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REVIEW ARTICLE

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A SURVEY ON TECHNIQUES FOR AUTOMATIC DETECTION OF DIABETIC RETINOPATHY

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ABSTRACT

Diabetic Retinopathy is a medical condition where the retina is damaged because fluid leaks from blood vessels into the retina. In extreme cases, the patient will become blind. So, early detection of DR is important. Since the presence of microaneurysm (MA) is usually the first sign of DR and occurs due to damage in the retina as a result of long term illness. Early (MA) can help to reduce the incidence of blindness and MA detection is the first step in automated screening of Diabetic retinopathy. The presence of MA and retinal bleeding in the retina is the earliest symptom of DR. The number and the shape of MA or retinal bleeding are used to indicate the severity of the disease. considering to Provide readers a view of existing work this paper reviews various existing techniques of DR detection and classification of DR into different stages based on severity levels.

Keywords: Diabetic Retinopathy (DR), Segmentation, Microaneurysms (MA).

1. INTRODUCTION

Diabetes has emerged as a major health care problem in India. According to the International Diabetes Federation (IDF), there were an estimated 40 million patients with diabetes in India in 2007 and this number is predicted to rise to almost 70 million patients by 2025. The countries with the largest number of diabetic people will be India, China and USA by 2030 [16]. It is estimated that every fifth person with diabetes will be an Indian. Diabetic retinopathy (DR) is a common retinal complication associated with diabetes. Diabetes affects blood vessels throughout whole body most of kidney and eye, long term diabetes causes brutal damage to human eye widespread cause is blindness. The number of people badly affected with the disease continues to grow at an alarming rate. The patients sight can be affected by diabetes which causes glaucoma and most importantly damage to blood vessels inside the eye this condition is known as \Diabetic Retinopathy (DR)", figure 1 shows symptoms of DR and different stages of DR. To find out heal on DR ophthalmologists in different parts of the world conduct the diagnosis of diabetic retinopathy by taking the retinal images of the patients, out of these retinal images DR can be detected from abnormality in the structure or extra growth of blood vessels. Early detection of these features helps the ophthalmologist to detect the DR and also help in preventing blindness. Detection of these features is done from fundus images. The fundus images are taken from a special type of

camera called fundus cameras. The detection of the mentioned features from the fundus images helps the ophthalmologists to decide on the severity of the DR, either Mild, Moderate and Severe as shown in figure 1 and advise the required treatment to the patients.

This paper is organized as follows: Section 2 describes various methods for detection and extraction of blood vessels, exudates and microaneurysm. Section 3 contains result summery of Different Reported Algorithms with the help graph at last section 4 concludes the paper.

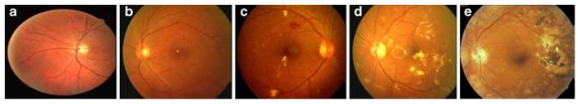

Figure 1: Retina images a) Normal b) Mild DR c)Moderate DR d) Severe e) Prolific DR

2. Review on Early Detection Methods for DR

Automatic detection of microaneurysms plays a key role in computer assisted diagnosis of diabetic retinopathy, A dangerous and frequent eye disease. MA detection algorithm divided into four main parts first image enhancement, second shade correction for detecting candidates with diameter closing and an automatic threshold scheme. Last image normalization of green channel automatically classify candidates into real MA and other objects; the classification relies on kernel density estimation with variable bandwidth. for experiment purpose authors used database of 21 annotated images and compared to manually obtained gradings of 94 images; sensitivity was 88.5% at an average number of 2.13 false positives per image[22].

An automated MA detection algorithm is developed by authors in [7] for accurate detection of MA. proposed method involves better pre-processing steps to enhance and highlight the MA. Then Based on MA detection DR stage is graded by the number of true positive values of MA. proposed method gives appreciable true positives when compared with the standard ground truth images. This method is an automated method and it does not involve human intervention at any stage with very high specificity,

A fully automated approach is presented in [11]. This work is aimed to develop an automated system to analyze the retinal images for extracting important features of DR using the image processing techniques. RGB retinal images are segmented in to two steps color normalization and contrast enhancement. The entire segmented images establish a dataset of regions. To classify these segmented regions into varying changes in blood vessels and different finding such as exudates, microaneurysms, a set of features such as color, size, edge strength and texture are extracted which can be used as part of an automated diabetes recognition system.

In this paper segment based technique for DR detection is presented, where Detection DR from retinal fundus images is done with help of SVM. This methodology is composed of morphological operation with the SVM algorithm. first pre-processinng is done on the image data set to get skeleton from dataset. Then morphological operation used for localization of optic disk from the retinal fundus image. Then features are extracted from input dataset using SVM which is a supervised learning technique [5]. Both qualitative and quantitative experiments on dataset images shows that proposed approach is effective and produce identical results. An automated process for the early diagnoses and intervention can hence be of great help to the patient and Specialist alike in the timely management of this widespread disease.

DR as the root cause of blindness it is important that we should detect it early for effective treatment. Main stages of DR are non-proliferative diabetes retinopathy (NPDR) and proliferative diabetic retinopathy (PDR). Attempt has been made by authors in[] to make use of neural network tool (MATLAB) in the medical eld [20]. Important consideration of this work in medical diag-nostics is to develop more cost effective and easy system, procedures and methods for supporting ophthalmologist to analyse important features of DR retinal images and an image classifier based on SVM which classify the images according to disease conditions.

Authors in [4] presented an improved approach to microaneurysm detection in color fundus images. This task optimally combines pre-processing methods and candidate extractors for mi-croaneurysm detection realized by candidate extraction, which is followed by a classification step with aim to increase the number of true positives in the first phase of the microaneurysm detection process. Result shows that the state of the art

candidate extractors offer significantly improved results, when they are optimally combined with pre-processing approaches. This approach successfully increased the number of TPs in the individual cases with 99% sensitivity. That means method drastically improves the recognition of actual microaneurysms with respect to the increment of FPs.

Akara Sopharak, Bunyarit Uyyanonvara and Sarah Barman are investigated a set of opti-mally adjusted morphological operators used for microaneurysm detection on non-dilated pupil and low-contrast retinal images. The detected microaneurysms are validated by comparing with ophthalmologists hand-drawn ground-truth. As a result, the sensitivity, specificity, precision and accuracy were 81.61%, 99.99%, 63.76% and 99.98% respectively[2].

Sekineh Asadi Amiri and another three [19] presents an automated method for detecting mi-croaneurysms in the retinal angiographic images by using image processing techniques. In order to fade or remove the pseudo images first retinal images are pre-processed. Then microaneurysms are identified by circular Hough transform(CHT) by using the CHT the central point of the microa-neurysms lesion is identi ed then by using the region growing technique the total areas of pixels associated with these lesions are identified. Due to the removal of the vascular diagnosis which has been very time consuming the speed of the algorithm has significantly been increased. Results show that the accuracy of the proposed method in detecting microaneurysms is about 88.5% that in comparison with other existing methods has higher speed and more accuracy. because of high speed this method is very suitable for practical applications.

SujithKumar S B and Vipula Singh presented different preprocessing, feature extraction and classification algorithms [21]. The performance of the automated system is assessed based on Sensitivity and Specificity. The Sensitivity and Specificity of this approach are 94.44 % and 87.5 %, respectively. Microaneurysm detection is done in non-dilated digital images from diabetic retinopathy patients and the system helps the ophthalmologist in the diabetic retinopathy screening process to detect symptoms faster and more easily on very poor quality images. There are some missing MAs located next to or nearby blood vessels which are removed as wrongly detected as blood vessels. The results of MA detection depend on the success of vessel detection. A main weakness of the algorithm arises from the fact that the algorithm depends on vessel detection.

Software based method is presented by N. S. Datta, R. Sarker, H. S. Dutta in [15] for early detection of diabetic retinopathy using non dilated retinal images. Here, initially an automated sys-tem is generated to identify diabetic affected eye among the several input retinal images. Graphical presentation of MA count for different images can easily classify the normal eye and the diabetic affected eye. Then the performance analysis of the above system is carried out graphically using the affected eye. The average sensitivity, specificity, precision and accuracy are the important per-formance analysis parameters and measured as 81.68%, 99.98%, 83.00% and 99.97% respectively for ten diabetic affected retinal images.

Image enhancement method applied for detection of diabetic retinopathy and presented by Jyoti D. Patil and Anant [10]. L. Chaudhari. This image enhancement method can improve the clarity and sharpness of image. Image sharpening is performed by spatial ltering. Image enhancement is done by 1st and 2nd derivative function. Contrast enhancement pre-processing is applied before four features, namely intensity, standard deviation on intensity, hue and a number of edge pixels, are extracted to supply as input parameters to enhance an images. In this paper, different DIP techniques of image enhancement for retinal image which can sharpen and can lter-information in infected eye are discussed. Second order derivatives give more sharpness in retinal blood vessals.

For detection of Hemorrhages in digital retinal image, rst the pre-processing is applied on retinal image to make the brightness of image and enhance the contrast between background and haemorrhage using CLAHE(contrast limited adaptive histogram equalization) algorithm. Then the template matching technique is used which includes a template of radius and outside width. According to the value of radius and outside width, then the number of Hemorrhagic and back-ground image is detected. Region growing segmentation using local threshold is used to detect proper size of Hemorrhage. For elimination of wrongly detected hemorrhage fovea filters are used to classify the candidate

haemorrhage is as either a red lesion or non red lesion. Classification of DR is depends on the number of MA and haemorrhage and according to that moderate NPDR, severe NPDR and PDR can be graded. The sensitivity for the detection of abnormal cases was 80% and 90% respectively [18].

Pooja Shetty [17] proposed a method of MA detection and grading of Diabetic retinopathy. Various pre-processing and candidate extraction techniques are used to enhance the input image to improve the visibility of microaneurysm in retinal fundus image. Based on colour and standard morphological features of retinal anatomical structure, each candidate is classified. Using neural network architecture like Back propagation algorithm , the candidates extracted can be classified as MAs or non MAs. Depending upon the number of MA count and the area of MAs spreading, the grading of Diabetic retinopathy is done. Circular Hough transformation is applied to improve MA candidate extraction. For classification, Levenberg-Marquardt Algorithm is used to obtain the severity of the disease.

In order to detect microaneurysms Murugan R and other three shown easier way by using mathematical concept [14] rather the other methods of segmentation, thresholding and region growing. Each and every evaluated based on the parameters such as sensitivity and specificity. Fast and efficient mathematical concept based on the mathematical operators for the purpose of segmenting the region of interest is the main objective of future work. microaneurysms can be easily detected after the process of segmentation. This new approach and techniques to detect microaneurysms accurately and efficient use of the already existing methods is the interest of future work.

A three-stage system for early detection of MAs using lter banks extracts all possible candidate regions for MAs present in retinal image is presented by group of researchers [12]. A feature vector for each region depending upon certain properties, i.e. shape, color, intensity and statistics is formed to classify a candidate region as MA or non-MA. A hybrid classifier which combines the Gaussian mixture model (GMM), support vector machine (SVM) and an extension of multi-model mediod based modelling approach in an ensemble is presented to improve the accuracy of classification. Hybrid approach gives higher accuracy which is better than previously published methods.

A new approach based on multi scale correlation ltering (MSCF) and dynamic thesholding is developed by authors in [8]. This method consists of coarse level and ne levels of microaneurysm candidate detection and classification, results after evaluating this method on two public datasets ROC and DIARETDB1 shows that proposed method by authors is more effective and efficient for intensity-based microaneurysm detection and localization for DR diagnosis.

To minimize ophthalmologist load and assessment of diabetic eye disease authors of [9] aimed to assess whether automated identi cation of diabetic retinopathy based on the presence of micro-aneurysms is an effective tool in clinical practice. They analysed 758 fundus images of 385 patients with diabetes using binocular indirect ophthalmoscopy. The sensitivity and specificity of the automated scheme used to investigate the retinal fundal images was determined by comparison with optometric and ophthalmologic assessment. This work result achieved 97 per cent sensitivity at 88 per cent specificity with respect to the ophthalmic classification and with automated retinopathy detector achieved 85 per cent sensitivity at 90 per cent specificity at detecting retinopathy. Result shows automated micro aneurysm detector has a lower sensitivity compared to the optometrists but Automated assessment can save time and be cost-effective.

Authors in [13] evaluated eye check algorithm and algorithm that won the 2009 Retinopathy Online Challenge Competition in 2009 because of that currently used in Eye Check. Evaluated from 16,670 patient visits from each visit was analyzed by a single retinal expert; 793 of the 16,770 sets were classified as containing more than minimal DR (threshold for referral). The results of the two algorithmic detectors were applied independently to the dataset and compared by standard statistical measures. Main result consist the area under the Receiver Operating Characteristic curve (AUC) and sensitivity and specificity detection. DR was detected with an AUC for detection was 0.86, the same as the theoretically expected maximum. At 90% sensitivity, the specificity of the EyeCheck algorithm was 47.7% and the Challenge2009 algorithm, 43.6%. finally

form above work author conclude that Additional validation studies on larger, well-defined, but more diverse populations of patients with diabetes are immediately needed, anticipating gainful before time detection of DR in millions of people with diabetes to triage those patients who need additional concern at a time when they have early rather than advanced DR.

To evaluate various fundus photograph analysis algorithm authors in [6] used Computer-assisted diagnostic system (CADS) for grading of diabetic retinopathy (DR) and the risk of macular edema (ME). For this purpose they had done automated detection of microaneurysms and exudates on two small image databases on which these lesions were manually marked, then CADS for the detection and grading of DR and ME on large database containing both normal and pathological images, and compared with manual grading. CADS demonstrated a sensitivity of 88.5%, with 2.13 false positives per image. The pixel-based evaluation had a sensitivity of 92.8% and a positive predictive value of 92.4%. same algorithms are also evaluated on 761 images from a large database, result shows sensitivity and specificity of the algorithm were 83.9% and 72.7% respectively and for detection of the risk of ME, the sensitivity and specificity were 72.8% and 70.8% respectively. This study shows that use of this system would permit considerable time reserves for physicians and, therefore, alleviate the time spent on a mass-screening programme.

This paper presents classifier for detection of diabetes using support vector machine (SVM). Linear SVM will be used in a multi-layered pattern to classify patients into diabetic, pre-diabetic or non-diabetic. This SVM based classifier can assist in the accurate decisions about Diabetes disease[3].

In this paper the MAs are detected by various stages such as pre-processing, feature extraction, feature selection and classifier. First of all greyscale image is selected then to indicate the lesions more effectively, the local histogram equalization was applied on the each partitioned area of an image. Bilinear interpolation was applied to remove boundaries between the regions. Before using edge detection, Images contrast is enhanced. circular border of image and blood vessel are removed. Then final MAs are detected after removing optical disk and small noise in the image. In feature selection the term probability value (P value) is used to show any di erence between the abnormal and normal sets of feature data. SVM classifier is used to classify the images as normal or abnormal stage. The performance of this method achieved as average sensitivity, specificity and accuracy as 89.125%, 92.55% and 95.025% respectively [1].

3. Results summery of Different Reported Algorithms

The performance of reported algorithms on the test set is evaluated by comparing the classifiers result. The sensitivity of image detection with one or more MAs gives the success rate for detection of this early sign of diabetic retinopathy. The performance of each classifier in terms of sensitivity, specificity and false positive rate per image is [10, 21] summarized in graphical representation is shown in Figure 1.

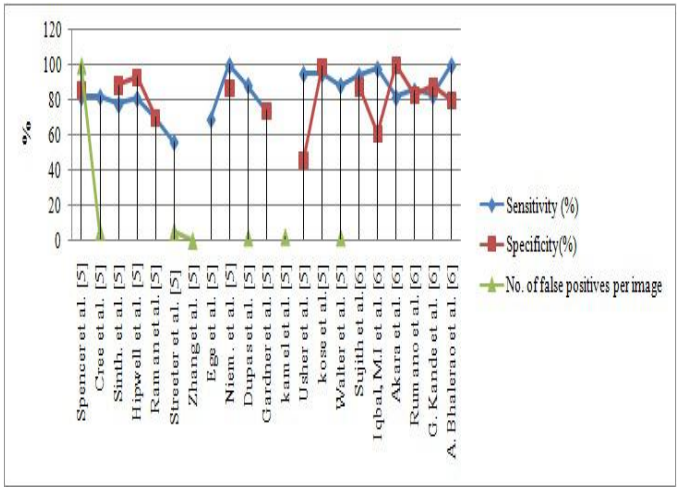

Figure 2: Graphical view of summarized information about sensitivity, specificity and FP per image of MA detection.

4. Conclusion

An automated DR detection system is a very important for the growing up number of diabetic patients in the world. In this paper a number of algorithms are surveyed and different algorithms are found to give better results as early as exudate detection. After the survey metrics local thresholding algorithm is detects exudates more accurately than other algorithms with a sensitivity, specificity, accuracy and precision. This paper reviews all existing methods to give a complete view of hayfield. Based on his work, researchers can get a head start of the problem and n develop better and more effective algorithms.

REFERENCES

[1]. D.Jeyakumari Adarsh.P. \a novel method for micro aneurysm detection and diabetic retinopa-thy diagnosis ". In International Conference on Innovations In Intelligent Instrumentation, Optimization And Signal Processing ICIIIOSP-2013, PP. 42-46,2013.

[2]. Sarah barman Akara Sopharak, Bunyarit Uyyanonvara. \automatic microaneurysm detection from non-dilated diabetic retinopathy retinal images using mathematical morphologymethods". IAENG International Journal of Computer Science, 2011.

[3]. Omkar Kulkarni Prathamesh Palaskar M. A. Pradhan Akshay Joshi, Anum Khan. \design of multi-class classi_er for prediction of diabetes using linear support vector machine". International Journal of Engineering Research and Technology, Vol. 3, Issue. 2, PP. 155-160 February2014.

[4]. Balint Antal and Andras Hajdu. \improving microaneurysm detection in color fundus imagesby using an optimal combination of preprocessing methods and candidate extractors",18th Eeuropean signal processing conference (eusipco-2010), aalborg, denmark,pp. 124-128, august23-27, 2010.

[5]. Abhishek Kumar Gaur Atul Kumar and Manish Srivastava. \a segment based technique fordetecting exudate from retinal fundus image",2nd international conference on communication, computing and security. Vol. 6, pp. 19, 2012.

[6]. A. Erginay R. Ordonez N. Deb Joardar P. Gain J. C. Klein B. Dupas, T. Walter and P. Massin. \evaluation of automated fundus photograph analysis algorithms for detecting microaneurysms, haemorrhages and exudates, and of a computer-assisted diagnostic system for grading diabetic retinopathy ". Diabetes and Metabolism, Vol. 36, pp. 213-220, 2010.

[7]. Dr. M. Ramakrishnan B. Sumathy, Dr. S. Poornachandra. \automated microaneurysms detection and grading of diabetic retinopathy", proc. of int. conf. on advances in computer science, aetacs,. pp. 93 -101, Elsevier, 2013.

[8]. Qin Li Lei Zhang Bob Zhang, Fakhri Karray. \detection of microaneurysms using multi-scale correlation coe_cients". Pattern Recognition, Vol. 43, PP. 2237-2248, 2010.

[9]. DavidWorsley Alan Luckie Herbert J Jelinek, Michael J Cree and Peter Nixon. \an automated microaneurysm detector as a tool for identification of diabetic retinopathy in rural optometric practice". Clinical and Experimental Optometry, pp. 299-305, September 2006.

[10]. Anant. L. Chaudhari Jyoti D. Patil. \tool for the detection of diabetic retinopathy usingimage enhancement method in dip". International Journal of Applied Information Systems (IJAIS), Vol. 3,issue. 3, PP.54-56,July 2012.

[11]. Puspalata Sah Kshetrimayum Lochan and Kandarpa Kumar Sarma. \innovative feature set for retinopathic analysis of diabetes and its detection". 2012, IEEE.

[12]. Shoab A.Khan M. Usman Akram, Shehzad Khalid. \identi_cation and classi_cation of mi-croaneurysms for early detection of diabetic retinopathy". Pattern Recognition, Vol. 46, issu.1, PP. 107-116.

[13]. Stephen R. Russell James C. Folk Vinit B. Mahajan Meindert Niemeijer Michael D. Abramo, Joseph M. Reinhardt and Gwenole Quellec. \automated early detection of diabetic retinopathy". Ophthalmology, Vol. 117, Issu. 6, PP. 11471154, June 2010.

[14]. Nasreen Fathima S. Venkata Haritha T. Murugan R, Dr.Reeba Korah. \microaneurysms detection methods in retinal images using mathematical morphology". International Journalof Advances in Engineering Science and Technology, Vol. 2, Issu. 1,pp. 120-128, February 2013.

[15]. H. S. Dutta M. De N. S. Datta, R. Sarker. \software based automated early detection of diabetic retinopathy on non dilated retinal image through mathematical morphological process".International Journal of Computer Applications (0975 8887), Vol. 60, Issue. 18,2012.

[16]. Bunyarit Uyyanonvara Parisut Jitpakdee, Pakinee Aimmanee. \a survey on hemorrhage detection in diabetic retinopathy retinal images ". IEEE, 2012.

[17]. Mr. Avadhoot R. Telepatil Pooja G. shetty, Dr Shrinivas A. Patil. \detection of microa-neurysm and diabetic retinopathy grading in fundus retinal images". International Journal of Engineering Trends and Technology (IJETT), Vol. 13, Issu. 7,PP. 331-336, Jul 2014.

[18]. Chavan M.S. Reshma M. Mulla. \detection of hemorrhage from fundus images using hybridmethod". International Journal of Computer Applicaions(0975-8887), Vol. 107, Issu. 12, PP.31-35, December 2014.

[19]. Masoumeh Shahir Reza Ghaderi Sekineh Asadi Amiri, Hamid Hassanpour. \detection of microaneurysms in retinal angiography images using the circular hough transform". Journal of Advances in Computer Research Quarterly, Sari Branch, Islamic Azad University, Sari, I.R.Iran, Vol. 3, Issu. 1, PP. 1-12, February 2012.

[20]. Asst. Prof. A Rafega Beham Soumya Sree M. \automated diagnosis of retina images fordiabetic patients based on bp and svm", international journal of computer science and mobile computing. Vol.4 Issue.2, February 2015, pp. 299-306, Feb 2015.

[21]. Vipula Singh SujithKumar S B. \automatic detection of diabetic retinopathy in non-dilatedrgb retinal fundus images". International Journal of Computer Applications, Vol. 47, Issu.19, 2012.

[22]. Ali Erginay Richard Ordonez Clotilde Jeulin ThomasWalter, Pascale Massin and Jean-ClaudeKlein. \automatic detection of microaneurysms in color fundus images",medical image analysis,. Vol. 11, pp. 555 566, May 2007.