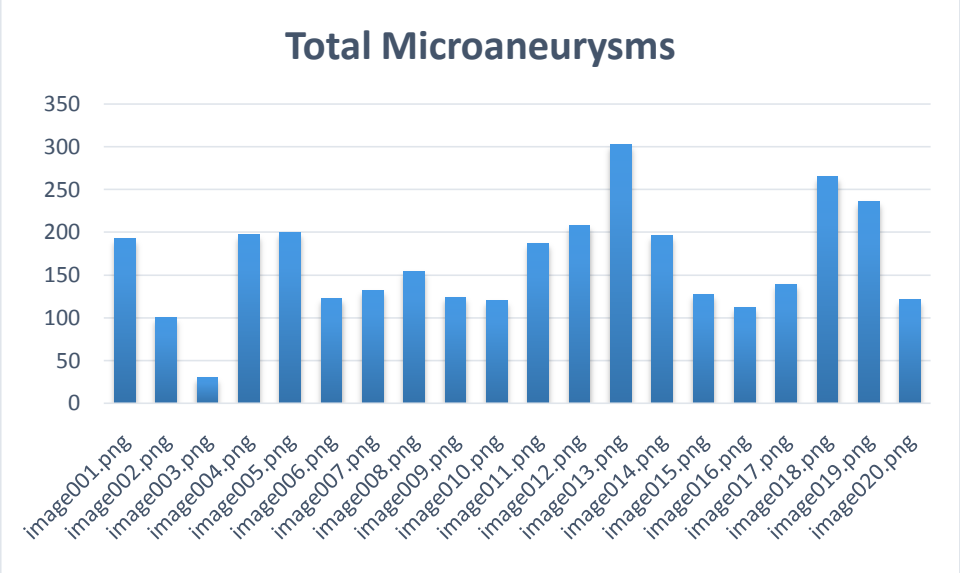


Fig. 3 Graph of detected microaneurysms

IV. CONCLUSIONS

For detection and counting of microaneurysms, DIARECT DB0 and DIARECT DB1 fundus image database is used.Also use digital image processing techniques and MATLAB 2012 software. Proposed algorithmachieved 92.69% accuracy, 203 images are correctly classified whereas 16 images were wrongly classified.

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[7] (DIARETDB0) http://www.it.lut.fi/project/imageret/diaretdb0/index.html.
[8] (DIARETDB1) http://www.it.lut.fi/project/imageret/diaretdb1/index.html.

