International Journal of Advanced Technology and Innovative Research
ISSN 2348–2370
Vol.07,Issue.06,
July-2015,
Pages:0874-0876
www.ijatir.org

Implementation of Diabetic Retinopathy Detection System for Enhance Digital Fundus Images

B. NAGARJUN SINGH[1], K. JAYASREE[2]
[1]Associate Professor, Dept of ECE, Sarada Institute Technology and Science, TS, India, E-mail: nagarjun.singh24@gmail.com.
[2]PG Scholar, Dept of ECE, Sarada Institute Technology and Science, TS, India, E-mail: jayasreekakarala@gmail.com.

Abstract: Diabetic retinopathy is the most common diabetic eye disease and a leading cause of blindness. It is caused by changes in the blood vessels of the retina. This paper, basically work on a computer based approach for the detection of diabetic retinopathy using enhances digital fundus images. There are many features present in retina but to examine it carefully and properly and to extract the feature properly which is one of the primitive step to detect signs of diabetic retinopathy and which is used to identify main cause of blindness that could be prevented with the help of this automatic detection process. The automatic detection process reduces examination time, and increase accuracy. In this paper provide key technique that helps to diagnose Diabetic Retinopathy in retinal fundus images. In this paper a new algorithm to detect the blood vessels effectively has been proposed. The initial enhancement of the image is carried out using pre-processing stage, followed by Curvelet Transforms that are applied to the equalized image. This enhanced image is used for the extraction of the blood vessels. The estimation of exudates is obtained from blood vessels and optic disc extracted image. The results shows the enhanced retinal images of blood vessels have a better PSNR and area shows the exudates severity.

Keywords: Fundus Image Enhancement, Blood Vessel Detection, Diabetic Retinopathy Detection.

I. INTRODUCTION

Digital fundus images (DFIs) are images obtained using fluorescence angiography (FA) through fundus photography, which capture the retina, fovea, optic disc, macular regions and the posterior surface of an eye. These regions are used by ophthalmologists during diabetic eye screening and diabetic retinopathy (DR) grading. DR is an eye condition that has complications faced by diabetic patient which may lead to permanent blindness. In some cases, pathological effects such as blood vessel raptures may present in patient's retina which can lead to retinopathy. There are a few characteristics in fundus images being used to detect the DR grades such as hard exudates, micro-aneurysms, hemorrhage and the blood vessels and cotton wool spots. Regular diabetic eye screening is an important step for detection of DR. Patients with sight threatening DR might be identified during the screening process so that necessary treatment to prevent blindness. The best approach to obtain perfect contrast for analysis of the fundus surface is through obtained from FA. However, FA is an invasive method as it is obtained by injecting a yellow dye (fluoresce in) into the patient's body to enhance the RV and choroid during photography and has its side effects which include physiological problems such as Urticaria, severe seizure attack, Myocardial infarction and an aphylactic attacks. According to, the DFI method does not need such invasive procedure but the contrast is much lower than those of FA.

DFI is known to have very low contrast between the retinal Visualize and diagnose lesions in certain areas. This in turn can seriously affect the diagnostic process and its product. Therefore, to guarantee visualization of their tonal blood vessels is at its best, image enhancement is required. Normalization method for DFIs is depending on the frequency domain and space. In, they used vessel central light removal and background equalization to enhance the images. Both methods were successful to remove brightness and standardize the intensity. 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. 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. 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. Image enhancement methods proposed by estimated non-uniform background intensity of fundus image 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. Meanwhile, V.Saravananetal Applied background subtraction after converting the fundus images to green channel and subtracted by median filtered gray scale image. In addition, they also used adaptive histogram equalization to enhance the DFIs contrast. The above methods are considered as intensity normalization in the preprocessing stage. This project focuses on Diabetic retinopathy using image enhancement and in this work, three different methods are considered. It is initially anticipated that the enhanced DFI can facilitate Ophthalmologists toper form manual DR Detection and gr a ding and thus, reducing the need for FA.

Additionally, this enhancement is a necessary pre-processing step for further processing techniques and it is important that any significant details in medical images to be preserved while being enhanced. This research focuses on DFI enhancement and in this work, three different methods are considered. It is initially anticipated that the enhanced DFI can facilitate ophthalmologists to perform manual DR detection and grading and thus, reducing the need for FA. Additionally, this enhancement is a necessary pre-processing step for further processing techniques and it is important that any significant details in medical images to be preserved while being enhanced.

II. 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.

III. METHODOLOGY

The images are pre- processed to correct the uneven illumination problem, nonsufficient contrast between exudates and image background pixels and presence of noise in the input fundus image. The block diagram of the sub sections that constitute the Pre- Processing stage (PPS) as shown in Fig.1. Median filtering operation replaces a pixel by the median of all pixels in the neighborhood of small sliding window. It gives better results than the neighborhood averaging (noise is impulsive). Median filter is robust and has the capability to filter only outliers. It is an excellent choice for the removal of salt and pepper noise and horizontal scanning artefacts. Adaptive histogram equalization (AHE) is suitable for improving the local contrast of an image and bringing out more detail. However, it has a tendency to over amplify noise in relatively homogeneous regions of an image. A variant of adaptive histogram equalization called contrast limited adaptive histogram equalization (CLAHE) prevents this by limiting the amplification.

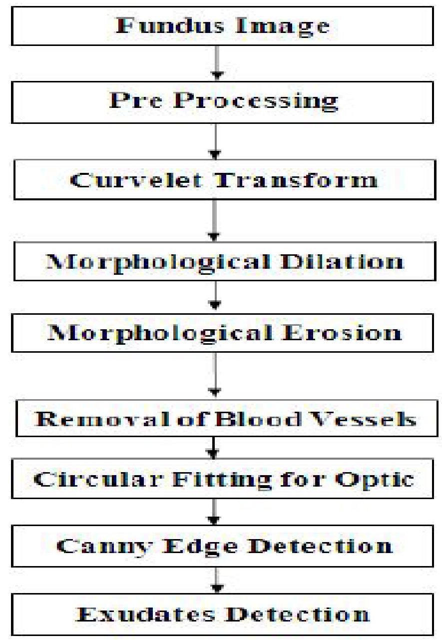

Fig.1. Overview f Retinopathy detection system.

A. Adaptive Median Filter

The median filter is to run through the image pixel by pixel and replaced each pixel with the median of neighboring pixels. The pattern of neighbors is known as window, which slides pixel by pixel, over the entire pattern. The median filter is a nonlinear filter which under certain criteria and condition, can preserve edges and remove noise like pepper and salt in preprocessing step to improve the results for further processing.

B. Histogram Equalization

The technique of Histogram Equalization (HE) applied on an image; adjust the contrast of the image using the image histogram. The method usually increases the global contrast of images, especially when the usable data of the image is represented by close contrast values. This allows for areas of lower local contrast to gain a higher contrast. Histogram equalization accomplishes this by effectively spreading out the most frequent intensity values. The method is useful in images with backgrounds and foregrounds that are both bright or both dark.

C. Histogram Modified Local Contrast Enhancement

HE uniformly distributes the output histogram by using cumulated histogram as its mapping function. However it produces over enhancement in the output image which leads to loss of more local information in the original mammogram. One more problem with HE is its large backward difference values of mapping functions and the contrast enhancement potential should be enriched without losing the fine details in the mammogram image. In order to lessen the level of enhancement that would be obtained by HE, the input histogram can be altered so that the modified histogram is closer to a uniformly distributed histogram. HM-LCE method incorporates a two stage processing both histogram modification and local contrast enhancement technique. The main objective of this method is to find a modified histogram that is closer to uniform histogram and to make the difference between modified and input histogram small, which in turn increases the potentiality of image contrast enhancement and resultant image would be the more relevant to the input image. Although the global approach for image contrast enhancement is suitable for some cases, there are situations in which it is necessary to enhance local details in the mammogram image.

The number of pixels in this area may have negligible influence on the computation of the global transformation. The solution is to device transformation function based on gray level distribution or other properties in the neighborhood of every pixel in the image. This method of approach is called local contrast enhancement. We have already implemented this method, but results were not the same. Namely, in the first step we could get back the same image, but after LCE the result has not really changed. The implementation of this function is available in the project directory.

Histogram Equalization: It is a method of contrast adjustment using the image histogram. This method usually increases the local contrast of many images, especially when the usable data of the image is represented by close contrast values. Through this adjustment, the intensities can be better distributed on the histogram. This allows for areas of lower local contrast to gain a higher contrast without affecting the global contrast. Histogram equalization accomplishes this by effectively spreading out the most frequent intensity values. The method is useful in images with backgrounds and foregrounds that are both bright or both dark. In particular, the method can lead to better views of bone structure in x-ray images, and to better detail in photographs that are over or under-exposed. A key advantage of the method is that it is a fairly straightforward technique and an invertible operator. If the histogram equalization function is known, then the original histogram can be recovered. The calculation is not computationally intensive. A disadvantage of the method is that it is indiscriminate. It may increase the contrast of background noise, while decreasing the usable signal.

IV. RESULTS AND ANALYSIS

This study is implemented in MATLAB R2012b. The algorithm is applied on the database of 40 images with both normal and abnormal criteria. Performance of three algorithms namely HE, CLAHE, and MD are analyzed in the preliminary study for enhancement of DFI before progressing to the next stage that deals with detection of blood vessels. A comparison was made and focused on the histogram of the enhanced images upon implementation of the three algorithms.

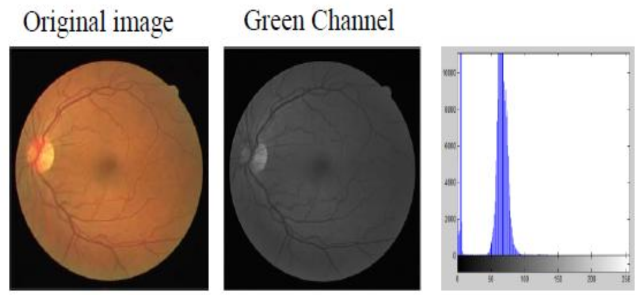

Fig.2. Original Green component and its histogram.

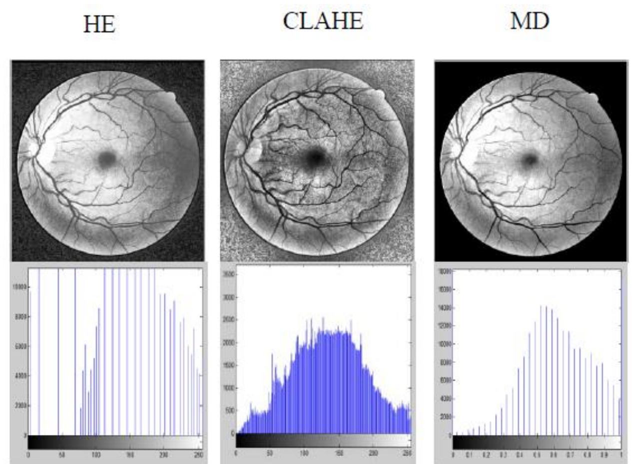

Fig.3. Enhancement using image_01.

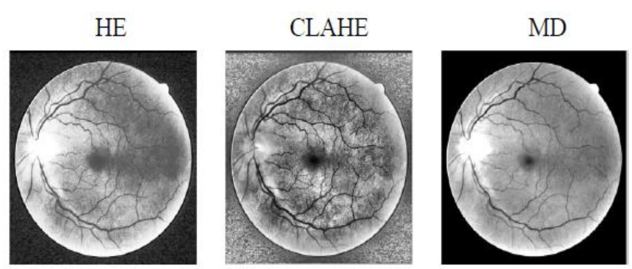

Fig.4. Enhancement using image_09.

Fig2 shows the green component of one of the original DFIs and its histogram to provide comparison for the enhancement experiment. Meanwhile Figs. 3, 4 and 5 show the fundus image with the enhancement algorithm using Histogram Equalization, CLAHE and Mahalanobis Distance with their histograms respectively. As seen from the above figures, CLAHE and MD produce an approximately similar curve to the ideal Gaussian-shaped curve and also the resultant images by the two methods are more enhanced to facilitate blood vessel detection. The blood vessel using both algorithms are more visible compared to HE. Histograms for CLAHE and MD have been normalized using the scales of 0 to 255 and 0 to 1, accordingly. As HE and CLAHE use the neighborhood-based approach on the pixels, the background also contributes to the overall performance. This also means that any noise that is presence will be enhanced as well into artefacts which would later on effects further processing steps. Their neighborhood-based approach also means that the two algorithms are imaging dependent, implying that the results can be inconsistent even using the same set of database. On the contrary, the MD approach works on every pixel and only enhances the foreground pixels, producing a better contrast between the background and the blood vessels. It is observed that the optic disc is enhanced without tampering the blood vessel nearby. In addition, this selective enhancement of MD creates fewer artefacts for further processing when compared with HE and CLAHE.

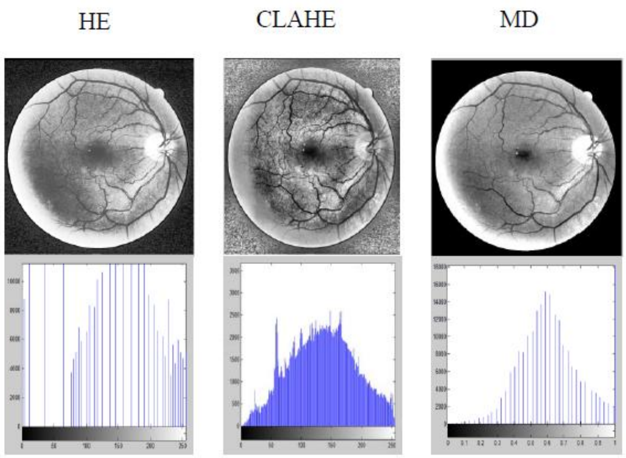

Fig. 5. Enhancement using image_17.

V. 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. This method is good for drive dataset. We are aim at to develop the method which can be applied universally on all datasets to get best of the output. Our future work is related to use this work for further post processing and classification purpose which will also predict the stage and severity of diabetic retinopathy.

VI. REFERENCES

[1] Husna Ab Rahim, Ahmad Syahir Ibrahim, W Mimi Diyana W Zaki, Aini Hussain, “Methods to Enhance Digital Fundus Image for Diabetic Retinopathy Detection”, IEEE 2014.

[2] H. K. Li1, L. D. Hubbard, R. P. Danis, A. Esquivel, J. F.Florez-Arango1, J. Nicola, N. J. Ferrier and E. A. Krupinski, “Digital versus Film Fundus Photography for Research Grading of Diabetic Retinopathy Severity” Association for Research in Vision and Ophthalmology, Fort Lauderdale, Florida, May, 2008.

[3] U. R Acharya, E. Y. K. Ng, J. H. Tan, S. V. Sree, and K. H. Ng. “An Integrated Index for the Identification of Diabetic Retinopathy Stages Using Texture Parameters”. Journal of Medical Systems, 2007.

[4] P. Mitchell. "Guidelines for the management of diabetic retinopathy” Medical Research C. Canberra, A.C.T.: National Health and Medical Research Council, 2008.

[5] A. S. L. Kwan, C. Barry, I. L. McAllister, and I. Constable. “Fluoresce in Angiography And Adverse Drug Reactions Revisited: The Lions Eye Experience”. Clinical and Experimental Ophthalmology 2006, 12 Ogos 2005. pp 33–38.

[6] M. H. Fadzil and H. A. Nugroho. “Retinal vasculature enhancement using independent component analysis”. J. Biomedical Science and Engineering, 2009, Volume 2, pp 543- 549.

[7] M. H. Fadzil, T. A. Soomro, H. Nugroho and H. A. Nugroho. “Enhancement of Colour Fundus Image and FFA Image using RETICA”. IEEE International Conference on Biomedical Engineering and Sciences. 2012.

[8] E. Grisan, A. Giani, E. Ceseracciu, and A. Ruggeri. “Model-Based Illumination Correction In Retinal Images“. Biomedical Imaging: Nano to Macro, 2006. 3rd IEEE International Symposium. pp 984-987.

[9] Y. Yi and D. Zhang. ”Observation Model Based Retinal Fundus Image Normalization and Enhancement’. 4th International Congress on Image and Signal Processing. 2011. pp 2-3.

[10] B. Sumathy and S. Poornachandra. “Retinal Blood Vessel Segmentation using Morphological Structuring Element and Entropy Thresholding”. 2012 Third International Conference on Computing Communication & Networking Technologies (ICCCNT), 26-28 July 2012, Coimbatore. pp. 1-5.

[11] V. Saravanan, B. Venkatalakshmi and V. Rajendran. “Automated Red Lesion Detection in Diabetic Retinopathy”. 2013 IEEE Conference on Information & Communication Technologies (ICT), 11-12 April 2013, JeJu Island. pp. 236-239.

[12] P. Prentasic. “Detection of Diabetic Retinopathy in Fundus Photographs”. University of Zagreb, Faculty of Electrical Engineering and Computing Unska 3, 10000 Zagreb, Croatia. 2013. pp 6-8.

Author’s Profile:

B. Nagarjun Singh, Associate Professor, Dept of ECE, Sarada Institute Technology and Science, TS, India, E-mail: nagarjun.singh24@gmail.com.

K. Jayasree, PG Scholar, Dept of ECE, Sarada Institute Technology and Science, TS, India,
E-mail: jayasreekakarala@gmail.com.