International Journal of Recent Technology and Engineering (IJRTE)
ISSN: 2277-3878 (Online), Volume-7 Issue-4s, November 2018

A Novel Method for Detection of Retinal Lesions Using Statistical Based Segmentation with Supervised Classifier

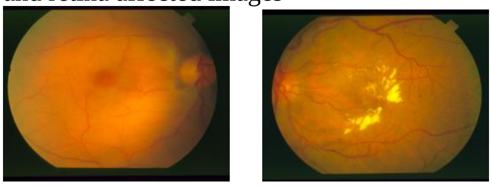
W. Jai Singh, R. K. Kavitha

***Abstract-** Lesion from the retinal images are one among the main sources of visual deficiency. It impacts veins in the light-sensitive tissue known as retina. Various kinds of marks in Diabetic Retinopathy (DR) will represent the abnormalities in the retina. The automated lesion segmentation in retinal pictures is a vital task in computer-aided detection systems. The research article proposes a computational framework for detection of lesion in retina images. In the initial process, Gabor filtering technique is used to enhance the lesion regions. Second, the segmentation of the suspicious region is based on expectation maximization bootstrap subgroup and mathematical morphology. A hybrid feature set is selected from the suspicious region. Finally, a classification method is applied to pin-point the lesions in the suspicious region. The projected technique has been evaluated on two public databases: DRIVE and STARE. The experimental result shows the proficiency and viability of the proposed strategy, and it can possibly be utilized to analyze DR clinically.*

***Key words:** Lesion, Diabetic Retinopathy, lesion, Segmentation, Feature extraction, Classification, Computer aided detection.*

I. INTRODUCTION

Diabetic Retinopathy is the important problem of visual impedance in a working age population on the earth [1]. The World Diabetes Foundation assesses that in excess of 438 million people will encounter the evil impacts of diabetic retinopathy by 2030. The World Diabetes Foundation assesses that in excess of 438 million people will encounter the evil impacts of diabetic retinopathy by 2030. It is additionally anticipated that, by 2040, in excess of 640 million individuals might live with diabetes [2] The Diabetic interrelated complexities are growing day by day. The diabetic retinopathy impacts 2 to 4 percent of the people with visual impairment and is the standard wellspring of visual lack in the twenty to seventy five age group in developing countries [3, 4]. Figure 1 demonstrated the normal and retina affected images



a **b**

Manuscript published on 30 November 2018.
***Correspondence Author(s)**
W. Jai Singh, Assistant Professor (SRG) Department of MCA, Kumaraguru College of Technology, Coimbatore (Tamil Nadu), India
R.K. Kavitha Assistant Professor (SRG) Department of MCA, Kumaraguru College of Technology, Coimbatore (Tamil Nadu), India.

c

Figure. 1: a) The Normal Image; b) and c) Lesion affected images.

In recent years, many techniques for detection of lesions in retinal images have been published. Qing Liu, et al [5] have developed a method for exudate extraction in retinal fundus images, which incorporates three phases: pre-processing, identification of location, and segmentation of exudate. He hung, et al [6] have developed a technique to detect lesions in retina images. The technique contains pre-processing for candidate lesion extraction, features extraction and classification. Usman et al [7] have developed an approach to identify the lesions in retina images by using a combination of M-Mediods and Gaussian Mixture mode. Singh, et al [13] have developed an approach for detection of lesions in mammogram images by using k-means clustering and bootstrap subgroup with learning classifier.

The literature shows that the segmentation and detection of lesions are focused on extraction of one feature. These kind of approaches will produce better diagnosis results on some particular of lesions, but it may give unreasonable detection results on many of form of lesions. In this manuscript, a combination of shape, gray and texture features are used to detect the lesions in retina images. These highlights are valuable to create progressively dependable and sensible discovery results, since these highlights are the most widely recognized attributes in all types of lesions. The organization of manuscript is as follows:

The proposed methodology is explained in section II. The results of the experiments and the performance are given in Section III. Finally, comparison with previous techniques, summary of the work, and conclusion are presented in section IV.

Published By:
Blue Eyes Intelligence Engineering and Sciences Publication (BEIESP)

II. PROPOSED METHODOLOGY

A) Image pre-processing

In this step, the enhancement of retina images are carried out. First, the colour images are transformed into gray scale. After that Gabor filter is applied with window size 7x7 to enhance the suspicious region in the retina images [6].

B) Suspicious Region Segmentation

After enhancement of the retina images, it contains the abnormalities which may exist of high intensity values. Therefore, it is hard to segment the suspicious region. Therefore, every pixel is taken in the image under consideration to detect abnormalities.

The Bootstrap computational approach proposed by Efron (1979), can be applied to estimate the samples obtained from the population [8]. Specifically, the non-parametric method can be utilized to assess the sample data. The sample data are independent and distributed in various level. The Bootstap method does not follow any distribution method about the population. However, it gives equal chances to all pixels in the retina image. Let us assume that x={X1, X2,…Xn} be a a collection of n numbers of pixels drawn at random from a matrix of ratina images, F.

$$F_n(x) = \frac{1}{n} \cdot (\text{Number of } X_i \leq x) \qquad (1)$$

C) Combination of Classical Segmentation with Re-sampling Method

The Expectation Maximization (EM) clustering procedure is generally utilized for the approximation of model attributes in retina affected images. Applied Mathematics models are normally utilized to represent the suitable system in the two dimensional representation of image data. The choice of image cells are random in nature. The Expectation Maximization Bootstrap Subgroup (EMBS) approach is developed to approximate the parameters of sampling distribution from collection of image data. The approach first segment a different kind of tissue types or approximates the class attributes associated with tissue types. The function of a random attribute $X^* = (x_1^*, x_2^*, \ldots x_n^*)$ is defined as:

$$f(x^*) = \sum_{k=1}^{K} p_k f_k(x^* \mid \theta_k) \qquad (2)$$

Where,

K – number of clusters.

$\theta_k = (\mu_k, \sigma_k^2)^t$, t → t[th] iteration.

$f_k(x^* \mid \theta_k)$ Is a sample density with mean μ_k and variance σ_k^2.

$(p_1, p_2, \ldots, p_k)$ is a set of different likelihoods such that k=1,2,…K and $\sum_{k=1}^{K} p_k = 1$.

Once the evaluated attributes are derived, the class of related pixels in the images can be classified effectively to form the suspicious region. The EMBS can be utilized to assess the suspicious regions. The following steps shows the proposed method:

(i) Get the DR image from the user and assign it to a variable.

(ii) Apply the Gabor filter to enhance the appearance of the lesion in the image.

(iii) Apply the EM clustering procedure to estimate parameters of Bootstrap data samples.

(iv) Get k groups of size n pixels for a total of n x k samples.

(v) Find e_{ij} by using the following equation.

$$e_{ij} = x_{ij} - \bar{x}_i,$$

(vi) Group the pixels from the input image. This is called samples.

(vii) Find the sample mean, $\bar{x}^*$, from $x_1^*, x_2^*, \ldots, x_k^*$. This sample is called bootstrap sample.

(viii) The samples to be sorted, ie., $\bar{x}_1^*, \bar{x}_2^*, \ldots, \bar{x}_k^*$. is estimated samples

(ix) Find Upper Bandwidth of Bootstrap Value (UBBV) using the formula $(1-(\alpha/2)).K$

(x) Extract the affected pixels based on the value of UBBV. The output of the pixel is known as R(x,y).

$$R(x,y) = \begin{Bmatrix} 1 \; if \; fsharp(x,y) > UBBV \\ 0 \; if \; fsharp\,(x,y) \leq UBBV \end{Bmatrix} \qquad (10)$$

(xi) The output pixels in the resulting image which contain the white pixels is called as affected pixels

D) Suspicious Regions Reconstruction

Morphological tools are applied to restructure the contours of the suspicious region. The individual while pixels are also removed from the image.

E) Feature Extraction and Classification

The features needs to be extracted from the suspicious region to detect lesions in the retina images. The combination of features are extracted from the suspicious regions. These features are gray, texture and shape features. The features are showed in the Table 1. The classifier knows as Support Vector Machine (SVM) is implemented as to classify the abnormalities into normal or abnormal.

TABLE 1
DETAILS OF FEATURES EXTRACTED FROM THE SUSPICIOUS REGION

Category	Features
Shape	Perimeter, Area, Orientation, Euler number, Solidity, Convex Area, Eccentricity, Diameter of the lesions
Texture	Variance of gradient, Mean Gradient, Inertia, Energy, Correlation, Entropy, Homogeneity
Gray	Mean, Variance, Standard Deviation, Min, Max

III. EXPERIMENT

To evaluate the accuracy of the proposed method, openly accessible standard databases, called DRIVE and STARE are used for the experiment. The DRIVE standard database contains 400 retina pictures of diabetic affected patients.

Published By:
Blue Eyes Intelligence Engineering
and Sciences Publication (BEIESP)

This standard database has 40 retinal images. The STARE database contains 30 images of normal retina images and 51 images of lesion affected retinas. The numbers of images and lesions are shown in the Table 2.

TABLE 2 – SPECIFICATION OF IMAGE AND LESION

S. No	Bench mark Data Base	Number of Image	Normal Image	Abnormal Image	Total number of Lesions
1	DRIVE	40	33	7	111
2	STARE	81	30	51	1435

A)Detection of Lesions

The performance analysis is done by using the DRIVE and STARE a standard database. The 58 and 790 images are selected for the assessment. We have implemented support vector machine as a potential approach for classification between the lesion region and a normal region in retina images. SVM classifier is to work well in diagnosis applications and handling well for small training sets [9]. The features depicted in the Table I were computed and SVM classification technique is used to detect lesions. The figure 2 demonstrate the detection of abnormalities by the proposed method.

The accuracy of the developed method is compared with the existing approaches. The Table 3 depicts the comparison of the detection of lesions in the retina images. The developed approach offers 90.10 % sensitivity, 93.2% specificity and 91.2% accuracy values for lesion detection.

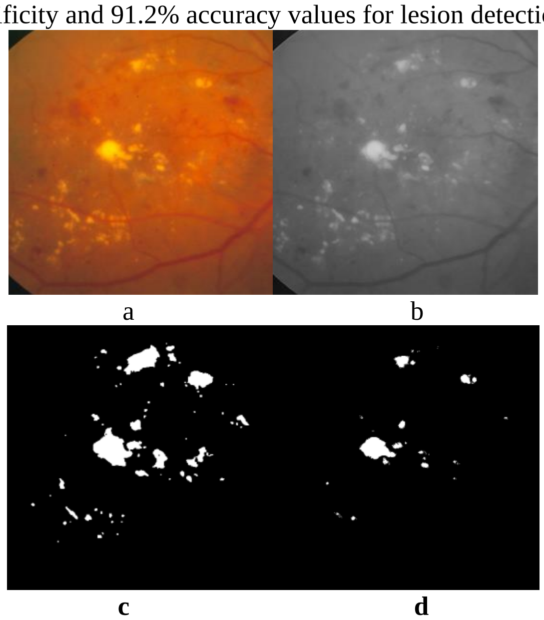


Figure 2. (a) and (b) The retina image (c) Segmented Image; (d) The resulting image.

TABLE 3 COMPARISON OF THE DETECTION RATES

Authors	Bench Mark Database	Method	Accuracy in %
Walter and Klein. [11]	Dieret DataBase1	Morphological	77
Qing et al. [12]	Dieret DataBase1	segmentation based on matched filter	79
Proposed Method	DRIVE	Classical Segmentation with resampling method	87.5
	STARE		91.3

IV. CONCLUSION

The proposed approach was designed to detect abnormalities from low-contrast, retinal images. The new developed approach is able to extract the suspicious regions even in the different intensity level in retina images. The result of the proposed approach given as sensitivity of 91.1% in lesion level. The experiments of the proposed algorithm rightly show that the abnormalities can be exactly detected in retina images.

REFERENCES

1. Lim, Registration of new blindness in Singapore for 1985–1995. Singapore Medical Journal. 39 (3), 1998, 104–106.
2. International Diabetes Federation, [Online] http://www.idf.org/wdd-index/.
3. Ramon Pires and Herbert F. Jelinek, Assessing the Need for Referral in Automatic Diabetic Retinopathy Detection, IEEE Transactions on Biomedical Engineering, Vol. 60, 2013, pp 3391 – 3398.
4. H. Taylor, J. Xie, S. Fox, R. Dunn, A. Arnold, and J. Keeffe, "The prevalence and causes of vision loss in indigenous australians: The national indigenous eye health survey," Med. J. Aust., vol. 192, no. 6, pp. 312–318, 2010.
5. Liu, Beiji Zou, Jie, Wei Yue, Zailiang Chen, and Guoying , "A location-to-segmentation strategy for automatic exudatesegmentation in colour retinal fundus images", Computerized Medical Imaging and Graphics, Vol. 55 2017 78–86.
6. HeHuang and HeMa Automatic detection of neovascularization in retinal images using extreme learning machine, Neuro computing, Vol 277, 2018, pp. 218-227.
7. UsmanAkram M, ShehzadKhalid, Anam Tariq, ShoabA.Khan and FarooqueAzam, "Detection and classification of retinal lesions for grading of diabetic retinopathy", Computers in Biology and Medicine 45(2014)161–171.
8. Efron. B, "Bootstrap methods: Another look at the Jacknife", Annals of Statistics, Vol.7, No. 1, 1979, pp: 1-26.
9. Desire Sidibe and Ibrahim Sadek, Discrimination of retinal images containing bright lesions using sparse coded features and SVM, Vol. 62, 2015, pp. 1750184.
10. Singh, W. J., and Nagarajan, B. Automatic diagnosis of mammographic abnormalities based on hybrid features with learning classifier. Computer methods in biomechanics and biomedical engineering, Vol 16, 2013, 758-767.
11. Walter, T., Klein, Massin, P., Erginay, A contribution of imageprocessing to the diagnosis of diabetic retinopathy-detection of exudates in color fundus images of the human retina. IEEE Transaction on Medical Imaging, Vol 21, 1236–1243, 2002.
12. Qing, Beiji Zou, Jie Chen, Wei, Kejuan Yue, Zailiang and Guoying Zhao, "A location-to-segmentation strategy for automatic exudate segmentation in colour retinal fundus images", Computerized Medical Imaging and Graphics 55, 2017.
13. Jai Singh W, S. Devaarul and R.K. Kavitha, "Detection of Abnormalities in Color Fundus Images of Diabetic Retinopathy using Bootstrap Segmentation with Learning Classifier", International Journal of Pure and Applied Mathematics, Volume 116 No. 12 2017, pp: 87-95.

Published By:
Blue Eyes Intelligence Engineering and Sciences Publication (BEIESP)