International Journal of Research in Advent Technology (E-ISSN: 2321-9637) Special Issue
1st International Conference on Advent Trends in Engineering, Science and Technology
"ICATEST 2015", 08 March 2015

Diabetic Retinopathy Detection Using Enhance Digital fundus Images

Jaykumar S. Lachure[1], A. V. Deorankar[2], Sagar Lachure[3]
GCOEA Department of computer science and engineering[1, 2],M-tech student Assoc. Professor,[1, 2]
Email: jaykumarlachure@gmail.com[1],avdeorankar@gmail.com[2], sagarlachure1@gmail.com[3]

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 enhance 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.

Keywords - Diabetic Retinopathy, Fundus images. Exudates, features.

1. INTRODUCTION

Digitalfundus images (DFIs) areimages obtainedusing fluorescence angiography (FA) through

undusphotography [1], which capturetheretina, fovea, opticdisc,macular regionsandtheposteriorsurface ofaneye.Theseregions are usedbyophthalmologists duringdiabeticeyescreeningand diabeticretinopathy (DR)grading[2].DRisaneyecondition that have complicationsfacedbydiabeticpatientwhichmaylead to permanent blindness.Insomecases,pathological effectssuchasblood vesselraptures maypresentinpatient's retina which can lead to retinopathy.Thereareafew characteristics infundusimagesbeingusedtodetecttheDR gradessuchas hard exudates, microaneurysms, hemorrhageandthe bloodvessels and cotton wool spots [3]. Regulardiabeticeyescreening isan importantstepfordetection ofDR.Patientswithsight-threatening DRmightbeidentifiedduringthescreening processsothatnecessarytreatmenttopreventblindness[4]. Thebest approachtoobtain perfectcontrastforanalysis of the fundussurfaceisthroughobtainedfrom FA.However,FAisaninvasivemethodas it isobtainedbyinjectingayellow dye(fluorescein) intothe patient's bodytoenhance theRVandchoroid during photography andhasitssideeffectswhichinclude physiologicalproblemssuchas Urticaria,severeseizureattack, myocardialinfarctionandanaphylacticattacks[5].According to[6],theDFImethoddoesnotneedsuchinvasive procedure butthecontrastis muchlowerthanthoseofFA. DFIisknowntohaveverylow contrast betweentheretinal visualizeanddiagnose lesionsincertainareas.Thisinturncanseriously affectthe diagnostic processanditsproduct[8].Therefore, toguarantee visualization oftheretinalbloodvesselsisatitsbest,image enhancementisrequired.Normalization methodforDFIsis depending onthefrequencydomainandspace[9].In[10],they usedvesselcentrallightremovalandbackground equalization to enhancethe images. Both methodswere successful to removebrightness andstandardize theintensity.Meanwhile, V.Saravananetal.appliedbackgroundsubtractionafter converting thefundusimagestogreenchannelandsubtracted bymedianfiltered grayscaleimage[11].Inaddition,theyalso usedadaptivehistogram equalization toenhancetheDFIs contrast.Theabovemethodsareconsidered asintensity normalizationinthepreprocessingstage.

This projectfocuseson Diabetic retinopathy using image enhancementand in this work,threedifferentmethodsare considered.Itis initially anticipated thattheenhancedDFIcanfacilitate ophthalmologiststoperformmanualDRdetectionandgrading andthus,reducingtheneedforFA.Additionally, this enhancementis a necessarypre-processingstep for further processingtechniques anditisimportantthatanysignificant details in medical images to be preserved while being enhanced.

2. METHODOLOGY

For DR theenhancement tests carried on55imagesobtainedfromthe MESSIDOR databasewereused.Eachimagewascapturedusing 8 bitspercolorplane. Eachof the imagesin this databasehasbeencroppedaroundtheFOV area andwasgiven amask image todelineatetheFOV. Asmentioned, thetechniques for enhancement consideredare1)Histogram Equalization (HE), 2) ContrastLimitedAdaptiveHistogram Equalization(CLAHE). The experimentalworkare as showninFigure1.

InRGBDFI,thegreenchanneltypically showsthebest contrastbetweenthe backgroundandvesselswhereasthe other two channelsproduce more noise [12]. As such, the gray imagesfromthegreen channelareusedsincetheretinal blood vesselsintheseimagesaremorevisible.Uponextraction, the imagesareprocessedusingthethreemethodsmentionedby the applicationoftherespectivealgorithms.

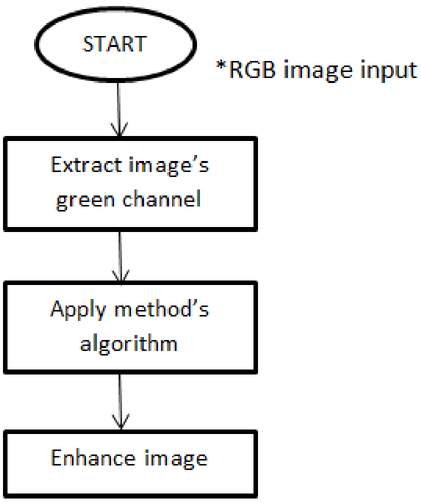


Figure.1Step-by stepproceduresofdigital fundusimageenhancement

2.1. Adaptive Median Filter

The median filter [1] 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 pre-processing step to improve the results for further processing.

2.2. 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.

2.3. 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 loosing 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 as in [3]. Namely, in the first step we could get back the same image as in [3], but after LCE the result has not really changed. The implementation of this function is available in the project directory.

2.3.1. *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 invertibleoperator. 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.

Consider a discrete grayscale image, and let ni be the number of occurrences of gray level i. The probability of an occurrence of a pixel of level i in the image is

$$p(x_i) = \frac{n_i}{n}, i \in 0, \ldots, L-1$$

L being the total number of gray levels in the image, n being the total number of pixels in the image, and p being in fact the image's histogram, normalized to 0..1.

Let us also define c as the cumulative distribution function corresponding to p, defined by:

$$c(i) = \sum_{j=0}^{i} p(x_j)$$

c is the image's accumulated normalized histogram.

We would like to create a transformation of the form $y = T(x)$ that will produce a level y for each level x in the original image, such that the cumulative probability function of y will be linearized across the value range. The transformation is defined by:

$$y_i = T(x_i) = c(i)$$

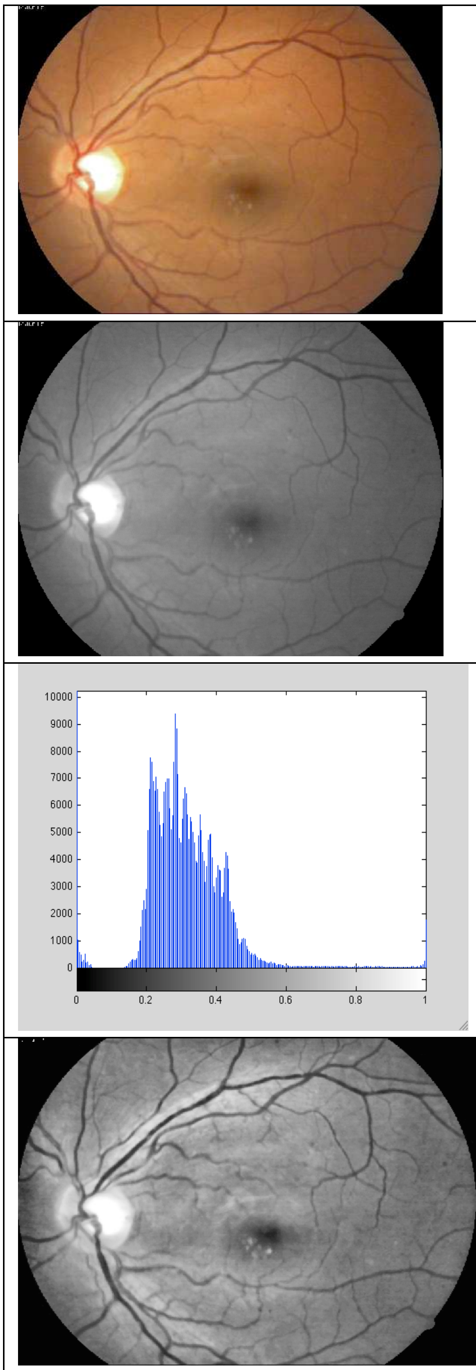
Notice that the T maps the levels into the domain of 0..1. In order to map the values back into their original domain, the following simple transformation needs to be applied on the result:

$$y_i' = y_i \cdot (\max - \min) + \min$$

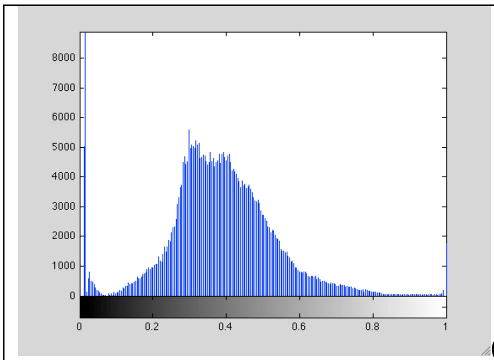
The above describes histogram equalization on a greyscale image. However it can also be used on color images by applying the same method separately to the Red, Green and Blue components of the RGB color values of the image

3. RESULT

We done our work on the drive dataset and found that the image obtain after the applying two method are superb and can futher consider and extended. The uptill work shown in diagram is shown below with diagram as follow.



(a) (b) © (d)



(e)

Figure. 2(a)Original Image (b) green channel image (c)histogram of green channel image (d) adaptive histogram image (e) adaptive histogram image histogram.

Overall study shows the output image is more better to used for feature extraction.

4. CONCLUSION

The over work proposed through figure 1 can be accomplished by combining the green channel , median filter and adaptive histogram equalization. This method are good for drive dataset. We are aim at to develop the method which can be apply 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.

REFERENCES

[1] H.K.Li1,L.D.Hubbard,R.P. Danis,A.Esquivel, J.F.Florez-Arango1,J.Nicola,N.J.FerrierandE.A.Krupinski, "DigitalversusFilmFundusPhotographyforResearchGrading ofDiabeticRetinopathySeverity"AssociationforResearchin Vision and Ophthalmology, Fort Lauderdale, Florida, May, 2008.

[2] U.RAcharya,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

[3]P.Mitchell."Guidelinesfor themanagementof diabetic retinopathy" MedicalResearchC.Canberra,A.C.T.:National HealthandMedicalResearchCouncil, 2008.

[4] A.S.L.Kwan,C.Barry,I.L.McAllister,andI.Constable. "FluoresceinAngiography AndAdverseDrug Reactions Revisited: The LionsEye Experience". Clinical andExperimentalOphthalmology2006,12Ogos2005.pp 33–38.

[5]M. H. Fadziland H. A. Nugroho."Retinal vasculature enhancementusing independentcomponentanalysis".J. BiomedicalScienceandEngineering,2009,Volume2,pp 543-549

[6] M.H.Fadzil,T.A.Soomro,H.NugrohoandH.A.Nugroho. "EnhancementofColourFundusImageandFFAImageusing RETICA".IEEE International Conference on Biomedical Engineering and Sciences.2012

[7] E.Grisan,A.Giani,E.Ceseracciu,andA.Ruggeri."Model- Based Illumination Correction In Retinal Images". Biomedical Imaging: Nano to Macro, 2006. 3rd IEEE International Symposium.pp984-987

[8] Y. Yi and D. Zhang."Observation Model Based Retinal Fundus Image Normalization and Enhancement'. 4th International Congress onImage andSignalProcessing.2011.pp2-3.

[9] B. Sumathyand S. Poornachandra."Retinal Blood VesselSegmentation using Morphological Structuring Element and Entropy Thresholding". 2012ThirdInternationalConference on ComputingCommunication &NetworkingTechnologies (ICCCNT), 26-28July2012,Coimbatore. pp.1-5.

[10] V. Saravanan, B. Venkatalakshmiand V.Rajendran.. "Automated Red Lesion Detection in Diabetic Retinopathy".2013 IEEE Conference on Information &Communication Technologies (ICT), 11-12April2013,JeJuIsland.pp.236-239.

[11]P. Prentasic."Detection ofDiabetic Retinopathy in Fundus Photographs".University ofZagreb,Faculty ofElectrical Engineering andComputingUnska 3, 10000 Zagreb, Croatia.2013.pp6-8.

[12] L.XuandS.Luo."A novelmethodforbloodvesseldetection fromretinal images". BioMedicalEngineeringOnLine2010,9:14 http://www. Biomedical - engineering-online.com/ content / 9/1/14.2010.pp2-3.

[13]T.AcharyaandA.K.Ray."Enhancementof ChestRadiographs usingGradientOperators".ImageProcessing: Principlesand Applications.2005.pp270-275

[14] A. A. A. Youssif, A. Z. GhalwashandA. S. Ghoneim. "ComparativeStudy ofContrastEnhancementandIllumination Equalization Methodsfor RetinalVasculature Segmentation".Proc.CairoInternationalBiomedicalEngineeringConference 2006.pp3

[15]C.ChaudharyandM.K.Patil."Review OfImageEnhancement Techniques Using Histogram Equalization". International Journal of Application orInnovationinEngineeringand Management(IJAIEM).Volume 2,Issue5, May2013.

[16]H. K. Sawant, andM. Deore. "A comprehensivereview of Image Enhancementtechniques". ISSN2249-6343International Journalof ComputerTechnologyandElectronicsEngineering.Volume 1,Issue 2. 2012

[17]S. M. Pizer, J. B. Zimmermanand E. V. Staab."Adaptivegrey levelassignmentinCT scandisplay",J.Comput.Assist. Tomogr.,vol.8,1984.pp.300-308.

[18]D.P.Sharma."Intensity TransformationusingContrastLimited AdaptiveHistogram Equalization".InternationalJournal of Engineering Research(ISSN:2319-6890). VolumeNo.2,Issue No.4,01Aug. 2013.pp282-285

[19]J.B.Zimmerman,S.M.Pizer,E.V.Staab,J.R.Perry, W.Mccartneyand B.C.Brenton."AnEvaluationofthe EffectivenessofAdaptiveHistogram EqualizationforContrast Enhancement".IEEETransactionsOnMedicalImaging, Vol.7.No.4,Disember 1988.pp304-312.

[20] M. Foracchia, E. GrisanandA. Ruggeri, "Luminosity and contrast normalization in retinal images", Medical Image AnalysisVolume9,Issue3,June2005.pp.179–190.