An Approach for Diabetic Retinopathy Detection using Image Processing Techniques

Amruta V. Anasane

Abstract: ***The medical system for computer-aided screening and grading of diabetic retinopathy which is depended on reliable detection of retinal lesions in infected images. The automatic detection of both microaneurysms and hemorrhages in color fundus images is described and validated in this paper. The various such as Gaussian Mixture Model, the k-nearest neighbor and support vector machine (SVM), AdaBoost are accepted to be analyzed for classifying retinopathy lesions from non-lesions. SVM classifiers are found to be the classifiers for bright and red lesion categorization. This lesion classification problem deals with unstable data sets and SVM or mixture classifiers derived from SVM using more classification error due to the data imbalance. Diabetic retinopathy is a difficulty of diabetes that can lead to impairment of vision and even blindness. It is the most common cause of blindness in the working age population. DR can be manage using available treatments, which are effective if diagnosed early. Since DR is asymptomatic until late in the disease process, regular eye fundus examination is necessary to check any changes in the retina. The several ways in which image analysis helps to examine DR from colour fundus images of the human retina. In order to give contribution, the image enhancement, by which the contrast and the sharpness of the images are enhanced to reduce noise.***

Keywords: Fundus images, SVM, Diabetic retinopathy (DR), micro aneurysms (MA) and hemorrhages (HE) etc.

I. INTRODUCTION

The early detection and treatment of DR can prove to decrease the risk of severe vision loss by over 80%. The guidelines established by the Association called ADA is followed for diabetic retinopathy detection. The statics show that 80% of the patients demanding surgery to prevent blindness do not receive treatment. The major reasons for this screening and treatment gap include inadequate economic difficulties and insufficient access to proper eye care. Telemedicine, with disseminated remote retinal fundus imaging and grading at either local primary care offices or centralized grading distantly by eye care specialists, has increased access to screening and follow-up necessary treatment. Considering the limited number of ophthalmologists, there is an urgent need for automation in the showing process in order to cover the large diabetic population while reducing the clinical burden on retina specialists. mechanization can be achieved at two levels: first, in detecting cases with DR, and in grade these cases. Indeed, the identification of the harshness level, through DR grade, allows more suitable and consistent referral to treatment centers. A computer screening and grading system relies on the automatic recognition of lesions. Fundus images with DR display red lesions, such as micro aneurysms (MA) and hemorrhages (HE), And light lesions, such as exudates and cotton wool spots. In this paper, we will focus only on MA and HE which are among the very first manifestation of DR. Even though MAs are among the first signs of DR, HEs are also highly important for DR screening and useful for grading. In fact, retinal HEs are the result of MA starting to leak into the retinal layers, indicating a more severe level of DR. According to the most common DR strictness scale, their existence and number indicate either a moderate or a severe no proliferative DR. A flame HE corresponds to blood leaking into the nerve fiber layer. A blot HE corresponds to blood leak deeper in the retinal layer. It appears larger than a dot HE, and its borders are irregular, leading to various shapes. In fact, no single pattern can match all the possible sizes and shapes of HEs. A common line of attack adopted in the literature for combined MA and HE detection consists in identifying all dark-colored structures in the image, mainly through a thresholding, combined with adapted preprocessing, and then in removing the vessels from the resulting set of candidates. In this paper, author has proposed a method for the detection of both MAs and HEs that does not require preceding vessel segmentation. Author has considered a supervised organization scheme to discriminate between lesions and other structures like vessel segments and background noise. The image preprocessing, candidate regions are recognized. Features are then extracted and used to sort each candidate. The condition of the human system is an important problem factor in a large number of medical conditions like atherosclerosis or diabetes. An organ that is particularly sensitive to vascular system pathologies is the eye.

II. BACKGROUND

The Diabetic Retinopathy is a medical term caused by erratic insulin level in the blood which causes vision loss in case of severity. The treatment of such risks requires identification of the first clinical symptoms like microaneurysms (MAs) and hemorrhages. A breakdown of blood vessels in the retina has severe impact on the quality of vision. In modern, the most common cause of such anomalies is diabetes, which according to American Diabetes continue to increase. As a result, diabetic retinopathy affects over a sector of adults with diabetes, and is currently the most common cause of sightlessness in the Western world. In pattern recognition terms, detection of blood vessels is a segmentation task, where the objective is to separate the arrangement of interest from the background. From the viewpoint of machine learning, it is a problem of binary classification: allot every image pixel to the positive or negative decision class.

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The Nayak et.al. [1] used features such as the area of exudates and the area of blood vessels together with texture parameters. Features are entered into the neural network to classify images into normal, non-proliferative retinopathy and proliferative retinopathy. The neural network used these features as input for classification. The detection results were validated by comparing with grading from expert ophthalmologists. They demonstrated a classification accuracy of 93%, sensitivity of 90% and specificity of 100%. This was carried out on a dataset of 140 images and feature extraction was required on all images in both training and testing which can be time consuming. The Acharya et.al. [2] also created a classification method by calculating the areas of several features haemorrhages, micro-aneurysms and blood vessel. The features determined to be the most crucial; blood vessels, micro-aneurysms, exudates, and haemorrhages, were extracted from the raw images using image processing techniques. The methods were performed on relatively small datasets and the drop-in sensitivity and specificity was likely due to the complex nature of the five-class problem. The author called Adarsh et.al. [3] also used image processing techniques to produce a diagnosis for DR through the detection of retinal blood vessels. The area of lesions and texture features were used to construct the feature for the multiclass SVM. This achieved accuracies of 92% and 94.688% on the public 91 and 128 image databases DIARETDB01 respectively. Phillips Phillips et al. [4] calculated the gradient of fluorescence intensity, and then threshold the gradient values only to determine leakage regions in DR images. However, the supervised methods are limited by their dependence on training datasets derived from manual annotation. The performance of the classifier will be inherently dependent on the quality of this annotation. Yuan et al. [5] proposed a saliency based sore detection method from the wireless capsule endoscopy (WCE) images. It uses a multi-level super pixel representation as the preprocessing step for saliency detection, and the saliency map is generated from different levels by integrating all obtained saliency maps according to the color and texture features. This method is capable of accurately representing the contours of the regions, and these regions are located through an image feature encoding and recognition method. The limitation of this method is that neither its efficiency nor its potential is well demonstrated, because the dataset used for validation is too small. Mahapatra and Sun et. al. [6] used the saliency and gradient information in a Markov random field for non-rigid registration of dynamic MR images. This approach attempts to address the problem that most no rigid registration algorithms fail to give satisfactory results in the presence of intensity changes. Although the saliency provides high quality contrast-enhanced images, the incline information can still be influenced by noise.

This paper introduces the methods for development of an automatic telemedicine system for computer-aided screening and grading of diabetic retinopathy depends on reliable detection of retinal lesions in fundus images. **Section I** Introduction. **Section II** discusses Background. **Section III** discusses previous work. **Section IV** discusses existing methodologies. **Section V** discusses attributes and parameters and how these are affected on images. **Section VI** proposed method and outcome result possible. Finally, **section VII** concludes this paper.

III. PREVIOUS WORK DONE

There are various approaches are widely implemented in image processing system reported in the literature, mainly for non-medical images but, in a smaller number of cases. The use of fuzzy approaches performed particularly in the processing stage on medical images. Many fuzzy image processing techniques are implemented like filtering, contrast image enhancement, image segmentation and image edge detection. The candidates are classified according to their probability of being actual red lesions. To perform segmentation specially on medical images a new algorithm of novel fuzzy level set was proposed by Li et al. [7] and thus output obtained by spatial fuzzy clustering. This algorithm resulted into robust and effective segmentation on medical image for segmentation task. To improve the brightness preservation and contrast enhancement capabilities, Sheet et al. [8] proposed a modification of brightness preserving dynamic histogram equalization, called the Brightness Preserving Dynamic Fuzzy Histogram Equalization (BPDFHE). Hence, side by side the computational complexity was reduced. Hence, the proposed technique was again experimented by Garud et al. in [9] for digital pathology images thus, redefining its ability. The image brightness better than histogram equalization and techniques based on contrast limited adaptive histogram equalization. In addition, fuzzy filter techniques proposed an aim to detect and remove the noise from the corrupted image.

An automate system for the localisation and detection of digital retinal images was proposed by Mubbashar et al. [11]. Prior to the detection of the macula by using the centre of optic disc, the optic disc centre and blood vessels extraction is carried out thus, followed by enhancement and locating the macula as the pixels in the region.

A new method was proposed by Akram et al. [10] along with the detection of exudates. The proposed system consisted of a contrast image enhancement, thresholding and blood vessel segmentation of image to detect the dark candidate. Again later, the classification of some features set for the macula detection was carried out by using a Gaussian mixtures model-based classifier. Sekhar et al. [12]. proposed the operations and Hough transform that can be implemented to place the optic disc. By using the spatial relationship with the optic disc and from the spatial distribution of the macula, location of fovea is traced. The region of interest is defined as an area of a sector originating at the optic centre at an angle of 30 degree above and below the line between the optic disc centre and the centre of the retinal image.

IV. EXISTING METHODOLOGIES

After studying various different methods to detect narrative method for automatic detection of both microaneurysms and hemorrhages in color fundus images is described and validate.

The main contribution is a new set of outline features, called Dynamic Shape Features, that do not require precise segmentation of the regions to be secret. These features represent the evolution of the shape during image flooding and allow to distinguish between lesions and vessel segment. It proves to be vigorous with respect to variability in image resolution, quality and gaining system.

A. White Lesions Detection Technique

The methodology of white lesions such as exudates and cotton-wool spots are the symptoms of moderate DR. According to author the detection of exudates is one of the key features in the early diagnosis of DR. Exudates are deposits on the retina which appear as yellowish regions in fundus image. Fundus images show considerable variation in glow which makes automatic detection of exudates hard. Brightness of the fundus image was changed by the nonlinear curve with brightness values of the hue saturation value space. In order to enhance brighter yellow regions, the gamma correction was performed on each red and green components of the image. Histogram of each red and green component were extended. Exudates candidates were detected using histogram analysis. Finally, false positives were removed by using multi-channel histogram analysis. Cotton-wool spots appear as white fluffy patches in the fundus image. Compared to exudates, these are blurred regions which need more attention in the process of detection. It should be noted that because no manual lesion segmentations were provided with these databases, author could not train lesion classifier on these datasets. Instead, used previously built classifiers, to identify the lesions in the new images. Although this might be seen as a disadvantage, which able to assess the performance of our lesion detection under sensible conditions and its robustness in the face of data changes. The binary thresholding was performed to detect cotton-wool spots. The threshold value chosen was automatically extracted from the histogram analysis.

B. Automated DR Detection using Eigen Value Analysis

In automated DR detection scheme starts by applying image pre-specified techniques followed by maximum region extraction. The possible candidate regions are obtained by using value analysis base on a Hessian matrix. The resulting image, feature analysis is performed and the final candidates are obtained using SVM classifier which classifies the possible candidates to final MAs and HEs.

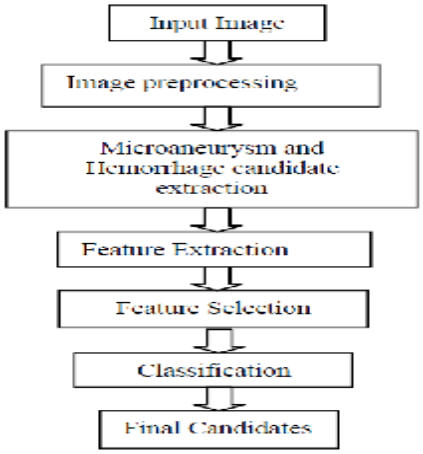


Figure 1: Automatic Diabetic Retinopathy Detection

V. ANALYSIS AND DISCUSSION

The algorithm implemented in this work can be effectively used for detection and analysis of structures in retinal images. The retinal blood vessel morphology helps to classify the severity and identify the consecutive stages of a number of diseases. The effectiveness of automated grading for DR has been an active area of research in computer imaging with encouraging. It has been done on detecting the features of DR using automated methods such as support machines and k-NN classifiers. The majority of these classification techniques are class classification for DR or no DR. The retinal blood vessel helps to classify the harshness and identify the consecutive stages of a number of diseases. The changes in retinal vessel width are one of the symptoms for diseases. The fuzzy image processing techniques that can be implemented are fuzzy image filtering, fuzzy image contrast enhancement, fuzzy image segmentation and fuzzy image edge detection.

The pixel samples are taken from vessel and non-vessel regions to train the neural network. Here, we are using the samples collected from the retinal images of original dataset which contains around 300 samples for training and testing the neural network. The A. M. Mendonca et. al [2] has the proposed method obtained an AUC of 0.89 and a sensitivity of 91.9% at a specificity of 60%. The CARA databases, the best performance was also achieved using R Fcara with an AUC of 0. 9666.The high-resolution Erlangen images, at a set point of 0.7, the method obtained a sensitivity and specificity both of 93.333%.

The SVM method gave an average accuracy, sensitivity, and specificity. The method by calculating the areas of several features such as Haemorrhages, micro-aneurysms, exudates and blood vessel. The features unwavering to be the most crucial like blood vessels, micro-aneurysms, exudates, and Haemorrhages, were extracted from the raw images using image processing techniques. These methods were performed on relatively small datasets and the drop-in sensitivity and specificity was likely due the complex nature of the five-class problem. We also used image processing techniques to produce an automated diagnosis for DR through the detection of retinal blood vessels, exudate, micro-aneurysms and texture features. In this paper a new diagnostic scheme is presented which automatically detects and segments the blood vessels in retinal images, without any user intervention. Computerized segmentation of blood vessels from fundus images provides the means for automated examination and assessment by opthal-mologists. The number of vessels in a retinal image is more, or when large number of images is captured, manual detection of the characteristics of vessels becomes impossible, and computerized segmentation is the only possibility in this situation. This retinal vessel segmentation technique gives the knowledge about the location of vessels which paves a way for the screening of diabetic retinopathy. The main advantage of our method is the ability to identify and classify the image pixels as vessels or non-vessels, automatically.

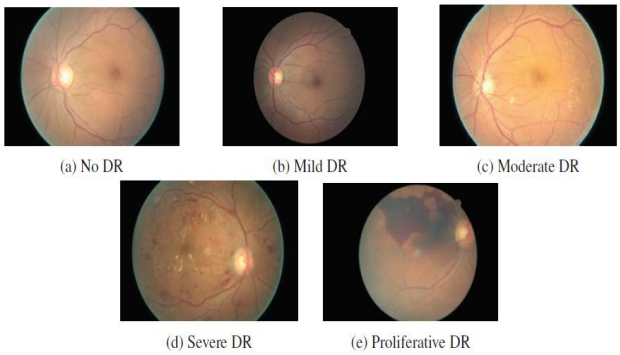
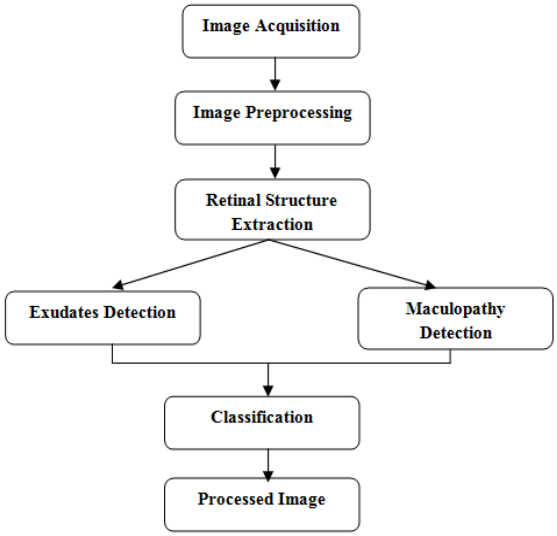


Figure 2: Stages of Diabetic Retinopathy (DR) with Increasing Severity

The majority of research on the five-class classification that has been carried out has used support vector machines. Features, which are extract from the raw data using a higher order spectra method, are fed in to the SVM classifier and imprison the variation in the shapes and contours in the images.

VI. PROPOSED METHODOLOGY

The proposed algorithm could be used as a pre-screening system for the early detection of diabetic retinopathy. The algorithm implemented in this work can be effectively used for detection and analysis of vascular structures in retinal images. The retinal blood vessel helps to classify the harshness and identify the successive stages of a number of diseases. The changes in retinal vessel diameter are one of the symptoms for diseases based on pathology. Training dataset is used for fundus image data mining, the SVM classifier is used for fundus image features extraction.



Flowchart 1: Exudates and Maculopathy Detection

Algorithm : DRDetection

Step 1: Image Acquisition from Fundus Image Dataset.

Step 2: Preprocessing of Image is done for accurate exudates identification.

Step 3: Retinal Structure Extraction is done using Optic Disk Localization Technique.

Step 4: Exudates and Maculopathy detection is done otherwise goto step 6.

Step5: Processed Image with exudates extraction is shown onto axes.

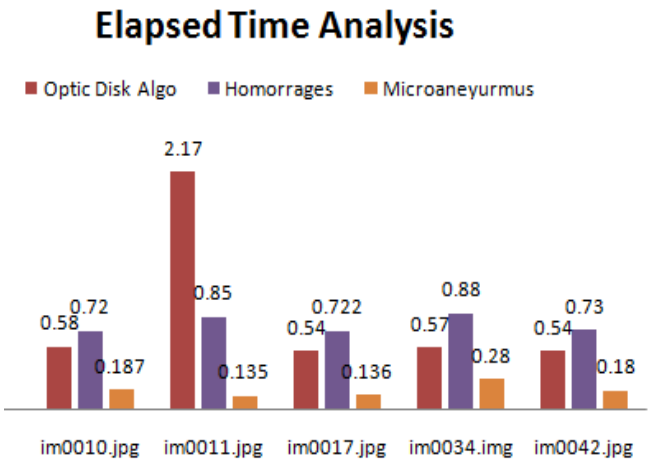
Algorithm: Exudates Detection Algorithm

The proposed algorithm Signs of DR include red lesions such as microaneurysms (MAs) and hemorrhages (Dot, blot and flame). A modified red lesion detection method has been incorporated. In this paper, the problem of detecting red-lesions in two phases by integrating the three-stage fine extraction of red-lesions and three stage false positive elimination. The algorithm classifies it into microanyermus or homorrages detection with mildDr and SevierDr. If NoDr and NoME detected then exited and print the message. If homorrages detected then processed image is displayed onto the axes, and if microaneuryms detected along the vessels then the small dots with processed image is detected.

VII. RESULT& ANALYSIS

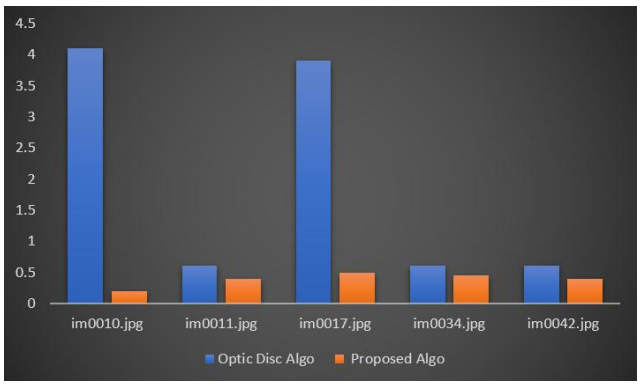
The blood vessels of the fundus image from an operator and the accuracy of the detection of blood vessels is found to be high. The algorithm for the automatic segmentation of blood vessels from the retinal images is tested with the images of Fundus Image dataset.

The algorithm for the automatic segmentation of blood vessels from the retinal images is tested with the images of Fundus Image dataset. The Elapsed time of existing methodology called Optic Disk Localization and proposed methodology called Db_detection is calculated along different fundus images as shown in following graph.



Graph 1: Elapsed Time Analysis of Algorithms

This technique comes under the basic classification of pixel processing-based approach.



Graph 2: Optic Disk and Proposed Algo Comparison for Time Calculation

From the results shown diagrammatically in Graph 2 it can be inferred that the detection rate of automated approach is lesser than that of automated approach with probability $p < 0.01$.

VIII. CONCLUSION

The Computerized segmentation of blood vessels from fundus images provides the means for automated examination and assessment by ophthalmologists. The number of vessels in a retinal image is more, or when large number of images is captured, manual detection of the characteristics of vessels becomes impossible, and computerized segmentation. However, the obtained results of automated method show that the method is able to perform the DR detection, it requires further development and parameter tuning to be fully adapted to this specific purpose.

FUTURE SCOPE

The demonstrated effectiveness together with its simplicity makes this computerized ME and HE detection method a suitable diagnostic tool for the complete pre-screening system for early diabetic retinopathy detection. In Future, more suitable algorithms are detected for future prediction of diabetic retinopathy precisely and correctly.

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