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Comparative Study of Classifiers for Diagnosis of Microaneurysm

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Abstract

Diabetes increases the risk of developing any type of eye disease. Since this disease is symptomless. But the main cause of blindness. Other disease like kidney problem, weight loss, heart problem, and hearing loss also gets develop. So need arises to detect it accurately at an early stage of DR which is only can diagnose by ophthalmologists. Microaneurysms are the earliest clinical signs of Diabetic Retinopathy. They are reddish in color and appear as small red spots on the retinal fundus images. Early detection of microaneurysm can help in the early treatment of Diabetic Retinopathy. New approach used to increasing sensitivity and reducing computational time for detection and classification of microaneurysm from the diabetic retinopathy images. Retina images are obtained from the fundus camera and graded by skilled professionals. This new strategy to detection MAs is based on (1) Elimination of non uniform part of an image and standardize grayscale content of original image. (2) Performed Morphological operations for detection of Region of Interest (ROI) and elimination of blood vessels. (3)To identify real MA's two features extracted where principal component analysis used for extract one feature of shape which discriminates normal eye image and abnormal eye image and for second feature used radon transform. SVM classifier used to increase sensitivity and accuracy. For this whole process of new method used publically available database called DiaretDB1 database. (4) To discriminate normal and abnormal images different classifiers used like kNN.

Keywords: Image Processing; Diabetic Retinopathy; Fundus Images; Microaneurysms Detection; Retinal Image.

INTRODUCTION

Diabetic retinopathy disease comes only when effect of diabetes on small blood vessels increases as well as it damaging the part of eye called the retina. The risky part is that patients not able to get that weather he has diabetes because usually it does not cause any observable symptoms in early stage. If we can able to detect diabetic retinopathy in this stage then proper treatment can stop worse condition of patients. Otherwise, there is very difficult to overcome the diabetes after getting some observable symptoms which are become much more untreatable.

Diabetes has turn out to be one of the quickly increasing diseases worldwide. Diabetic Retinopathy is one of the main reasons for getting blindness. In before stage of the Diabetic Retinopathy (DR) there are no symptoms presents in eye and when disease starts, the presence of microaneurysms (MAs), soft exudates and hard exudates and new damaged blood vessels increases.

Any disease can be treatable if it will detect and monitored properly by ophthalmologist through fundus camera as well as more efficient detection and monitoring saves costs. Taking pictures or photographs of retina by Fundus camera has an important role to control diabetes and the presence of retinal abnormalities are common but consequences of it are serious. In this whole process of detecting diabetes, screening plays an central role in which capturing high resolution or accurate pictures of retina and also reliable or more beneficial use of algorithms and techniques can help to get success in detecting abnormalities. In this paper, a new technique, method and algorithm surveyed for efficient detection of micro aneurysms from fundus images. The first mark of DR are Microaneurysms (MAs) that not able to damage vision. The Number of MAs has taken into account by the specific tool which gives progress of diabetic retinopathy in particular candidate. A number of different methods or techniques used for detecting MA automatically, these methods were tested on different databases which are publically available like DirectDB1 database but still there is need to increase sensitivity and availability.

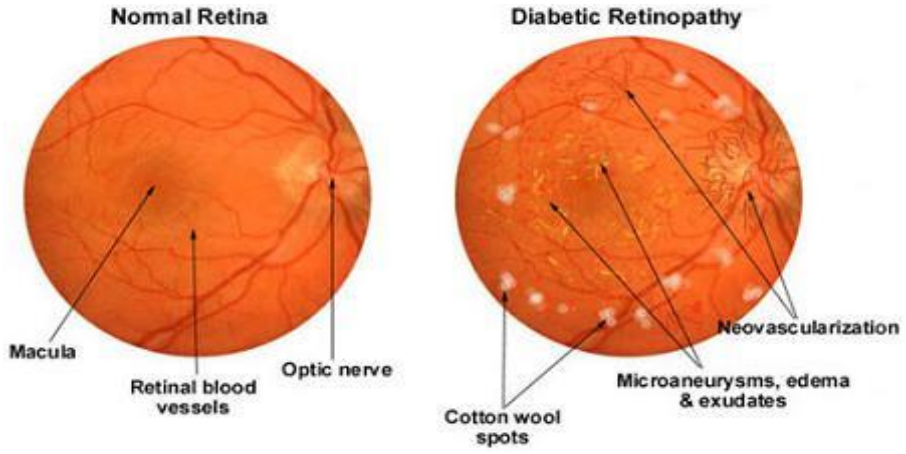


Fig. 1. Normal retina and abnormal retina[16]

Above fig.1 depicts both that normal retina structure at left most side who doesn't has diabetes and abnormal retina structure at right most side who has diabetic retinopathy.

RELATED WORK

Spencer Timothy and john Olson [1] author has describe some segmentation techniques which are helps to identify microaneurysms present in retina for which bilinear top-hat transformation and matched filtering technique used. Also used novel region-growing algorithm which helps to mark the object and find the size, shape, and energy characteristics. This approach is vital for increasing accuracy of monitoring the progress of diabetic retinopathy.

Niemeijer, Meindert, et al.[2] In this, Hybrid approach used to locate the red lesion which are present in fundus images and Pixel classification method can separate red lesions from background of an image. Also for classification Knearest neighbor classifier used.

Walter, Thomas, et al. [4] author has used four stages, in that, shade correction, image enhancement and image normalization. Second stage designed for detection of candidate achieved by diameter closing and automatic threshold scheme. In last stage, perform feature extraction for classification of candidate into Microaneurysm and other objects in automatic manner.

Fleming, Alan D, et al. Fleming, Alan D., et al. [5] author here used watershed transform method as well as image contrast normalization to derive no vessels or other lesions of region and differentiate MAs and other injuries which are present in retina respectively. The dots within the blood vessels handled successfully by using Local vessel detection technique. A genetic algorithm which helps into optimizes a process and analyzed some images.

Esmaeili, Mahdad, et al. [6] Here, separates red lesions and other unwanted part and improve non-uniform background of an image by new curvelet based algorithm and new illumination equalizations algorithm. In next stage, produces an enhanced image applied digital curvelet transform as well as modified curvelet coefficient and also gives sparse representation of the object.

Antal, Blint, and Andrs Hajdu. [10] Here candidate extraction takes place to find Microaneurysm categories and also selects pre-processing method for it. And adaptive weighting approach used to categorize spatial locations like near to vessel, in the macula, on the periphery and also works on contrast of the detected microaneurysms.

Sopharak, Akara, Bunyarit Uyyanonvara, and Sarah Barman [13] author presents techniques by which tiny sizes, low contrast, and similar blood vessels of microaneurysms can be detected for which coarse segmentation and fine segmentation used.

Tavakoli, Meysam, et al. [14] with the various microaneurysms detection methods author has introduced a novel method based on random transform (RT) and multi-overlapping. Top hat transformation used to remove background and random transform and thresholding helps to detect and numbered microaneurysms.
Adal, Kedir M., et al. [15] author has characterized blob regions by scale adapted region descriptor. Classifier trained to detect true MAs for which semi-supervised based learning method introduced. For classification of microaneurysms at pixel level logistic regression classification method has used.

PROPOSED SYSTEM

Detection of microaneurysms or any injuries which are observable in fundus retinal images has to be improved. And it will achieve by analysing the images which are captured by fundus camera. This detection process starts with pre-processing of the images after that extraction of different feature which will use for more effective treatment. In an early stage need to be detect the diabetic retinopathy automatically to diagnose it completely without any delay. At the time of first screening of any candidate, the ophthalmologists have to examine a large number of retinal images in order to achieve successful or accurate treatment. In order to do large number of screening required more cost. Solution to this is to develop an automated screening method for retinal images in diabetic retinopathy in early stage. This kind of system should be able to distinguish between an image which has true microaneurysm (MA) and normal retinal images so that workload of ophthalmologists will get reduce and more no of candidates will get diagnosed. This new system gives early detection of microaneurysms as well as it increases sensitivity and efficiency than before.

Table 1: List of Symbols and Description

Symbol	**Description**
MA	Microaneurysm
FP	False Positive
DR	Diabetic Retinopathy
ROI	Region of Interest
SVM	Support Vector Machine
FA	fluoresce in angiography
RT	Random Transformation
ONH	Optic Nerve Head
RGB	Red Green Blue

A. System Architecture

The proposed detection process consists of three main modules such as Preprocessing module, Feature Extraction module, Clustering and classification module.

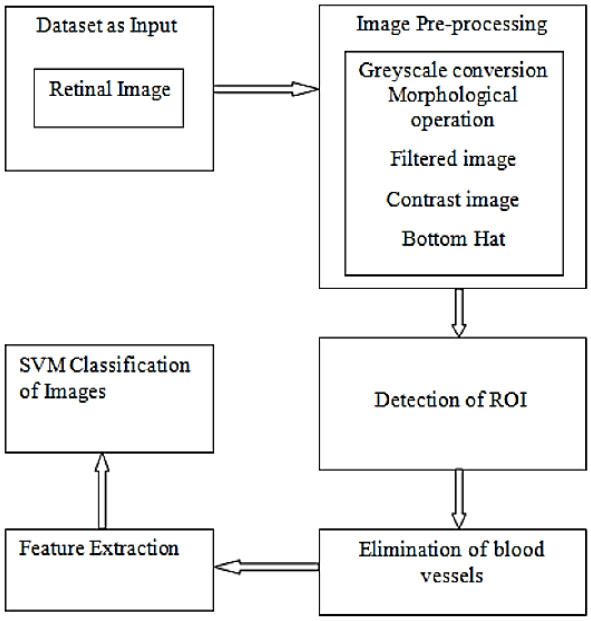


Fig. 2. Process of detection of microneurysm

1) Preprocessing Module

The proposed approach to solve the problem of detecting candidates on retinal fundus images, where candidates are regions possibly corresponding to microaneurysms (MAs), is separated into tow stage. As shown in Fig. 1, this module takes High Definition (HD) Retina images from publically available database as an input to do the preprocessing. The first stage is reduction of non uniform illumination and to analyze grayscale content images. And second stage is to perform morphological operations to eliminate blood vessels and detect Region of Interest (ROI).

Grayscale Conversion

An original image which captured by fundus camera in which the value of each pixel is a single sample. It holds only intensity information. These images converts into grascale image which are like in color of black and white also it looks like more in gray color so that it called grayscale image. To convert an image based on an RGB color model to a grayscale form. Weighted sums must be calculated in a linear RGB space, that is, after the gamma compression function. For RGB color space.

Mathematically this can be represented as:

$$Y = 0.2126R + 0.7152G + 0.0722B$$

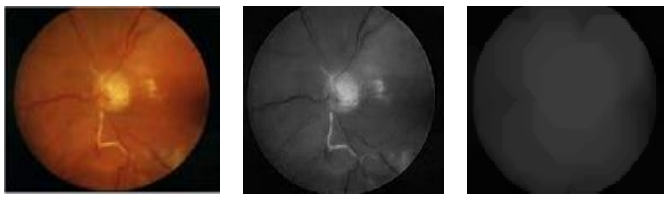
Below fig shows response of grayscale conversion after applying it on original retinal image. In fig.3 Left image has taken as original retinal image and right image is response of grayscale conversion after calculating RGB values.

a) Retinal b) Green Plane c) Red Plane d) Blue Plane e) Grayscale

Fig. 3. Grayscale conversion

Morphological Operations

Below fig.4 shows how blood vessels removed from original image by applying morphological operations on grayscale converted image.



a) Orignal b) Grayscal c) Morphological

Fig. 4. *Morphological Operations*

Morphological opening operation applies to grayscale image of retina to create an image which has removed blood vessels. In a morphological operation, the value of each pixel after applying operations is based on a comparison of the corresponding pixels. To detect microaneurysms properly, morphological operations done by choosing the size and shape of the neighborhood pixel. Morphological operation can perform on grayscale images. Some operations like dilate, erosion, opening, closing, hit or miss transformation used to on retinal images to remove blood vessels.

Filter

Here, two filters used for removing noise and unwanted part of retinal image. One is Median Filter to remove noise as well as to preserving edges and Gaussian Filter to blur and to remove the details of an image. Bellow fig.5.b) and fig 5. c) shows how median filtering and Gaussian filtering worked.

a) Original image b) Median c) Gaussian

Fig. 5. Filtering

2) Feature Extraction

This module performs feature extraction by extracting features from the original retinal image which may be in the form of .jpeg or .png or digital image. In order to understand weather particular person has diabetes or not, there need to extract some feature like shape color, size, texture. Weather round shaped candidates or elongated shaped ones which distinguish real MAs from FPs. In order to extract features, principal component analysis and radon transform used.

3) Classification

In this classification module, preprocessed images used instead of original images. The images obtained after grayscale images and morphological operations as well as filtered images are only useful for correct classification which gives fast availability of particular candidate record as well as increases sensitivity of diabetic retinopathy system application. For better classification SVM (Support Vector Machine) and Distance are suitable classifier and also for comparative study K-N-N classifier best to reduce a high computation time.

RESULT

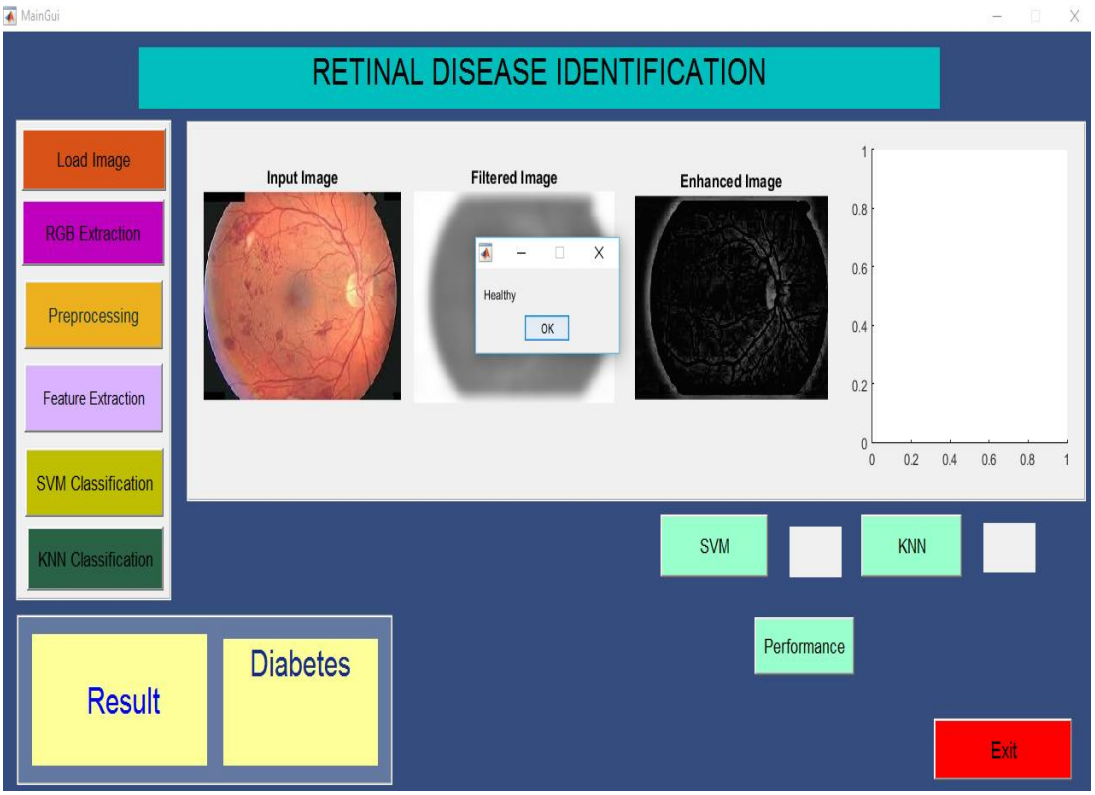


Fig. 6. Result Diabetes detection by proposed system for subimages(Message box is showing result of kNN classifier and ResultWindow showing classification of SVM classifier)

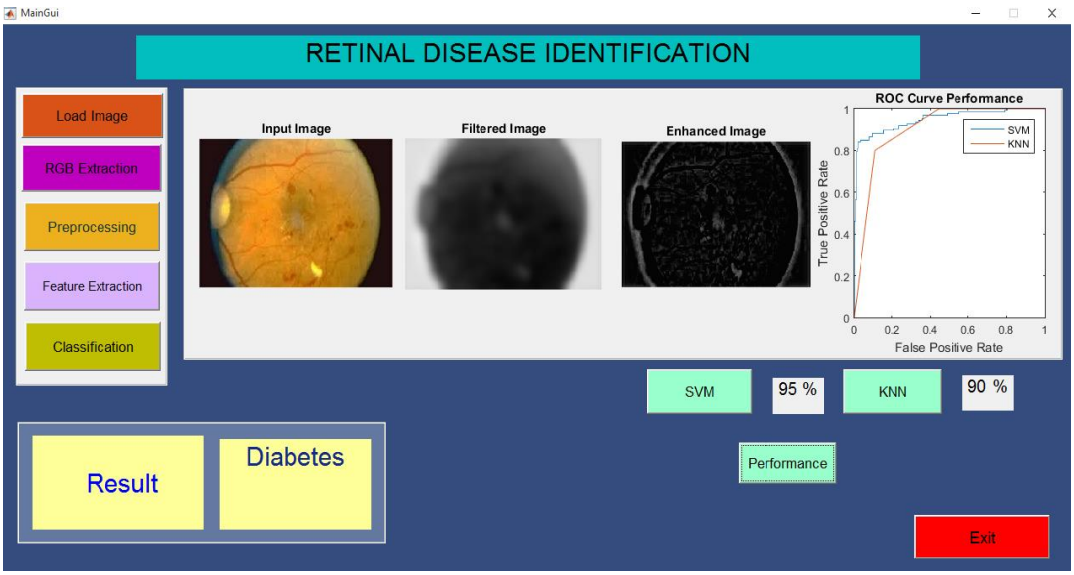


Fig. 7. Diabetic Retinopathy Detection by proposed system for retinal image

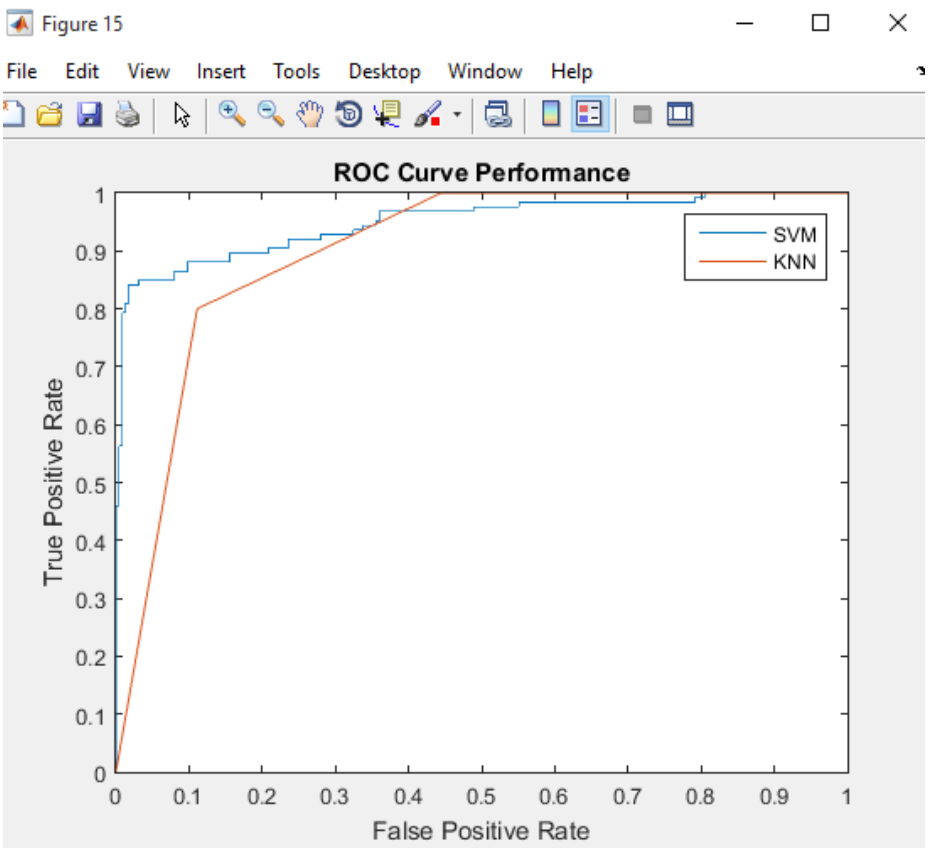


Fig. 8. ROC curve for dataset iamges suffering from diabetes

Table 2: Classifier with its performance

Classifier	AUC
SVM Classifier	0.95
kNN classifier	0.90

Table shows the classifiers and their performance for dataset images. From above table we can say that SVM classifier performs better classification of blood images.

CONCLUSION

The Proposed system takes input retinal image and processes that image by using different techniques. During Feature extraction proposed system extract and saves number of features of testing image and compares features with training set of features. These extracted features are used for classification. SVM and k-nn classifiers consider features and successfully classify image either in healthy or suffering from diabetes. From table1 SVM is producing better classification result.

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REFERENCES

[1] Spencer, Timothy, et al. "An image-processing strategy for the segmentation and quantification of microaneurysms in fluorescein angiograms of the ocular fundus." Computers and biomedical research 29.4 (1996): 284-302.

[2] Niemeijer, Meindert, et al. "Automatic detection of red lesions in digital color fundus photographs." Medical Imaging, IEEE Transactions on 24.5 (2005): 584-592.

[3] Fleming, Alan D., et al. "Automa ted microaneurysm detection using local contrast normalization and local vessel detection." Medical Imaging, IEEE Transactions on 25.9 (2006): 1223-1232.

[4] Walter, Thomas, et al. "Automatic detection of microaneurysms in color fundus images." Medical image analysis 11.6 (2007): 555-566.

[5] Quellec, Gwénolé, et al. "Optimal wavelet transform for the detection of microaneurysms in retina photographs." Medical Imaging, IEEE Transactions on 27.9 (2008): 1230-1241

[6] Esmaeili, Mahdad, et al. "A new curvelet transform based method for extraction of red lesions in digital color retinal images." Image Processing

(ICIP), 2010 17th IEEE International Conference on. IEEE, 2010.

[7] Fadzil, MH Ahmad, Lila Iznita Izhar, and Hanung Adi Nugroho. "Determination of foveal avascular zone in diabetic retinopathy digital fundus images."Computers in biology and medicine 40.7 (2010): 657-664

[8] Niemeijer, Meindert, et al. "Retinopathy online challenge: automatic detection of microaneurysms in digital color fundus photographs." Medical Imaging, IEEE Transactions on 29.1 (2010): 185-195..

[9] Bae, Jang Pyo, et al. "A study on hemorrhage detection using hybrid method in fundus images." Journal of digital imaging 24.3 (2011): 394-404.

[10] Antal, Bálint, and András Hajdu. "Improving microaneurysm detection in color fundus images by using context-aware approaches." Computerized Medical Imaging and Graphics 37.5 (2013): 403-408.

[11] Akram, M. Usman, Shehzad Khalid, and Shoab A. Khan. "Identification and classification of microaneurysms for early detection of diabetic retinopathy."Pattern Recognition 46.1 (2013): 107-116.

[12] Kade Mahesh k, "A Survey of Automated Techniques for Retinal Disease Identification in Diabetic Retinopathy". International Journal of Advancements in Research & Technology, May-2013 ISSN 2278-7763.

[13] Sopharak, Akara, Bunyarit Uyyanonvara, and Sarah Barman. "Simple hybrid method for fine microaneurysm detection from non-dilated diabetic retinopathy retinal images." Computerized Medical Imaging and Graphics 37.5 (2013): 394-402

[14] Tavakoli, Meysam, et al. "A complementary method for automated detection of microaneurysms in fluorescein angiography fundus images to assess diabetic retinopathy." Pattern Recognition 46.10 (2013): 2740-2753.

[15] Adal, Kedir M., et al. "Automated detection of microaneurysms using scale-adapted blob analysis and semi-supervised learning." Computer methods and programs in biomedicine 114.1 (2014): 1-10.

[16] http://nei.nih.gov/health/diabetic/retinopathy

[17] Digital Image Processing 3rd edition by Rafael C.Gonzalez and Richard E.Woods