Analysis of Diabetic Retinopathy Classification and Techniques of Retinal Lesionson Fundus Image-A Review

Pallavi V. Bhosle, Prof. G. K. Pakle

Dept. of Information Technology

Shri Guru Gobind Singhaji Institute of Engineeing and Technology 431606, Nanded (MH)

Abstract—Diabetic retinopathy (DR) is the most common cause of blindness in diabetic patients, but early detection and prompt therapy can prevent this problem.This is aimed at automatically detecting these lesions in fundus images and improving the quality of the fundus image.There are several physical measures used to diagnose diabetic retinopathy, however time consuming and impacting patients, the authors focused on disease presence decisions by applying classification algorithms such as machine learning. Identifying the microanuerysms, exudates, red lesions on fundus images for early stage identification of diabetic retinopathy is essential to avoid full blindness using ophthalmologist and machine learning techniques.Non-invasive retinal disease diagnostic information is provided by digital fundus imaging, such as diabetic retinopathy (DR), glaucoma, age-related macular degeneration, and vascular anomalies.This work is going to helpful to the diabetic patients.

Index Terms-Computer-aided diagnosis, Fundus Imaging, Lesions Segmentations, Image Processing, Mathematical Morphology, Machine Learning,Image ,Image Binarization, Region of Interest, Morphological Reconstruction(MR)

I.INTRODUCTION

In recent years, Diabetic Retinopathy has been the leading cause of blindness in the Western world's working population.It is an eye disease that affects 17% of diabetic subjects in some cases five years after diagnosis with diabetes of 97%. Early diagnosis has demonstrated avoiding vision loss and blindness by routine screening and prompt care.Digital colour fundus photography allows for non-invasive processing of background images, a requirement for large-screening.Thereafter, a convolutionary network is used to automatically extract and identify each candidate region, equipped with sample learning to improve.The literature focuses primarily on the identification and/or

segmentation of exudates with respect to bright lesion segmentation.

Developing an integrated telemedicine device to track and diagnose diabetic retinopathy is focused on accurate identification of defects in the photographic retinal fundus.Lesions that include micro aneurysms and haemorrhages are anomalies in retinal fundus images based on DR.Automatic detection in colour fundus images of abnormalities such as micro aneurysm and haemorrhages is important for the classification of patient diabetes levels within an automated framework.Diabetes particularly affects the light sensitive part of the eye, the retina.

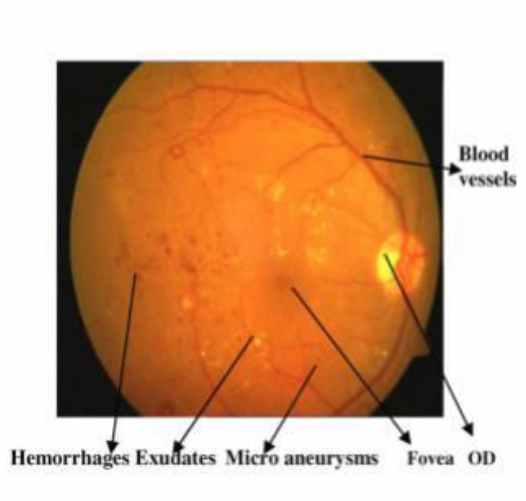

Figure 1: Retina Image

Long-term diabetes can lead to leakage of blood vessels into the retina, resulting in vision loss and even blindness. An early diagnosis in diabetic patients is crucial to avoiding vision loss.The process of analysing the photographs of the eye fundus involves care from an ophthalmologist and is time consuming and repetitive. The ophthalmologist function greatly increases as the disease's progress needs to be checked on a regular basis.The ophthalmologist should give patients more time to see from and every photo of the fundus requiring their attention as well.This can be achieved by automating the grading of the procedure, whereby new patients can be assessed and submitted for further testing if appropriate.The rapid development of the information management system and the introduction of affordable ophthalmic imaging technology have helped improve automated diabetic eye disease detection techniques.The generalization theory among those automated techniques is very difficult to achieve.It is important to review numerous available techniques to highlights their suitability for the automatic identifications of eye diseases.

The methods proposed first pre-process to improve the quality of the fundus image to achieve this goal, and then detect and remove the Optic Disc to avoid interference with performance.The identification of retinal diseases has become much simpler using automated retinal image processing, but other approaches such as eye pupil dilation are time-intensive.Diabetes occurs when the small vessels that provide the retina with nutrients and oxygen are compromised by high blood glucose.For picture classification, the characteristic features derived from algorithms for structural component analysis and lesion

detection are used.A classifier ensemble then uses these characteristics to determine whether or not a picture has diabetic retinopathy.Protein and lipid leakage from damaged blood vessels into the retina are the principal cause of the exudates.Therefore, to determine the occurrence of eye problems in a frame, machine learning techniques based on an ensemble are used.

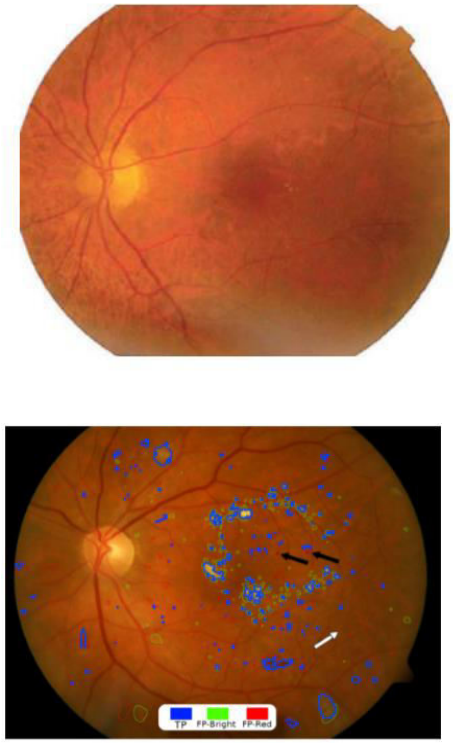

Figure 2: Fundus Photographs

The novel technique of exudate prediction is discussed and analyzed in the sense of computer-assisted diagnosis of eye diseases.The existence of exudates in the retinal zone, which allows the detection of high sensitivities, is an important feature of diabetic macular edoema.Exudate identification is therefore an excellent clinical technique that the computer assistance may play an essential part.Exudates use their difference in broad pixel values, and their outlines are measured using morphology techniques for reconstruction.For this method it is important to classify the optic disc.For detecting the optic disc use morphological filtering techniques. and transformation watershed.

II.PRIVIOUS WORK

Automated system[1] for identifying retinal lesions, i.e. red and bright lesions, on fundus pictures.For this paper , the author built a technique for training convolution with supervised learning and poorly supervised multitask learning architecture.At the same time, the architecture is qualified for three activities: differentiation of red and white lesions, all of which are performed at the same time as identification of lesions. The benefits of a modern pre - processing type that ensures colour between the raw image and its enhanced image.The method of specialization is focused on CNN,AHE and Guassian Filter. The of DIAREDTEDB1 data contains89,IDRID data contains 81 images,e-optha 47 images were used for evaluation.

Auto System[2] for identifying microaneurysms on images of the retina. In order to enhance the efficiency of a system, the author found a better-placed transformation function inside the context of the lifting model approach. The method of specialization is focused on an

evolutionary algorithm by Powell. The data of 120 retinal pictures wereused for evaluation.

Mathematical Morphology[3] for identifying exudates on image of the retina.In order to enhance the performance, the author found a better technique as image processing. The presence of exudates is a key characteristic of diabetic macular edoema in the macular region and allows high sensitivity identification.Robustness was measured with regard to changes in the algorithm's parameters. The system of specialization used morphological filtering techniques and the transformation of the watershed to detect the optic disc.

Image Binarization, Region Of Interest (ROI),MorphologicalReconstruction(MR)[4] for adequately automated removal of the exudates for early detection of lesions in the fundus photos.The author, found a better method i.e. image binarization, to improve the quality of the images.Exudates were shown to become one of the symptoms and severe DR defects, thus careful diagnosis of defects and care must be done promptly to avoid eye problems.The method of early detection focused on MR.The data of 100 fundus images were used for evaluation and the experimental result shows that 91% .

Automatic Telemedicine System[5] for identifying the abnormalities andscreening of diabetic retinopathy on retinal fundus images.The author proposed new process dynamic shape features and SVM to enhance the automatic detections of anomalies in the retinal fundus picture.The first detection is based on pixel classification and second is on SVM classifier.In Lesions includesmicroaneurysms and haemorrhages are defects in retinal fundus images due to diabetic retinopathy.The data contains 56 testing images and 28 training images DIRETEDDB1 and STARE database with accuracy 90% and 80% by cross training.

Automated Image Processing System[6] for identifying the classification of diabetic retinopathy phase system based on digital fundus images exudates.In order to ,perform the early treatments for diabetic patients.The author proposed methods i.e rough segmentation using morphology or column-wise action, and segmentation of Fine exudates is performed using morphological reconstruction.This classification system, along with other methods for extracting and classifying retinal features, can perform a good and quick diagnostic classification for diabetic retinopathy.Fundus images databases from Sungai Buloh Hospital, Malaysia were used for the proposed process.This segmentation method provides fast and easy, better diseases and improved the accuracy.

Automated Screening System[7] for red lesionsidentification in digital fundus

photograph.The author has proposed two contributions: first,a new detection system for red lesion people based on a method of pixel-wise classification to distinguish red lesions from the background of the image, and second, Spencer-Frame has introduced a large number of new functions.The method of red lesion detection is described on the basis of a hybrid approach.The machine had 93.1 % sensitivity and 71.4 % precision per patient basis.The detected candidates are classified using all features and k-nearest neighbour classifier.

Automated Computer-aided Detection[8] describes the technologies and methods that are used for diagnosing and detecting the diabetic eye disease on fundus image of retina.There are several physical measures used to diagnose DR, however time consuming and impacting patients, the author focused on disease presence decisions by applying classification algorithms to machine learning.This paper focuses on automated computer-aided identification of eye problems using different algorithms for retinal image recognition functionality and performance.Decision Tree, Naïve Byes, Random Forest and SVM were used to make decisions to predict the existence of DR.

Automated Detection System[9] identifying the microanuerysms on fundus images of the retina.Rapidly rising health risks worldwide, the author focussed on early care can be done through microaneurysm detection.The detection algorithm with mathematical morphology for microaneurysm is the main point of this paper.Mathematical morphology is selected because it appears that typical kinds of microaneurysms are found.The specialization algorithm-focused approach consists of 3 steps: one of those is pre-processing, the next is detecting applicant microaneurysms, and the last is post-processing, managing the unused features removal step. The performance is analysed using the DIRETEDDB1 database, which provides the collected ground truth to various experts and a strict assessment procedure.

Automated DR screening system[10] to classify the picture quality classification on the fundus image for diabetic retinopathy.Previous approaches consider basic features on a lower level, such as hand-designed graphical and functional properties.The author proposes a new method of classification of image quality in this paper which executes mathematical techniques that simulate the functioning of the human vision system.The proposed approach merged unmonitored features from the feature vector with monitored features from completely convolutionary neural networks (CNN) to detect high-quality retinal fundus images efficiently versus poor-quality.The efficiency of the proposed algorithm a broad retinal fundus dataset for device effectiveness and greate accuracy in order to achive than other approaches.

III TECHNIQUES FOR ANALYZING FUNDUS IMAGE PATTERNS

In this section, We present a description of the different methods of machine learning used for DR analysis and extraction.In Random Forest, each patch is graded according to the presence or absence of injuries.We apply some image processing methods to study characteristics, these images must be pre-processed.In order to analyse and process geometric structures, as well as random functions, mathematical morphology is used.The SVMis used for detecting anomalies in the retinal fundus picture.Naive bayes is a algorithm used for predicting the image Patterns.Based on CNN features, classification accuracy has been improved.

Techniques	Tasks	Accuracy
Random Forest, kNN	It is Classifies each patch of lesions and for better Detection	93%
Image Processing	Pre-processed the retinal images and classifies the stages based on digital fundus images	93%
Mathematical morphology, Image Binarization, Region Of Interest (ROI)	Analysis and processing of geometrical structures, removed the unused features in images, improved the quality of fundus image	91%
SVM	SVM classifier to improve automatic detection system in retinal fundus images.	90%
Naïve Byes	Predicting the patterns, improved the color intensity from images	92%
CNN	A convolution network is used for the automated extraction of each candidate patch function and classification.	94%

Figure 3: Summary of various Techniques for Analysis

IV CONCLUSION

This study has successfully developed algorithms that can evaluate the DR phase of the patient depending on the number of lesions identified in the image of the retinal fundus.The paper aimed to help ease the detection of early symptoms of diabetic retinopathy by ophthalmologists.Morphological operation such as opening is used to detach optic discs, since we only need to focus on blood vessels and exudates. The design of the automated primary healthcare device for diabetic retinopathy testing and evaluation is focused on the precise identification of anomalies in retinal fundus images.Based on the adoption of the source image and the characteristics obtained from CNN, the accuracy of the final classification has been improved, which would be an extremely valuable method in the broad-scale diagnostic

phase of eye problems.This paper also addresses numerous methods for the identification and diagnosis of diabetic eye disease.We use machine learning techniques to improved more accuracy and for early detection and improved the performance of segmentation.

REFERENCES

[1] Cl´ementPlayout, Renaud Duval, and Farida Cheriet, Senior Member, IEEE ,"A novel weakly supervised Multitask Architecture for Retinal Lesions Segmentation on Fundus Images"JOURNAL OF L ATEX CLASS FILES, VOL. 14, NO. 8, AUGUST 2015.

[2]G. Quellec, M. Lamard, P. M. Josselin, G. Cazuguel, B. Cochener, and C. Roux, "Optimal wavelet transform for the detection of microaneurysms in retina photographs," IEEE Transactions on Medical Imaging, vol. 27, no. 9, pp. 1230–1241, Sept 2008.

[3]T. Walter, J. C. Klein, P. Massin, and A. Erginay, "A contribution of image processing to the diagnosis of diabetic retinopathy-detection of exudatesincolorfundusimagesofthehumanretina, "IEEETransactions on Medical Imaging, vol. 21, no. 10, pp. 1236–1243, Oct 2002.

[4] S. Sreng, J. i. Takada, N. Maneerat, D. Isarakorn, B. Pasaya, R. Panjaphongse, and R. Varakulsiripunth, "Automatic exudate extraction for early detection of diabetic retinopathy," in 2013 International Conference on Information Technology and Electrical Engineering (ICITEE), Oct 2013, pp. 31–35.

[5] V. Sathananthavathi, G. Indumathi, R. Rajalakshmi," Abnormalities Detection in Retinal Fundus Images" International Conference on Inventive Communication and Computational Technologies (ICICCT 2017).

[6]Ahmad ZikriRozlan, HadzliHashim, Syed Farid Syed Adnan,Chen Ai Hong,MiswanudinMahyudin,"A Proposed Diabetic Retinopathy Classification Algorithm with Statistical Inference of Exudates Detection", International Conference on Electrical,Electronics and System Engineering 2013.

[7] M. Niemeijer, B. van Ginneken, J. Staal, M. S. A. Suttorp-Schulten, and M. D. Abramoff, "Automatic detection of red lesions in digital color fundus photographs," IEEE Transactions on Medical Imaging, vol. 24, no. 5, pp. 584–592, May 2005.

[8] Karan Bhatia, ShikharArora, Ravi Tomar,"Diagnosis of Diabetic Retinopathy Using Machine Learning Classification Algorithm ",2nd International Conference on Next Generation Computing Technologies (NGCT-2016) Dehradun, India 14-16 October 2016.

[9] ArdimasAndiPurwita, KresnoAdityowibowo, AshlihDameitry, Made Widhi Surya Atma ,"Automated

Microaneurysm Detection Using Mathematical Morphology"2011 International Conference on Instrumentation, Communication, Information Technology and Biomedical Engineering 8-9 November 2011, Bandung, Indonesia.

[10]FengLi Yu, Jing Sun, Annan Li, Jun Cheng, Cheng Wan, Jiang Liu,"Image Quality Classification for DR Screening Using Deep Learning",978-1-5090-2809-2/17/$31.00 ©2017 IEEE.

[11] Kevin Noronhal, K. PrabhakarNayak,"Fundus Image Analysis for the Detection of Diabetic Eye Diseases-A Review ",2012 International Conference on Biomedical Engineering (ICoBE),27-28 February 2012,Penang.

[12] KöseCemal, İkibaşCevat, Expert Systems with Applications, (2011)Hill Robert Retina Identification (1976)

[13] J. L.Wayman, Fundamentals of biometric authentication technologies, Int. J. Image Graphics, vol. 1, no. 1, pp. 93-113, 2001.

[14] Doç. Dr.İbrahim Doğan, A' dan Z' ye MatlabileÇalışmak, Şubat 2004.