

Feature Extraction and Classification of Fundus Images for Detection of Microaneurysms

M.Rajesh Reddy¹, T.Mohith Sai², Shaik Jafar Sadik³, Sk.Maksood⁴, R.Srikanth⁵

¹M.Tech, (PH.D), Assistant Professor of CSE, KKR & KSR Institute of Technology & Sciences, Guntur, AP, India

^{2,3,4,5} B.Tech, CSE, KKR & KSR Institute of Technology & Sciences, Guntur, AP, India

Abstract— Diabetes increases the risk of developing any deterioration in the blood vessels that supply the retina an ailment known as diabetic retinopathy (DR). Since this disease is asymptomatic, it can only be diagnosed by an ophthalmologist consequently, this work proposes a new approach for MA detection based on deduction of non-uniform illumination; normalization of image gray scale content to improve dependence of images from different contexts; application of the Top hat transform to leave reddish regions intact while suppressing bright objects; binarization of the image of interest with the result that objects corresponding to MAs, blood vessels from the ROIs; the features are extracted from a candidate to distinguish real MAs from FPs, is characterized by values obtained from sensitivity and specificity. The proposed approach is tested on publicly available database Messidar. The proposed MA detection method achieves good results in detecting MA's.

Index Terms: CPS processor, CPS host, database, proxy value, CPS web portal, fund transfer.

I. INTRODUCTION

According to International Diabetes Federation (IDF), in 2011, 366 million people were recognized with diabetes. It is hard to identify the symptoms in the patients; who have DR, So that it would be late for giving effective treatment. MAs are the first scientific sign to illustrate the diabetic retinopathy and specify it as red lesions. There are two types of diabetic retinopathy.

1) Non proliferative diabetic retinopathy:

In this more common form - called non-proliferative diabetic retinopathy (NPDR) - new blood vessels aren't growing (proliferating).

When you have NPDR, the walls of the blood vessels in your retina weaken. Tiny bulges protrude from the walls of the smaller vessels, sometimes leaking fluid

and blood into the retina. Larger retinal vessels can begin to dilate and become irregular in diameter as well. NPDR can progress from mild to severe as more blood vessels become blocked.

Sometimes retinal blood vessel damage leads to a buildup of fluid (edema) in the center portion (macula) of the retina. If macular edema decreases vision, treatment is required to prevent permanent vision loss.

2) Proliferative diabetic retinopathy:

Diabetic retinopathy can progress to this more severe type, known as proliferative diabetic retinopathy. In this type, damaged blood vessels close off, causing the growth of new, abnormal blood vessels in the retina. These new blood vessels are fragile and can leak into the clear, jellylike substance that fills the center of your eye (vitreous).

Eventually, scar tissue from the growth of new blood vessels can cause the retina to detach from the back of your eye. If the new blood vessels interfere with the normal flow of fluid out of the eye, pressure can build in the eyeball. This buildup can damage the nerve that carries images from your eye to your brain (optic nerve), resulting in glaucoma.

II. LITERATURE REVIEW

It is noted that in

- 23 countries for one million patients there have less than one ophthalmologist.
- 30 countries with less than four.
- 48 with lesser than 25 for every million citizens.
- 74 countries with less than 100.
- Only 18 have more than 100 ophthalmologists for every one thousand people.

- It is anticipated that the count of ophthalmologists will grow just 2%, while the diabetic patients will be 54% in 2030.
- For examination of each eye it takes 15 to 30 minutes.
- For this reason the work mainly concentrated on algorithm evaluation and that algorithm is used to detect Micro aneurysms in eye images.

An image is a 2-D rectilinear array of pixels. An image is an array, or a matrix, of square pixels (picture elements) arranged in columns and rows.

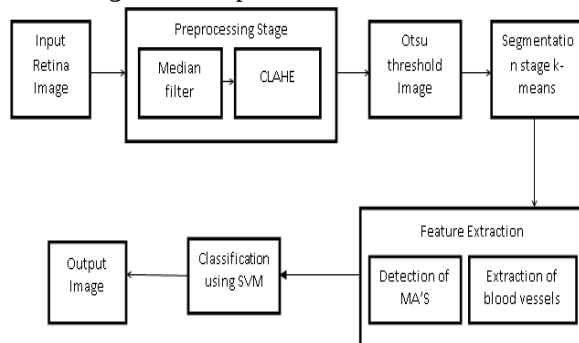
Pictures are the most common and convenient means of conveying or transmitting information. A picture is worth a thousand words. Pictures concisely convey information about positions, sizes and inter relationships between objects. They portray spatial information that we can recognize as objects. Human beings are good at deriving information from such images, because of our innate visual and mental abilities. About 75% of the information received by human is in pictorial form.

III. PROPOSED SOLUTION AND RESULTS

The lesion detection is done in two phases

1. Micro aneurysms extraction and
 2. Classification of MAs.
- An algorithm is projected for MAs detection based on red lesions which are produced by the wavelet transform of an image.
 - The retina of eye is captured using ophthalmoscope.

Block diagram of Proposed method



Methods for MA detection:

The methods involved in detection of micro aneurysms are:

- Pre-processing
- Fine segmentation using K-Means classifier
- Coarse segmentation using Top-Hat transform for detection of MAs
- Classification using SVM.

Input Retina Image:

- The initial step in the image examination is to retrieve retinal image.
- Image capturing is normally done by a fundus camera which has an embedded digital camera at the back i.e., it is embedded with an image sensor.

Preprocessing:

- To slim down the image variations and to amend the image quality the Preprocessing stage is really important.
- Preprocessing involves two stages.
 - ~ Median filter
 - ~ CLAHE

Median filter:

- Median filter is a non linear method applied to (fg) green plane images for reducing the noise.
- In this process, adaptive histogram equalization is used and then the image is separated into regions and then histogram equalization is enforced on every region.
- It is used to visualize the hidden things in the image gray values is used.

CLAHE:

- Contrast Limited Adaptive Histogram Equalizer (CLAHE)
- In the consecutive step, for contrast enhancement and to avoid over saturation of the same areas in retinal image CLAHE is applied.
- Median filter and CLAHE is applied to the original RGB images for correcting background variation and close-ups of MAs is as depicted.

Otsu's Threshold Image:

- Otsu's method is used to perform cluster-based threshold and converting the grey image to a binary image.
- In Otsu's algorithm the image contains two classes of pixels.

- They are
 - ~ Background pixels and
 - ~ Foreground pixels
- which are known as bi-modal histogram.

Phases in Otsu's threshold image:

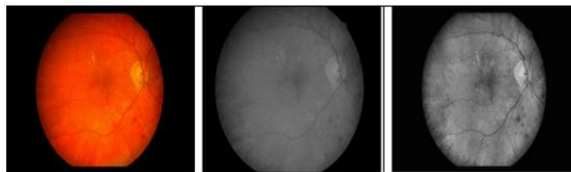
- The optimal threshold value is calculated in two phases
 - ~ Intra-class variance is minimal.
 - ~ Inter-class variance is maximal.
- The intra-class variance is defined as a weighted sum of variances:

$$\sigma_w^2(t) = \omega_0(t)\sigma_0^2(t) + \omega_1(t)\sigma_1^2(t)$$

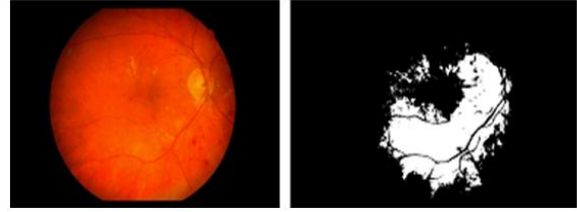
Software Requirement Specification:

- MATLAB is a multi-paradigm numerical computing environment. It is a program that was originally designed to simplify the implementation of numerical linear algebra routines. It has since grown into something much bigger, and it is used to implement numerical algorithms for a wide range of applications. The basic language used is very similar to standard linear algebra notation, but there are a few extensions that will likely cause some problems at first.
- It allows matrix manipulations, plotting of functions and develops implementation of algorithms, creation of user interfaces, and interfacing with programs written in other languages, including C, C++, C#, JAVA, FORTRAN and PYTHON.
- It is applied in Operating Systems like WINDOWS, macOS, LINUX.
- The filename extension for MATLAB is ".m"

Examination Results: The resultant image obtained after applying media filter and CLAHE



The resultant image obtained after Otsu's threshold image process



IV.CONCLUSION

The proposed method is an innovative procedure to detect exudates by means of morphological closing operation and Otsu's Threshold method along with more noise suppression with the use of median filter. In this whole procedure, the I-band of the Grey image is used. As more noise involves in the fundus image, various pre-processing procedures are applied for removing the noise and for enhancing features using adaptive histogram equalization to equalize all the regions in an image for showing irregular contrast. This procedure can be applied to every retinal image. The percentage of sensitivity as 92.32% and specificity as 93.87%.

REFERENCE

- [1] AlauddinBhuiyan, BaikunthNath, KotagiriRamamohanara and Tien Y. Wong; "RetinalImage Matching Using Hierarchical Vascular Features"; The University of Melbourne, VIC3002, Australia.
- [2] M. Zubair; Dept. of Computer Eng., NUST, Rawalpindi, Pakistan; A. Yamin; S. A.Khan; "Automateddetection of Optic Disc for the analysis of retina using colorfundusimage"; IEEE International Conference, Published in: Imaging Systems and Techniques(IST), 2013.
- [3] Jayakumari, C., Santhanam, "Retinal blood vessel segmentation for assessment of diabetic retinopathy using a two-dimensional model", Asian J. Inf. Technol., pp. 1205–1211, 2007.
- [4] Robert Hirsch," Exploring Colour Photography: A Complete Guide", Laurence King Publishing. ISBN 1-85669-420-8, 2004.
- [5] Robert Hunt," The Reproduction of Colour", 6th ed. MN: Voyageur Press, ISBN 0-86343-368-5, 2004.
- [6] K. Zuiderveld, "Contrast Limited Adaptive Histogram Equalization", In: P. Heckbert:

Graphics Gems IV, ISBN 0-12-336155-9, Academic Press 1994.

- [7] Herman J. Blinichoff, Anatol I. Zverev, "Filtering in the Time and Frequency Domains".
- [8] J. Serra, "Image Analysis and Mathematical Morphology", Academic Press, 1982.
- [9] "Document Image Binarization Using Post Processing Method", Computer Engineering and Intelligent Systems, ISSN 2222-1719 (Paper) ISSN 2222-2863 (online), Vol. 2, No.4, 2011.
- [10] "An Adaptive Logical Thresholding Method for Binarization of Blueprint Images".
- [11] Maureen C. Stone, "A Survey of Color for Computer Graphics", Course at SIGGRAPH 2001.
- [12] Keith McLaren; "Dyes, General Survey"; Ullmann's Encyclopedia of Industrial Chemistry; Wiley-VCH; 15 June 2000.