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Comparison of Classifiers Performance for Lesion Detection in Retina

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Abstract—Diabetic retinopathy is complication of diabetic that can lead to vision loss or blindness. So early detection is important for saving patient vision. An automated screening system for computer aided screening and grading for diabetic retinopathy can help to reduce the chance of complete blindness. Fundus images with DR exhibit red lesion such as microaneurysm, Hemorrhages, Exudates and cotton wool spot. However various schemes for lesion detection appear but the report many false positives detection. They report some lesion as non-lesion and also system are time consuming. Proposed system focused exclusively on MA detection which is earliest sign of DR. Classifier such as ASOboost and SVM are analyzed for classifying retinopathy lesion from non-lesion. The main contribution of this proposed system is comparison of classifier with accuracy, sensitivity, specificity.

Keywords-Diabetic retinopathy, segmentation, Microaneurysm, classification, fundus image processing, severity grade.

I. INTRODUCTION

Diabetic is a type of metabolic diseases in which patient have high blood sugar, because body does not produce enough insulin [1]. One of the most common complications in diabetic is diabetic retinopathy. If a person has diabetic for more than 20 year, he or she has the more possibility to suffer from diabetic retinopathy [2]. It is widely spread diseases small blood vessels are damage and resulting vision loss. In order to prevent the damage of this sever complication of patient vision, it is very important to diagnosis diabetic retinopathy and provide appropriate treatment. Since MA is early sign of DR are caused by the focal dilations of thin blood vessels. So detection of MA in retinal image is important. MA is appear as small circular dark spots (lesion) on the surface of the retina,other structure present in retina causes complication for detecting MAs. Therefore, Automatic methods have been developed to help reduce the burden on specialist. Proposed system involves the steps of initial detection of MAs candidate, feature extraction and classification. System has been tested on DiaretDB dataset. Results verify the effectiveness of proposed automatic microaneurysm detection system. Fundus image of an eye consists of different parts like optic disc, fovea, vessels and different abnormalities as bright and dark lesions which are labeled in Fig. 1.

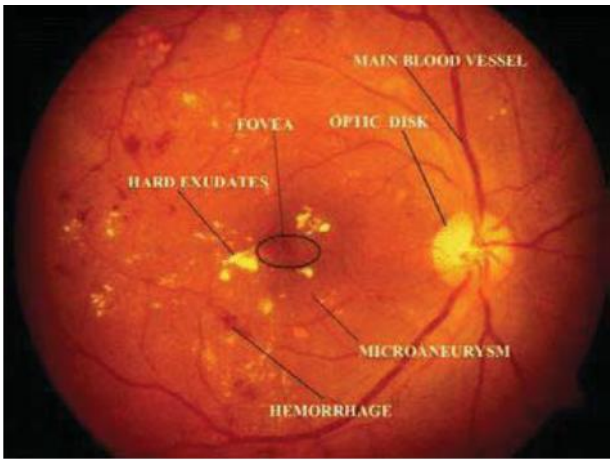


Fig.1. Fundus image of an eye

In this area some research has been carried out for detection of bright and dark lesion. Most important part of this process is detection of MAs with comparison of classifiers.

II.MOTIVATION

Novel contribution of proposed system is fully automated, fast and accurate DR detection in retina. Automated DR screening system has been used for finding patients suffering from DR with accuracy. It is simple but effective method for diagnosis diabetic retinopathy.

III.OBJECTIVES

a) To combine the screening outcome with manual analysis of the images that are classify as abnormal by the automated system has shown to reduce the clinical workload.

b) Toremove the ambiguity and subjectivity of practitioner which are associated with diagnosis result.

c) To reduce the unnecessary visits to medical specialists, Minimize cost of treatment.

The rest of the paper organized: related work in section IV, proposed work in section V, Experiment result in section VI and Conclusion in section VII.

IV. LITERATURE SURVEY

Many researchers in the literature investigated classification of DR in retinopathy. Some of them given below.

Istvan L, Andras H. et al.[5]proposed method for identification of MAs through local rotating cross section profile analysis. The local maximum pixels were selected as candidates. The cross sectional scanning was applied to each profile and 7 properties of the peak is calculated. Several statistical measures of resulting peak are used as features for classification.

Adal et al. [6] proposeda semi- supervised based learning approach to train a classifier which can detect true MAs, Which can detect be built from few supervised information together with large number of unsupervised information.

M. P. Bala, S. Vijayachitra etal.[7] proposed method removed blood vessels. They are not detecting lesion but remove vessels. They extracted vision based features to classify image into normal or affected by DR. This method affected by inaccuracies in vessel segmentation.

Shahin et al. [8] proposed a system which can detect the blood vessels, exudates and microaneurysms. Also system calculated area of these extracted lesions. Moreover they find out the entropy and homogeneity to classify lesion by applying artificial neural network (ANN).

Mahendran, Dhanasekaram&Narmadha et al. [9] focused on an automated method to detect exudates applying morphological processing and calculated the gray level matric for the extracted lesion. Their classification is done using Probabilistic Neural Network (PNN) classifier. However they didn't report accuracy of the system.

V. METHODOLOGY

The Block diagram of proposed methodology for automatic detection ofMAs is shown below in Fig 2.

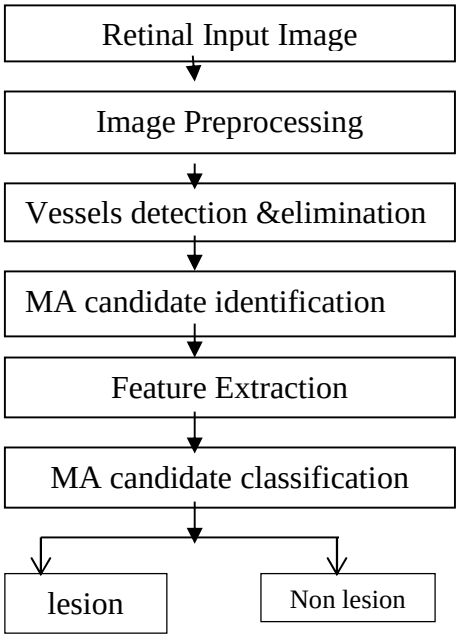


Fig. 2.Block diagram of proposed method

The method is performed on the green channel of retinal images. Green channel is ued because it gives greteast contrast to red lesion [3].MA detection id divided into image preposecssing, Vessel detection & elimination, MA candidates identification, Feature extraction, MA candidates classification.

1.Retinal input image

In this methodology we collect color fundus images from standard diabetic retinopathy datasets such as DiaretDB. The images are initially kept to a standard size before detecting lesion.

2. ImagePreprocessing

Retinal fundus images are available with non-uniform illumination, poor contrast and noise. MAs are hardly visible in regions of low brightness and poor contrast. In order to reduce this problem image prepocessing is done. The color image has been converted into gray scale image and the image is resized so that small dots would be visible. The contrast of the image is adjusted so that the exudates will be clearly visible.Then Adaptibe

Histogram Equalisation (AHE) is performed for uniform intensity distribution which increases illumination or some negatives in an image therefore we use gassian filter for blurring, smoothning and for removal of such negatives.

3. Vessel Detection & Elimination

The most important stage is detection & elimination of vessels. Since both MAs and and vessels are appear in reddish color. The aim of the removle of vessels is to reduce the number of false positives which caused by similar apperance of vessel segment and microaneurysm. Proposed method used morphological top hat transform to remove vessels and false positives. Gaussian filter is used to remove noise and smoothning the image. After that binarized the enhanced image with the fixed value. This binarized image is further processed by morphological processing for vessel extraction.

4. MA candidate identification

Here segemnted vessels image is again binarized to remove small intensity vessels with some threshold value. Again filter is applied for increasing the vessels edges width,so it is easily suppressed. Again top hat filtering in applied for darked pixels.Here AHE is performed again to reduce the intensity of enhanced borders because of previous operstions.Then image is converted into gray image. Gabor filter is applied for removing white patches in binareized image.At the last calculating the regional properties of that objects and remove that object whoes values is less than 331. And finally identifies the MA in retinal fundus image.

5. Feature Extraction

Feature extraction plays an important role in classification of MAs. However there is no single feature which differentiates accurately the MAs from non-MAs. This is due to the fact that MAs varies in shape, appearance and volume. The majority of false positives mainly blood vessels. Some of false positives are easily distinguished from true MAs. However large numbers are difficult to distinguish. Therefore for getting a high classification in candidate MAs classification we should extract some other feature such as intensity, shape, entropy etc.

6. MA Candidate Classification

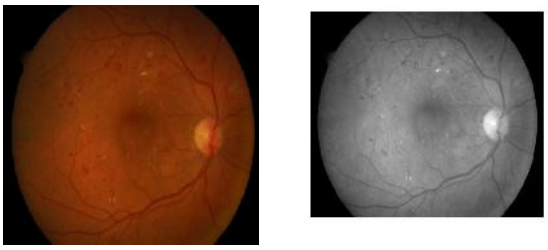
After detecting the features, the extracted features are applied to the classifier to distinguish between MAs (lesion) and non- MAs (non-lesion). In proposed system, we used different classifier for getting and comparing best result on the bases of statistical measures. The statistical measures which are used for comparison are accuracy, sensitivity, specificity.

VI. RESULTS

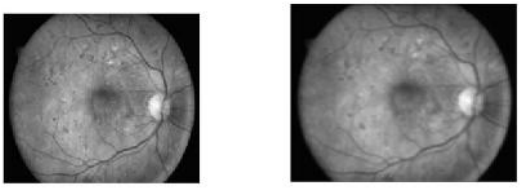
Database

To evaluate the performance of proposed method we test our proposed DR screening system for normal patient and patient with DR using public available dataset. Proposed system evaluate on DiaretDB dataset. DiaretDB is dataset which is designed to evaluate automated lesion detection [4].

Following are the result obtained for MAs detection in proposed method.



(a) Input image (b) Gray image

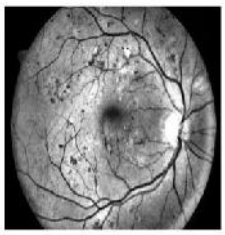


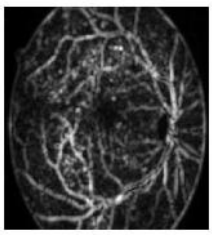
(c) Top hat transform (d) Filter image

(e) Extracted vessels (f) Removed Vessels

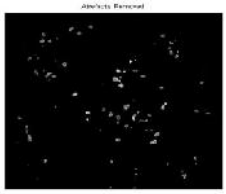
Fig. 3. Vessel segmentation

Fig. 3 Shows stepwise detection of a blood vessels in retinal images. Fig.3 (a)shows original retinal image, Fig. 3(b) shows gray image in green channel of the original image, Fig. 3(c) top hat transform to suppress dark region for further processing, Fig.3(d) shows filtered image with Gaussian filter which removes noise, Fig.3(e) shows extracted vessels, Fig.3(f) shows Removed Vessels

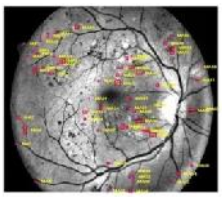




(a) Gray image (b) Expanded image



(c) MA candidate in retinal image



(d) Lesion found in original image

Fig.4. Detection of MA candidate

TABLE III
COMPARISON OF CLASSIFIER

Classifier	Database	No.of Images	Accuracy	Sensitivity	Speci-ficity
ASOBOOST	Diaretdb	25	83.45%	82.47%	88%
SVM	Diaretdb	25	79.42%	78.90%	87%

VII. CONCLUSION

The accurate detection of microaneurysms (MAs) is a critical step for early detection of diabetic retinopathy because they appear as the first sign of the disease. Classification plays an important role in reduction of false positives. We propose a system for detecting the object and classification of DR. We used fundus images from DiaretDB datasets and local datasets. We detect microaneurysm from retinal input image. And then extracted necessary features for classification and classified using ASOBoost and SVM classifier. The proposed method evaluated performance on statistical factor such as accuracy, sensitivity, specificity.

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