Design a Novel Detection Using KNN Classification Technique for Early Sign of Diabetic Maculopathy

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Abstract. Scientists call diabetic maculopathy a pathological disorder. It's one of the most serious consequences of diabetes [1]. When diabetic patient having so much sugar level in the body that time its impact on some part of body one part is retina. The retina has macula when near macula having some red dots it's called as microanurysms. Microanurysms is the first sign of diabetic maculopathy it is the initial stage of diabetic maculopathy [2]. In this research paper using image processing technique we can detect the microanurysms and its count using STARE database. For classification used KNN algorithm and got 95.7%good result.

Keywords: Image Processing · Maculopathy · KNN · Microanurysms

1 Introduction

The first ever sign that indicates the development of Diabetic Maculopathy is Microaneurysms. When sugar level increases in the body, the body gives up some signs; one of these sign is the Microaneurysms which signs a red, tiny and circular darkest dot near the Macula of the eye [3]. This red dot with its increase in size may damage the Macula if not detected at an initial stage. So detecting this Micro aneurysm at its initial stage is very important. If at its initial stage Micro aneurysm is not detected then a person has a possibility to lose his or her vision 15 completely as Macula is the central vision of the Retina. That's why diabetic maculopathy detection is very important.

2 Methodology

To detect Maculopathy through the Classification techniques a strong database is required. Collection of this database is not possible at initial stage of research study. If collection of database is considered it may become a different research study as there are many stages in the development of the Macula. So the present study is focused by

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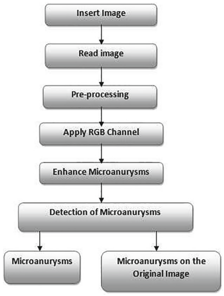

Fig. 1. Flowchart of Detection of Microanurysms.

getting the Standardized available database. These Standard database that have been considered for the present study are of STARE. STARE is the (STructured Analysis of the Retina) it is the 400 retinal image dataset but for present research study we can use only 100 images [4] (Fig. 1).

2.1 Preprocessing

Images that are present in the Standard Database of STARE are captured through the Fundus Camera. The Images captured through this Fundus Camera always does not give 100% result. So the preprocessing helps to get clear images. With the help of these clear images the detection of the object i.e. the detection of the features is possible. Digital Image Processing helps to detect these features with the Pre-processing technique [5].

2.2 RGB Channel

When the Fundus Camera gives an output Image is captured it consists of 256 colors. These fundus image captured are in pixels. This ranges from 0 to 255. The following is the sample of the retina [6] (Fig. 2).

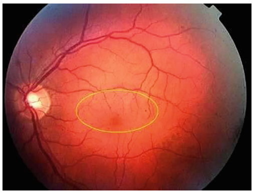

Fig. 2. Microanurysm on the retina

From these colures only Red, Green and Blue are the three channels which give clarity in the images. The following are the result of the RGB Channel image.

Red Channel
See Fig. 3.

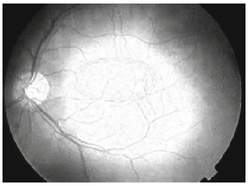

Fig. 3. Red Channel

Green Channel
See Fig. 4.

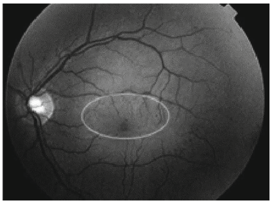

Fig. 4. Green Channel

Blue Channel
See Fig. 5.

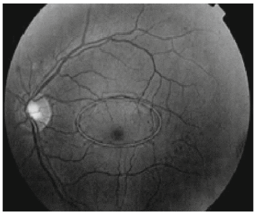

Fig. 5. Blue Channel

2.3 Histogram

Histogram gives the graphical representation of the data points in the data set. For the above three channels the histogram that has been obtained is (Figs. 6, 7, and 8).

With reference to 2.2 and 2.3 above i.e. RGB Channel and Histogram it is very clear that the Red Channel displays only boundary of the Retina while blue channel gives only the noise present in the Retina image but when we take the green channel it perfectly displays whole information that also in detail. So for the further study the Green Channel.

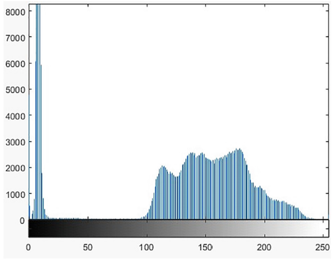

Fig. 6. Histogram of Red channel

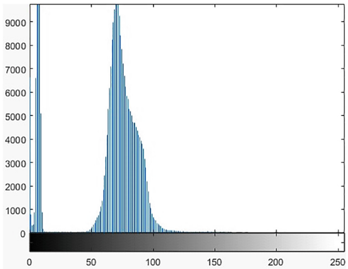

Fig. 7. Histogram of Green channel

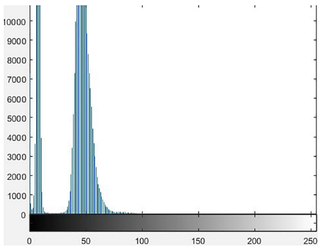

Fig. 8. Histogram of Blue channel

2.4 Enhancement

2.4.1 Intensity Transformation Function

For the enhancement of Microaneurysms, we used the Intensity Transformation Function If the need for an image at a certain period is brighter or darker, it modifies the frequency principles, the frequency metamorphosis purpose, that also improves the contrast with certain values [7]. Pixel pre and post- processing values are denoted as f(x, y) & g(x, y).

$$g(x, y) = T\big[f(x, y)\big] \tag{1}$$

T converts the pixel value from f (x, y) to Pixel (x, y). The input image is f (x, y) and g (x, y) is the output or processed image [8].

2.4.2 Histogram Equalization

Histogram equalization produces an output image with the same pixel intensity distribution. This means that the histogram of the output image will be compressed and systematically increased [9]. Where ps (s) and pd (d) are image probability density functions. Histogram equalization of an image follows the following equation [9].

$$\begin{aligned} u &= T(s) \\ &= \int_0^{\mathrm{s}} ps(x)dx \end{aligned} \tag{2}$$

The histogram equalization image is acquired by a same transformation function as follows:

$$v = Q(d) = \int_0^{\mathrm{d}} pd(x)dx \tag{3}$$

The values of d for the image is acquired as follows:

$$d = \mathrm{Q}^{-1}[u] = \mathrm{Q}^{-1}[T(s)] \tag{4}$$

2.4.3 Using Segmentation Detection of Boundaries

The segment label $C(\vec{X}) = K$ for a pixel $(\vec{X})$ is the k which maximizes the ownership of $\vec{F}$ $(\vec{X})$ in the MoG model M. That is,

$$c(\vec{x}) = \arg\max_k \left[\frac{\pi_k g(\vec{F}(\vec{x})|\vec{m}_k, \Sigma_k)}{p(\vec{F}(\vec{x})|M)} \right] \tag{5}$$

2.5 KNN Classification

K-Nearest Neighbor is that the supported Supervised learning technique. This algorithm stores all the available data and classifies a replacement datum supported the similarity. This implies when new data appears then it are often easily classified into a decent suite category by using K-NN algorithm. K-NN algorithms are often used for Regression also as for Classification but mostly it's used for Classification problems. It's a non-parametric algorithm, which suggests it doesn't make any assumptions on underlying data [10].

3 Experiment Result

In this study, we used a publicly available standard database to extract microaneurysms and count them. Depending on the count, after applying the classifier and results, usually determine the Normal and Abnormal grades. If the number of microaneurysms is 0 at this point, this is normal and if this is greater than 1 that time, we said Abnormal.

Extraction of Retinal Microanurysms
See Figs. 9, 10, 11 and Table 1.

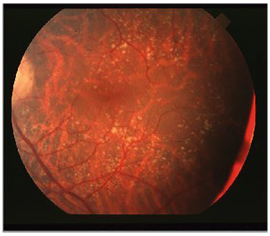

Fig. 9. Original Image

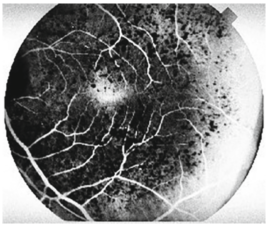

Fig. 10. Pre-processing

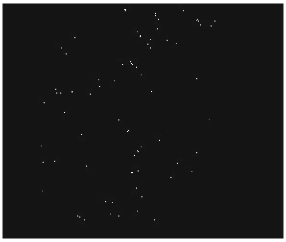

Fig. 11. Extraction of Microanurysms**.**

Classification and Grading

We used KNN classification technique for the classification and Grading, and we got the 95.7 percent accuracy on 100 fundus picture, Fig. 12 shows the classifier Result.

We can see in the figure right-hand side there is the result of the classification is that 95.7%. in the figure left-hand side of the bottom there is two-colour blue and orange, they showing the grading of Microanurysm count. Blue indicates the Abnormal, orange colour indicates the Normal of the maculopathy lesion "Microanurysm" Grading. In that classification, we used five- fold cross-validation.

Table 1. Statistical Count of Microanurysms

Sr.No	Image Name	Microanurysm Count
1	Image	10
2	Image	5
3	Image	1
4	Image	5
5	Image	8
6	Image	0
7	Image	0
8	Image	11
9	Image	9
10	Image	25

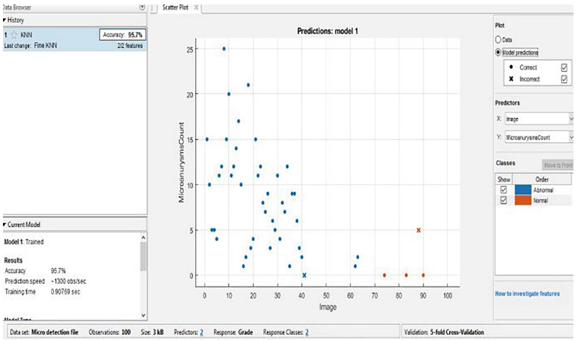

Fig. 12. KNN Classification Technique for Grading of Microanurysms Normal and Abnormal

4 Conclusion

The detection of Microanurysm is extremely crucial in diabetic Maculopathy. Micoanurysms are the main indication of maculopathy. Assuming Microanurysm makes close to a macula it tends to be harm a macula and in the event that the macula harmed, the patient can be lost his vision that is the reason identification is vital then the patient will take the treatment on it and the patient will be saved from losing the force of vision. In that exploration work, we utilized the KNN classifier and acquired 95.7% result, on the 100 stare Fundus Image. This current examination is helpful for ophthalmologists.

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