ISSN (ONLINE): 2454-9762
ISSN (PRINT): 2454-9762
Available online at www.ijarmate.com

International Journal of Advanced Research in Management, Architecture, Technology and Engineering (IJARMATE) Vol. 3, Special Issue 12, March 2017

Automatic Exudate Detection in Color Retinal Images for Screening of Diabetic Retinopathy

Paintamilselvi N[1], Dr.T.Muthumanikam[2]
PG Student[1], Professor[2]
Dept of ECE, V.M.K.V Engineering College
Vinayaka Missions University
Salem, Tamilnadu - 636308

Abstract- Diabetic retinopathy(DB) is a serious eye condition that can lead to decreased eyesight, or even blindness. This paper presents a novel approach for automatic detection of micro aneurysms and hemorrhages in fundus images. First, the green channel of the color retinal fundus image is extracted and pre-processed using various enhancement techniques such as Top-hat filtering and contrast enhancement and denoising. Second, all regional minima with sufficient contrast are extracted and considered as candidates. Third, in an image feature extraction method is used to find the DB affected eye by identifying the microaneurysms and hemorrhages. Finally, a Random Forest classifies the candidates into lesions and non-lesions. The method is validated with Stare, Drive, messidor and Diaretb0 and Diaretb1 databases, which are publicly available. It proves to be robust with respect to variability in image resolution, quality and acquisition system. The accuracy of this method is 94.42% in finding the blood vessels with DRIVE database.

Keywords— Image processing, features extraction, computer aided detection, fundus images.

I. INTRODUCTION

In the modern era, Diabetes has become one of the rapidly increasing health threats worldwide. Diabetes occurs due to the fluctuating insulin levels in a human body. Diabetes tends to affect multiple organs of the body like kidney, eyes, liver, heart etc. When diabetes affects human eyes, the disease is termed as diabetic retinopathy (DR). The blood vessels in a human are very small in size and hence more susceptible. The corrosion of blood vessels starts occurring when the blood sugar levels are increased much above the normal levels for a prolonged period of time. This pathological condition is referred to as DR [2]. In DR, the normal vision of a human is hindered and as time passes by, the vision tends to become weaker. Exudates, micro aneurysms and abnormalities in blood vessels are some features extracted to classify DR. The retina of a human eye gets damaged when proteins and lipids start leaking from the blood vessels causing exudates. Microaneurysms are small areas of balloon like swelling in the retinas tiny blood vessels [1]. DR can also be detected from abnormality in the structure or extra growth of blood vessels. Early detection of these features helps the ophthalmologist to detect

ISSN (ONLINE): 2454-9762
ISSN (PRINT): 2454-9762
Available online at www.ijarmate.com

International Journal of Advanced Research in Management, Architecture, Technology and Engineering
(IJARMATE) Vol. 3, Special Issue 12, March 2017

the DR and also help in preventing blindness.With the increasing prevalence of diabetes and the aging population, it is estimated that, 30% of people with DM and DR in worldwide will require retinal examination each year. Our aim is to detect and sort patients with suspected retinal problems with DR and to refer them to an ophthalmologist with more priority. So this will help the ophthalmologists to reduce their clinical burden on retina diagnosis.Hence lots of research has been carried out to attain better enhanced images mentioned in the literature [2–4]. One more approach proposed a three-stage system for early detection of microaneurysms using filter banks [5] and The true microaneurysms regions were selected and classified using a hybrid classifier which was a weighted combination of multivariate m- Mediods, Gaussian mixture model and support vector machine.The proposed system had achieved higher accuracy which was better than previously published methods. Another approach is to use a priori shape knowledge and to perform a convolution with a double ring filter [5] or through template matching with multistate Gaussian kernels [6], [7], [8]. Contrary to vascular segments, which are directional, Mas indeed show a Gaussian-like peak in all directions. Many paper are proposed for blood vessel segmentation of retinal vessel to diagnosis of Diabetic Retinopathy such as "Review of retinal blood vessel detection methods for automated diagnosis of Diabetic retinopathy" by Preethy et al. [19], "Blood vessel segmentation methodologies in retinal images – A survey" by Owen et al. [9], and "A survey on Blood Vessel Segmentation Methods in Retinal image" by Navdeep et al. [20]In this paper, a novel approach for the detection of MAs and HMs in high resolution fundus images is proposed and validated. It introduces a novel set of dynamic shape features used for region classification.

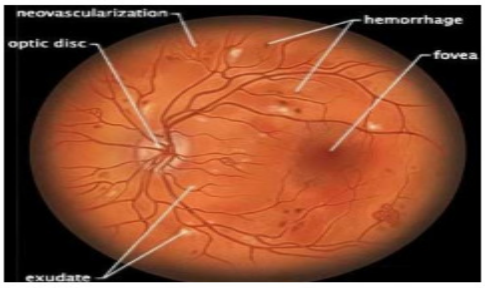

Fig. 1. Eye image with HE, exudate and fovea, optic disc

It is motivated by the fact that the shape of a candidate region depends highly on the intensity threshold for which the region is defined in the Fig 1.Diabetic retinopathy falls into two main classes: non proliferative and proliferative. The word "proliferative" refers to whether or not there is neovascularization (abnormal blood vessel growth) in the retina. Early disease without neovascularization is called non proliferative diabetic retinopathy (NPDR). Again NPDR is classified: Early NPDR – At least one microaneurysm present on retinal exam.Moderate NPDR – Characterized by multiple microaneurysms, dot-and-blot hemorrhages, venous beading, and/or cotton wool spots.Severe NPDR – In the most severe stage of NPDR with cotton wool spots, venous beading, and severe intraretinal microvascular abnormalities (IRMA).In the previous work most of them are mainly focused only on microaneurysms. But here we will focus on finding the microaneurysms, dot-and-blot hemorrhages both by using the feature extraction method and principal component analysis.

ISSN (ONLINE): 2454-9762
ISSN (PRINT): 2454-9762
Available online at www.ijarmate.com

International Journal of Advanced Research in Management, Architecture, Technology and Engineering (IJARMATE) Vol. 3, Special Issue 12, March 2017

II. PROPOSED METHOD

The proposed method classified into five steps. As the inputs are taken from different databases the size and resolution will be different so our First step is to remove the black background, second step is color RGB image is converted into gray scale and morphological operations are used to reduce small noise. In the third step to obtain the vessel structure a unique technique called top hat transformation was used. In the fourth step, the resultant image was obtained after binarization and thresholding. Finally, the Extracting the region of interest in the retina through feature extraction method to find the DB affected eye.

A. Image background reduction:

Inputs are taken from different databases so the size and resolution will be different. We need a particular region from the image to find the disease. Mean filter is applied to take only Region of interest(ROI).

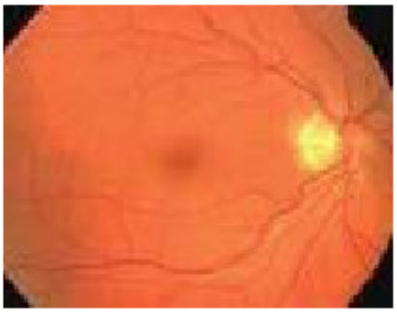

Fig. 2 background reduced image

B. Image Binarization and noise reduction:

The retinal fundus images normally have a poor contrast hence detection of blood vessels is tougher, so to reduce correlated color information, RGB image is converted into gray-scale (I1)I1= 0.3 × R + 0.59 × G+ 0.11 × B Morphological opening operation (I2) and Morphological closing operation(I3) is applied a disc shaped structuring element on gray-scale image to reduce the small noise and to remove the vessels structure.

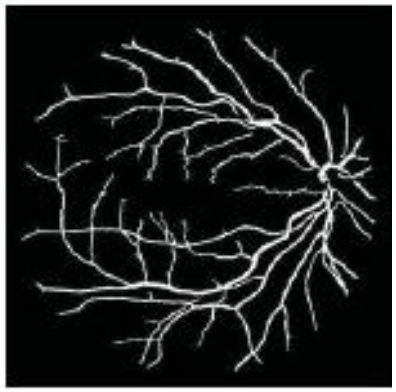

Fig. 3 *Binarized and noise reduced image*

C. Blood vessel Extraction:

The Binarized image from the last step is applied to extract the blood vessels. By using Top-Hat transformation (I4), the vessels like structure are extracted.I4 = I3 – I1 The extracted image is thresholded to produce a resultant image.By connected component analysis, the remaining noise is reduced for any arbitrary shape.

ISSN (ONLINE): 2454-9762
ISSN (PRINT): 2454-9762
Available online at www.ijarmate.com

International Journal of Advanced Research in Management, Architecture, Technology and Engineering (IJARMATE) Vol. 3, Special Issue 12, March 2017

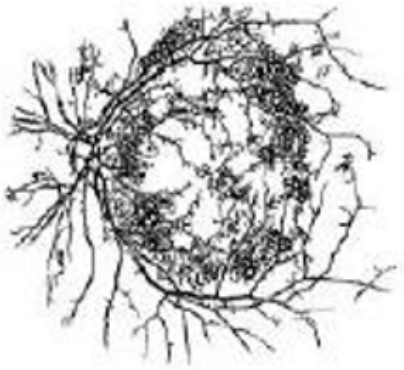

Fig. 3 Blood vessel extraction

D. Fovea and Optic disc removal:

As per the study Blood cells are originated from the optic disc, so origination point is noted and identified as Optic disc.When finding the DB, the False positives may occur from the Optic disc and fovea. So it is must to identify both of the region and remove that. Locate a point P horizontally at a distance 2.5×d from optic disc center towards the centroid is the fovea region. Apply a k×k sliding window along the strip and form the chain of numbers denoting the black pixels in the window. Maximum run length of zeros is found in the number chain. That is known as a fovea region.To remove those convolving a multi-scale ring- shaped matched filter to the image in a sub-ROI centered on the OD's center is applied as per entropy- based approach [10].

E. Exudate extraction:

Extracting the region of interest in the retina through feature extraction by using Red Lesion Detection Using Dynamic Shape Features method [18] by Lama Seoud.Among the candidates, several regions correspond to non-lesions, such as vessel segments and remaining noise in the retinal background. To discriminate between these false positives and true lesions, an original set of features, the DSFs, mainly based on shape information, is proposed.In a topographic representation of GP, each candidate corresponds (by analogy) to a water source, denoted SJ.Morphological flooding is applied to GP starting from the lowest water source and ending when the retinal background is reached. It is indeed hypothesized that when the flooding reaches the retinal background intensity, the catchment basins degenerate and no longer contextually represent a red lesion.

At each flooding level, pixels that are adjacent to a water source and lower than the flooding level are added to the catchment basin of, denoted. When two basins merge, they start sharing the same pixels and thus the same attributes.

We implement the image flooding using hierarchical queues.At each flooding level i, for each candidate SJ, six shape attributes are computed on the catchment basin BJ:1. Relative area: number of pixels in BJ, divided by the total number of pixels in the ROI.2. Elongation :1-W/L with W and L the width and length, respectively, of the bounding box of oriented along its major axis.3.Eccentricity: √l2-w2/l2with w and 1 the width and length, respectively, of the bounding box of oriented along its major axis.4.Circularity: ratio of the area of Bi over its squaredperimeter and multiplied by 4∏.5. Rectangularity: ratio of the area of Bi over the area of its bounding box oriented along its major axis.6. Solidity: ratio of the area of over the area of its convex hull. Extracted region is further processed by implementing principal component analysis to find MA and HE.

ISSN (ONLINE): 2454-9762
ISSN (PRINT): 2454-9762
Available online at www.ijarmate.com

International Journal of Advanced Research in Management, Architecture, Technology and Engineering
(IJARMATE) Vol. 3, Special Issue 12, March 2017

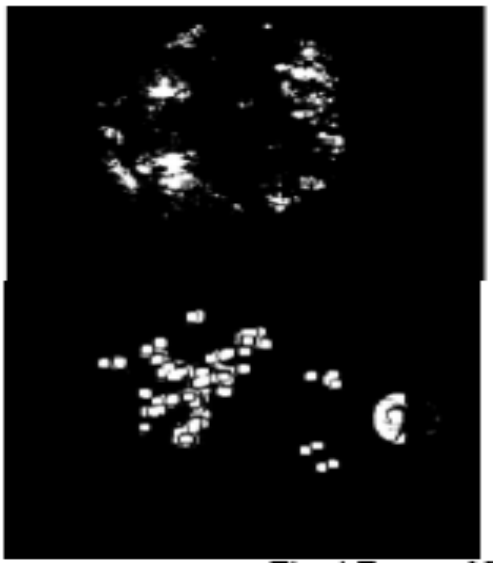

Fig. 4 Detected MA and HE

III.EXPERIMENTAL

SETUP

Retinal Image Database:

Image fetching is a process to collect the image from direct image shooting or from publicly available database. And below are public database's which are available for retinal image processing:

1.DRIVE

Database

DRIVE (Digital Retinal Image for Vessel Extraction) is a fundus image database which available for public. Fundus images in this database were collected through diabetic retinopathy screening program in Netherland, from 453 people in the age of 31-86years old. Fundus images in this database sums up to40 images with 20 training and 20 testing images.

2.STARE Databae

STARE Database contains 20 images for blood vessel segmentation. Image size on this database is 700x605 pixels with 8 bit per color channel.

3.Image Set

This database was recorded in 2008 and divided into two sub databases namely, DIARETDB0 and DIARETDB1. DIARETDB0 contains 130 retina images, 20 of them are normal images while the other 110 are images with various symptoms of diabetic retinopathy. Meanwhile, DIARETDB1 consists of 89 retina images with 5 healthy images and 84 images with light symptoms of diabetic retinopathy. These sub databases were determined by diabetic retinopathy symptoms such as microaneurysms, hemorrhages, hard exudates, and soft exudates. Image size on the database is 1500x1152 in PNG format.

IV. CONCLUSION

This paper evaluates methods for detection of diabetic retinopathy through feature extraction method of retinal image. It performs well and evaluated on six different databases. This method is robust also. This proposed methodology can be utilized in hospitals to detect diseases occurring on the eyes by doctors easily. Future scope of this project is to detect many eye diseases thus making mankind to be benefitted in large extent to be free from eye diseases leading to blindness with higher efficiency.

References

[1] G.Rajput, Preethi N. Patil and Ramesh Chavan, "Automatic detection of microaneurysms from fundus images using morphologicaloperations", Lecture Notes in Electrical Engineering/Springer India 2013.

ISSN (ONLINE): 2454-9762
ISSN (PRINT): 2454-9762
Available online at www.ijarmate.com

International Journal of Advanced Research in Management, Architecture, Technology and Engineering
(IJARMATE) Vol. 3, Special Issue 12, March 2017

[2] J. Ding and T. Y. Wong, "Current epidemiology of diabetic retinopathy and diabetic macular edema," *Curr. Diabetes Rep.*, vol. 12, no. 4, pp. 346–54, 2012.

[3] Alan D Fleming, Sam Philip, Keith A Goatman, John A Olson and Peter F Sharp 2006 Automated microaneurysms detection using local contrast normalization and local vessel detection. IEEE Trans. Med. Imaging 25(9): 1223–1232

[4] Anderson Rocha, Tiago Carvalho, Herbert F Jelinek, Siome Goldenstein and Jacques Wainer 2012 Points of interest and visual dictionaries for automatic retinal lesion detection. IEEE Trans. Biomed. Eng. 59(8): 2244–2253

[5] Usman Akram M and Shoab A Khan 2013 Multi-layered thresholding-based blood vessel segmentation for screening of diabetic retinopathy. Eng. Comput. 29(2): 165–173

[6] G. Quellec *et al.*, "Optimal wavelet transform for the detection of microaneurysms in retina photographs," *IEEE Trans.Med. Imag.*, vol. 27, no. 9, pp. 1230–41, Sep. 2008.

[7] A. Mizutani, C. Muramatsu, Y. Hatanaka, S. Suemori, T. Hara, and H. Fujita, "Automated microaneurysm detection method based on doublering filter in retinal fundus images," in *SPIE Med. Imag.*
Comput.-Aid. Diagnosis, 2009, vol. 7260, pp. 72601N–72601N-8.

[8] B. Zhang, X. Wu, J. You, Q. Li, and F. Karray, "Detection of microaneurysms using multi-scale correlation coefficients," *Pattern Recognit.*, vol. 43, no. 6, pp. 2237–2248, 2010.

[9] I. Lazar and A. Hajdu, "Retinal microaneurysm detection through local rotating cross-section profile analysis," *IEEE Trans. Med. Imag.*, vol. 32, no. 2, pp. 400–7, Feb. 2013.

[10] A. M. Mendonça, A. Sousa, L. Mendonça, and A. Campilho, "Automatic localization of the optic disc by combining vascular and intensity information," *Comput. Med. Imag. Graph.*, vol. 37,no. 5-6, pp.409–17, 2013.