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Tool for the Detection of Diabetic Retinopathy using Image Enhancement Method in DIP

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ABSTRACT
Diabetic retinopathy(DR) is a symptom of early blindness.It causes due to high pressure on blood vassals. Pressure on eye may be origin of hemorrhages and microaneurysms, hard exudates, and cotton-wool spots. Hence to detect early lesions of diabetic retinopathy computer system has been developed using image processing.This paper describes the development of an automatic fundus image processing and analytic system to facilitate diagnosis of the ophthalmologists. Color fundus photographs are useful to detect hemorrhages and microaneurysms, hard exudates, and cotton-wool spots. Digital image processing technique (DIP) involves the modification of digital data. This can recover the image clarity, sharpness & details of features of interest towards the information extract & further analysis with the help of computer. This paper proposes tool for the early detection of Diabetic retinopathy using Image Enhancement method [1].

Keywords
Contrast enhancement, Exudates, Fundus image,Digital Image Processing.

1. INTRODUCTION
Medical image analysis is one of the research area consists of the study of digital images with computational tools that assist quantification and visualization of interesting anatomical structures. Diabetic retinopathy is eye decease happens when the tiny blood vessels are damaged which results in blindness. So it is necessary to detect & diagnosis quickly .Method used in this work involves preprocessing the retinal image for enhancing the information for optic disk segmentation and classification using fractal measures. The main features of a fundus retinal image are to identify optic disc, and blood vessels. Exudates are the primary sign of diabetic retinopathy. Exudates can be identified on the ophthalmoscope as areas with hard white or yellowish colors with varying sizes, shapes and locations [2, 3]. Spatial filters are used to sharpen image. Contrast enhancement pre-processing is applied before four features, namely intensity, standard deviation on intensity, hue and a number of edge pixels, are extracted to supply as input parameters to enhance a image [4]. This part of the paper describes how contrast enhancement of image. Gardner et al. proposed an automatic detection of DR in the pre-processing step, adaptive, local, contrast enhancement is applied[5].Image enhancement methods proposed by Niemeijer et al. [6] estimated non-uniform background intensity of fundus image. Fleming et al. [7] had divided green channel with background intensity image. In addition, the shade corrected image was normalized for global image contrast by dividing with its standard deviation. Multiple local contrast enhancement methods were tested to improve detection accuracy. Sinthayothin et al. [8]

used local contrast enhancement to equalize the intensity variationin fundus images. The fundus images were transformed from RGB color model to IHS color model and the local contrast enhancement was applied to the intensity component of the image. Sinthanayothin et al. [8] sharpened the edges of red finding regions by applying moat operator to green channel of the contrast enhanced image. From the result image, red findings were extracted with recursive region growing . Narasimha-iyer et al. [9] used normal retinal findings (vasculature, optic disk, fovea, and abnormal findings) to estimate the illumination component using iterative robust homographic surface fitting to compensate the non-uniform illumination in fundus images.

2. IMAGE ENHANCEMENT
The aim of image enhancement is provide `better' input for other automated image processing techniques. It improves the quality (clarity) of images for human eye. Enhancement method consists of removing blurring and noise, increasing contrast, and revealing details. Reducing the noise and blurring and increasing the contrast range could enhance the image. Adaptive algorithms reveals very high and very low intensity of the original image which can adjust their operation based on the image information (pixels) being processed. In this case the mean intensity, contrast, and sharpness could be adjusted based on the pixel intensity [5,6].

3. Methods of Detection

3.1. Image Sharpening using spatial filters
Sharpening: spatial filters seek to highlight fine detail removing & blurring from images & highlighting edges. A sharpening filter seeks to emphasize changes.

Spatial filtering
Filtering in the spatial domain by convolution directly on the pixels which need a filter mask (or the impulse response) for operation. Calculate the response at each point (x, y) (i.e., slide the filter mask from point to point).The classic mask for a sharpening filter is the mask shown below.

Table 2: The classic mask

$$W = \frac{1}{9}\begin{bmatrix} -1 & -1 & -1 \\ -1 & 8 & -1 \\ -1 & -1 & -1 \end{bmatrix}$$

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When the mask is over a region of uniform brightness it has zero output. It has maximum output when the center pixel differs significantly from the surrounding pixels. The following matrix was selected for the Image Enhancer [10]. A retinal image is given as the input which is digital image and it is pre-processed by Spatial filtering which result in more sharpen image. Thus as shown in figure 1 (a) & (c) the difference between the original and final image is often subtle, but should show a noticeable increase in clarity. We can observe original diabetic image having yellowish hemorrhages & exudates. Using an Image enhancement noise is removed, we found yellowish objects and sharp edges using various rotated versions of Kirsch masks on the green component of the original image as shown in figure 1(b) & Fig.1. (d).

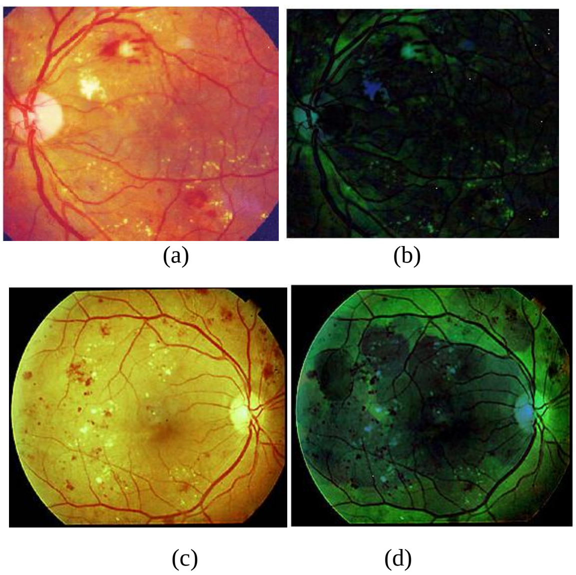

Fig. 1(a) & (c) Original Digital Image, (b) Enhanced image using the mask with Centre coefficient -8 &(d) Enhanced image using the mask with Centre coefficient -4. Images before convolving with edge enhancement matrix.

3.2 Enhancemet with Ist & IInd Derivative

- The formula for the 1st derivative function is

$$\frac{\partial f}{\partial x} = f(x+1) - f(x)$$

It's just the difference between subsequent values and measures the rate of change of the function. First-order derivatives generally produce thicker edges in an image. & generally have a stronger response to a gray level step.

- The formula for the 2nd derivative of a function is

$$\frac{\partial^2 f}{\partial^2 x} = f(x+1) + f(x-1) - 2f(x)$$

Second-order derivatives have a stronger response to fine detail, such as thin lines and isolated points & it produce a double response at step changes in gray level. The 2nd derivative is more useful for image Enhancement than the 1st derivative because it gives stronger response to fine detail & simpler implementation.

Original infected diabetic image shown in figure 2(a)will be enhanced and alter the grey level values of the image to increase the image contrast, thus nerves can be classified as shown in figure 2 (b) Observe figure 2 (c) using first order derivative the input image was sharpened in the output image. A Retinal image is given as the input which is pre-processed by second order derivative and the image obtained is shown in figure 2(d) which helps in feature extraction by enhancing image and optic disk segmentation. After segmenting the optic disk, textural features of the affected region are obtained clearly.

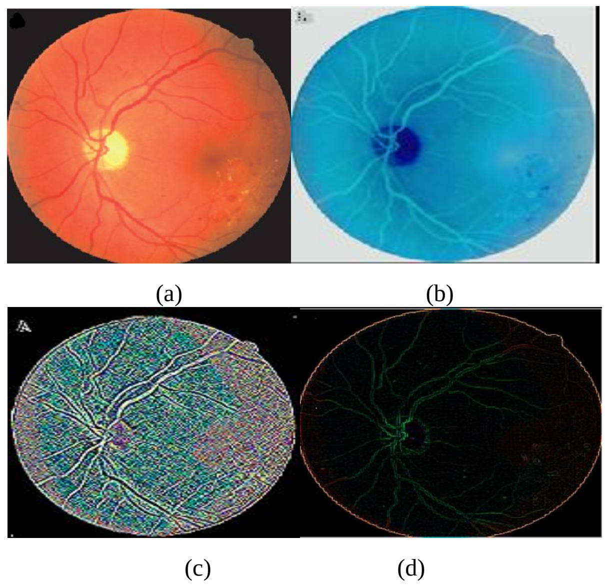

Fig. (2)(a) Original digital Image (b) Image after increase in Contrast (c) Sharpened image using first order derivative (d) IInd order derivative is applied.

3.3 Image: after Contrast Enhancement Contrast stretching Transformation:

Contrast enhancement pre-processing is applied before four features, namely intensity, standard deviation on intensity, hue and a number of edge pixels, are extracted to supply as input parameters to enhance an images shown in figure 3 (a) & (b).

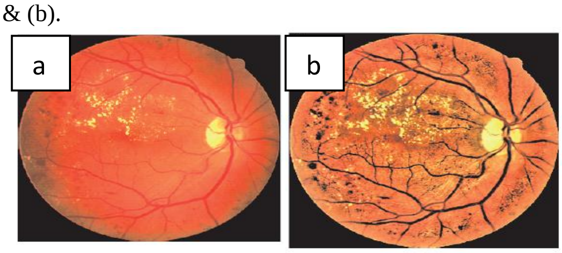

Figure (3) (a) Original digital colour retinal image, (b) Retinal image after pre-processing by local color contrast enhancement.

4. CONCLUSION

Eye deceases like Diabetic retinopathy (DR) is responsible for blindness in human eye. Therefore it is necessary to detect such deceases at early stage with the help technology like of digital image processing. DIP is able to detect clear part of images & can focus image so that ophthalmologist can detect damaged blood vessels due to pressure in eye. In this paper we discuss different DIP techniques of image enhancement for retinal image which can sharpen & can filter information in infected eye. We observe that Second order derivatives give more sharpness in retinal blood vassals.

5. ACKNOWLEDGEMENT

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2) International Workshop On Green Energy Technologies (IWGET),"Production of biodiesel using jatropha".

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