IJNRD.ORG ISSN : 2456-4184
INTERNATIONAL JOURNAL OF NOVEL RESEARCH AND DEVELOPMENT (IJNRD) | IJNRD.ORG
An International Open Access, Peer-reviewed, Refereed Journal

CLASSIFICATION OF RETINAL DISEASES USING RESNETMODEL

Arde Apeksha [1], Deshmukh Sonal [2], Jagtap Om [3], Patekar Onkar [4]
Computer Engineering Department GHRCOEM, Chas, Ahmednagaí-414002.

Abstract: **Retinopathy is the most prevalent cause of avoidable vision impairment, mostly affecting the working-age population in the world. Recent research has given a better understanding of the clinical eye care practice to identify better and cheaper ways of identifying, understanding, managing, diagnosing, and treating Retinal Diseases. The number of people suffering from Diabetic Retinopathy is much more when compared to that of the ophthalmologists present. So a computer aided diagnosis tool is required which detects and classifies the fundus retinal image. In previous studies, the deep learning systems were usually trained directly end-to-end from original fundus images to the labels of DR grades, these end-to end systems might fail to encode the lesion features due to the Black-box nature of deep learning. In our study, we improved the image processing quality using the RESNET model and increased the accuracy above 90 percent. The GUI wedeveloped classified the images into different classes of DR. These classes include No DR, Mild DR, Moderate DR, andProliferate DR.**

Keywords: **Diabetic Retinopathy, ResNet Model, Feature extraction, Image processing quality, classification.**

I. INTRODUCTION

Diabetic retinopathy (DR) is a common diabetes complication that occurs when the retina's blood vessels are damaged due to high blood sugar levels, resulting in swelling and leaking of the vessels. In an advanced DR stage, the vision may be lost completely. The percentage of blindness worldwide resulting from DR is 2.6%. Therefore, diabetes patients need regular screening of the retina to detect DR early, manage its progression
and avoid the risk of blindness [1].
Diabetic Retinopathy is a condition that may occur in people who have diabetes. It causes progressive damage to the retina, the light-sensitive lining at the back of the eye. Diabetic retinopathy is a serious sight-threatening complication of diabetes. Diabetes interferes with the body's ability to use and store sugar (glucose). The disease is characterized by too much sugar in the blood, which can cause damage throughout the body, including the eyes. Over time, diabetes damages small blood vessels throughout the body, including the retina. Diabetic retinopathy occurs when these tiny blood vessels leak blood and other fluids. This causes the retinal tissue to swell, resulting in cloudy or blurred vision [2].

Diabetic retinopathy usually affects both eyes. The longer a person has diabetes, the more likely they will develop diabetic retinopathy. If left untreated, diabetic retinopathy can cause blindness when people with diabetes experience long periods of m high blood sugar, fluid can accumulate in the lens inside theeye that controls focusing. This changes the curvature of the lens, leading to changes in vision. However, once blood sugar levels are controlled, usually the lens will return to its original shape and vision improves. Patients with diabetes who canbetter control their blood sugar levels will slow the onset and progression of diabetic retinopathy [3].

According to a 2018 American Eye-Q survey conducted by the AOA, nearly half of Americans didn't know whether diabetic eye diseases have visible symptoms (often which the early stages of diabetic retinopathy do not). The same survey found that more than one-third of Americans didn't know a comprehensive eye exam is the only way to determine if a person's diabetes will cause blindness, so the AOA recommends that everyone with diabetes have a comprehensivedilated eye examination at least once a year. Early detectionand treatment can limit the potential for significant vision loss from diabetic retinopathy [4].The diabetic retinopathy isquantified and features are recognized so far, on the fundus images. Even when it is possible to analyze few particularfeatures of retina, a reliable or robust technique has not been derived by researchers yet. A three- step algorithm is designed which helps in calculating the severity of DR and automaticallygrade it. The ophthalmic fundus images are used in this automatic process [5]. The preprocessing stage includes few issues such as image blurriness, non-clarity or problems related to image size. In the initial step, the image is resized and then the color space conversion and image restoration steps are performed further. The final stage includes the enhancement of image [6]. In the color space conversion process, the color fundus input image is transformed into HSI (Hue, Saturation and Intensity). HSI format includes decoupling of color model space from the color images. The first step performs histogram equalization which is followed by contrast enhancement. In the preprocessing step, the pixel intensities are then scaled [7]. The candidate extraction process includes performing different morphological operations for recognizing the micro-aneurysms and exudates features. The invert image technique is applied to invert the image. The holes are then filled in the image towards the end. Optical disc is the brightest part of a normal eye in the fundus images. The shape of this part is either oval or elliptical[8].

In case of colored fundus images, the optical disc is presented
As s bright yellow or white area. The exudates include
high and similar intensity values for the optic disc. Therefore,

necessary to remove the optic disc from the retinal image. The brighter optic disc can be masked and removed with the help of region properties and area recognition processes [9]. For the detection of micro- aneurysms and exudates from retinal images, it is important to remove the blood vessels and optical disc from it since the concentration levels of all of these features are same. On an intensity image, dilation is applied so that the high levels contrasts vessels available in blood can be removed. After the removal of blood vessels and optical disc from the image, it is possible to identify the exudates features. Exudates are the bright lesions existing in a retina image. Such important features are recognized by applying the morphological closing operation [10]. After recognizing the exudates and micro-aneurysms present in a color image, the features can be extracted from the fundus image. All the features are calculated and different classifiers are used to which these output values are given as input. Someof the commonly used classifiers in this process are explained further. The SVM (Support Vector Machine) classifier is commonly known for handling mostly the binary classification issues. This classifier studies the multi-class pattern recognition issue [11]. The calculation of k-nearest neighbor classifier value is done based on the Euclidean distance which is present in between a test sample and the specific training samples. Naïve Bayes Classifier is designed on the basis of Bayes Theorem and the assumption that there are independent predictors. Neural Network is comprised of neurons that self- optimize through learning [12]. Each neuron will still receive an input and perform an operation (such as a scalar product followed by a non-linear function) the basis of countless Artificial Neural Networks (ANNs).

I. LITERATURE REVIEW

Diabetic Retinopathy Detection [1]

Journal: International Journal of Engineering and Advanced Technology(IJEAT).

Methodology: This paper uses image processing for the detection of diabetic retinopathy. It is used to enhance and extract useful information from the images which undergone the process based on characteristics and features associated with that image. The methodology in Image processing follows (1) Image acquisition,(2) pre-processing (3) edge- detection, (4) segmentation, (5) Image restoration, and (6) output processed image. It reduces the noise, and segments and enhances them for improved quality which accurately detects the focus of diseases and communicates medical and pathological information of a particular image by visual representation. There are two stages namely proliferative Diabetic Retinopathy (PDR) and non-proliferative Diabetic Retinopathy (NPDR). At the stage of NDPR, the retinal blood vessels get damaged and become wet and swollen. The PDR stage occurs when abnormal blood vessels appear in various areas of the retina. This paper used only 20 to 50 images in each of the six classes and achieved accuracy above 95%.

Detection of Retinal Hemorrhage from fundus images using ANFIS classifier and MRG segmentation [2]

Journal: Biomedical Research

Methodology: In this paper ANFIS classifier and MRG segmentation are used for the detection of retinal hemorrhage from the fundus images. Retinal fundus images were apprehended with the help of a fundus camera. . With the fluoresce angiograms; ophthalmologists can perceive hemorrhages and microaneurysms. They have also developed a graphical user interface (GUI) model that establishes the classification and segmentation performance metrics.The projected hemorrhage detection procedure experiments in the working platform of MATLAB 2015a with the system configurations as an i5 processor with 4GB RAM and the assessment is done in respect of the classification and also the segmentation. Subsequently, in the segmentation, the performance evaluation is carried out in terms of sensitivity, specificity, accuracy and some performance parameters. The segmentation process they used attained 92.56% accuracy. The accuracy level attained in this paper has clearly demonstrated that the projected algorithm is decidedly efficient in perceiving the affected portions of the retinal image.

Diabetic retinopathy detection using machine learning [3]

Journal: International Journal of Engineering Research & Technology (IJERT)

Methodology: In this paper several classifiers in machine learning are used for diabetic retinopathy detection. In the proposed method they are implementing a hybrid classifier. That is they are using combination of five classifiers, Support vector machines, K nearest neighbors, Random forest. SVM classifier with kernel radial biasfunction and degree 3 is used. Training and testing set are prepared in ratio 80:20. In this proposed method hemorrhages, exudates and microaneurysms are detected. For exudate detection green channel extraction, masking, smoothing, bitwise AND are done which results in better calculation and extraction of exudates. For detection of hemorrhages and micro aneurysms, morphological operations are performed like opening. For diabetic retinopathy detection, count the number for MA occurred, count the number of hemorrhages occurred and count the number of exudates occurred in the image so as to decide the condition of image. Then features are calculated and feed to both SVM, KNN, Random Forest classifier. Voting of three classifiers are chosen as final prediction. In this paper, the overall accuracy attained is 82%. Out of 49 test samples 36 produced the correct output.

A deep learning system for detecting diabetic retinopathy across the disease spectrum [4]

Methodology: This paper used deep learning system for the detection of Diabetic Retinopathy. To facilitate the screening process, they developed a deep learning system, named DeepDR, that can detect early-to-late stages of diabetic retinopathy. DeepDR is trained for real-time image quality assessment, lesion detection and grading using 466,247 fundus images from 121,342 patients with diabetes. Evaluation is performed on a local dataset with

200,136 fundus images from 52,004 patients and three external datasets with a total of 209,322 images. Several deep learning algorithms with high specificity and sensitivity have been developed for the classification or detection of certain disease conditions based on medical images, including retinal images. Finally, they developed an automated, interpretable, and validated system that performs real-time image quality feedback, retinal lesion detection, and early- to late-stage DR grading. With those functions, DeepDR system is able to improve image collection quality, provide clinical reference, and facilitate DR screening.

Early detections of diabetic retinopathy based on deep learning and ultra-wide-field fundus images [5]

Methodology: In this paper, Resnet-34 model is used for the detection of Diabetic Retinopathy. The proposed DR detection system requires an automatic segmentation of the ETDRS 7SF to remove undesirable components such as eyelashes and skin. Using the segmented ROI image, they employ the deep learning architecture, the residual network with 34-layer (ResNet-34) model21 as a classifier for the DR detection task. To evaluate the DR detection performance, they compared their system with the one based on the ROI containing only the ETDRS Field 1 and Field 2 (F1–F2) in terms of several metrics. In this study, they configured a deep learning system for DR detection using the ETDRS 7SF image extracted from the UWF fundus image. Although the UWF imaging provides a widecaptured area, the far periphery of the retina in UWF images may contain eyelids and eyelashes. By segmenting the ETDRS 7SF from UWF photography, we can save the time and effort for capturing the ETDRS 7SF photography usinga single-field fundus camera. They attained an overall accuracy of 83%.

Examination of diabetes mellitus for early prediction automatic detection of exudates for diabetic retinopathy[6]

International Journal of nonnative Technology and ExploringEngineering (IJITEE)

Methodology: In this paper, the major objective of the proposed methodology and Hypothetical Research Survey Analysis for recognition of Exudates in diabetic retinopathy images for diverse categories of image considerations. It is constructed on studying texture insight competencies in fundus images to distinguish vigorous patients from DR images. The former discovery of diabetic retinopathy using state of art of image technologies will have several applications based on the hypothetical analysis survey in this paper. The strategy talked about where less human correspondence offering increment to amazingly sterile procedure and making the framework recognizable proof completely programmed. The study will be supported for the discovery & its pertinent constraints Wide-ranging collected works survey has been done in the hypothetical analysis in the domain of medical solicitations. In the reference of hypothetical analysis to give a vision into numerous AI models and its prognostic exactness in relations of the recital, accuracy improvement from 2.05% to 12.4% across various models.

Automatic Classification of Preliminary DiabeticRetinopathy Stages using CNN [7]

Journal: International Journal of Advanced Computer Scienceand Applications (IJACSA)

Methodology: This paper used Convolutional Neural Networks for detecting diabetic retinopathy. The approach mainly replaces the old-fashioned manual diagnosis of (DR), with a modern automated method. The aim of this proposed system is to be able to automatically detect and classify the various Diabetic Retinopathy stages using a "5-Stages" modelarchitecture, in which deep learning mainly depends on raw colored Retinal Fundus images as its source of input. The main goal of this software is to automatically detect the early stages of Diabetic Retinopathy and classify the level of the disease in the patient's body. Using a deep learning approach,the system will then detect whether a person suffers from Diabetic Retinopathy or not; based on the answer, the system will then classify the level of the disease and finally propose asolution to the patient. This research is additionally centered around distinguishing and immediately perceiving the characteristics and qualities of (DR) for ideal precision duringthe classification operation. The overall accuracy attained by this paper is 84%.

II. RESEARCH METHODLOGY

This research work is based on the diabetes retinopathy detection. The diabetes retinopathy detection has the various phases which are the image pre-processing, segmentation, feature extraction and classification. The phase of theproposed work is described below:-

1. Data Pre-Processing:- In this phase, the diabetes retinopathy image is taken for the detection. The input imagein the RGB format which need to convert into the gray scale format. The gray scale image is further processed forthe detection

Figure 1: Data Pre-processing Phase (a) Input Image

(b) Gray scale Image

Optical Disk Segmentation:- The OD is seen as a bright yellowish or white area within the colored fundus images. For the optic disc, high and similar intensity values are available for exudates. Thus, the removal of optic disc from the retinal image is very important. The region properties and area identification are used for masking and removing this brighter optic disc. The optic disc and blood vessels are detected by applying edge detection algorithm after preprocessing. The counter detection is performed using canny edge detection algorithm. All the local maxima known as the gradient is preserved for improving the blurrededges by the canny edge detection algorithm.

1.1. Blood Vassal Extraction: - This is due to the fact that their concentration levels are similar. The high levels of contrasts vessels present in the blood are removed by applying dilation on the intensity image. Further,

the dilation operation is used to fill the small holes present within the images along with the help of structuring element. There are different shapes in which structure elements (SE) exist. The optical disc and blood vessels are removed here using the flat disc shaped structure.

1.2. Classification: - The last phase is of classification which is applied with the NN (Neural networks). The NN approach is the unsupervised approach for the diabetes retinopathy detection.

III. CONCLUSION

In this paper, it is concluded that the retinal images are evaluated to diagnose the DR. It is however, time consuming and resource demanding to manually grade the images such that the severity of DR can be defined. When the tiny blood vessels present within the retina are damaged, only then can one notice this problem. Blood will flow from this tiny blood vessel and features are formed from the fluid that exists on retina. The diabetes retinopathy detection has the three phases which are pre-processing, feature extraction and classification. The NN classification approach is proposed in this research for the diabetes retinopathy

IV. REFERENCES

1. **Walter, T., Klein, J.-C., Massin, P., Erginay, A. 'A contribution of image processing to the diagnosis of diabetic retinopathy — detection of exudates in color fundus images of the human retina.' IEEE Trans. Med. Imaging 21 (10) (2002): 1236–1243**
2. **Xiaohui, Z., Chutatape, A. 'Detection and classification of bright lesions in color fundus images.' In Proceedings of the International Conference on Image processing (ICIP 04), 2004, vol. 1, pp. 139–142**
3. **Varun Gulshan, Subhashini Venugopalan and Rajiv Raman, "Development and Validation of a Deep Learning Algorithm for Detection of Diabetic Retinopathy in Retinal Fundus Photographs", JAMA, vol. 316, no. 22,2016, pp. 2402-2410.**

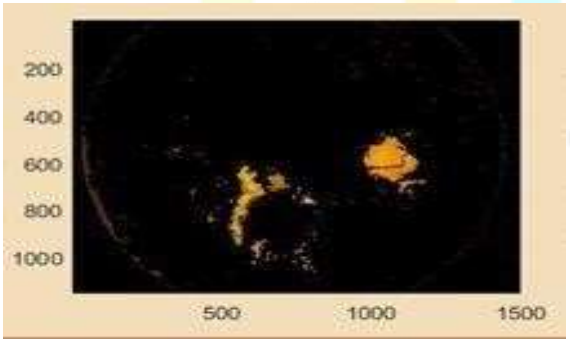

Figure 2:Optical Disk Segmentation

As shown in figure 2, the optical disk technique is applied which can segment the input image. The segmentation technique will segment the highlighted part of the image detection.

The proposed model is compared with the SVM classification model and it is analyzed that results are optimized up to 5 percent with the use of NN.

4. **Osareh, B. Shadgar, and R. Markham, "A computational-intelligencebased approach for detection of exudates in diabetic retinopathy images," IEEE Trans. Inf. Technol.., 13(4): pp. 535–545 (2009).**
5. **L. Math and R. Fatima, "Adaptive machine learning classification for diabetic retinopathy", Multimedia Tools Appl., vol. 80,Oct. 2020,pp.51735186.**
6. **U. Morphological, E. Detection, A. Aquino, M. E. Gegu´ndez-arias, and Dr. Mar´ın, "Detecting the Optic Disc Boundary in Digital Fundus Feature Extraction Techniques," 29(11): pp. 1860–1869 (2010).**
7. **R.GargeyaandT.Leng,"Automated identification of diabetic retinopathy using deep learning," Ophthalmology, vol. 124, no. 7, pp. 962–969, 2017.**
8. **L. W. Yun, U. R. Acharya, Y. V. Venkatesh, C. Chee, L.C. Min and E.Y.K. Ng, "Identification of different stages of diabetic retinopathy using retinal optical images", Information Sciences, vol. 178, 2008, pp. 106-121.**
9. **Tang L, Niemeijer M, Reinhardt J, Garvin MK, AbramoffM. "Splat feature classification with application to retinal hemorrhage detection in fundus Images". IEEE TransactMed Imag 2013;32: 364-375.**
10. **Hatanaka Y, Nakagawa T, Hayashi Y, Hara T, Fujita H, "Improvement of automated detection method of hemorrhages in fundus Images", J MedImaging 2008; 978:5429-5432.**
11. **N. Patton, T. M. Aslamc, M. MacGillivrayd, I. J. Dearye, B. Dhillonb, R. H. Eikelboomf, et al., "Retinal image analysis: Concepts applications and potential", Retinal and Eye Research, vol. 25, 2006,pp. 99-127.**
12. **Sudha, K. Priyanka, T. Suvathi Kannathal, S. Monisha, "Diabetic Retinopathy Detection", International Journal of Engineering and Advanced Technology (IJEAT), vol. 9, 2020.**
13. **Godlin Atlas L, Kumar Parasuraman, "Detection of retinal hemorrhage from fundus images using ANFIS classifier and MRG segmentation", Biomedical Research, vol. 29, 2018,pp. 1489-1497.**
14. **Dilip Singh Sisodia, Shruti Nair and Pooja Khobragade, "Diabetic Retinal Fundus Images: Preprocessing and Feature Extraction For Early Detection of Diabetic Retinopathy", Biomedical &Pharmacology Journal, vol. 10, 2017,pp. 615-626**
15. **Revathy R, Nithya B S, Reshma J J,Ragendhu SS, Sumithra M D, "Diabetic Retinopathy Detection using Machine Learning", International Journal of Engineering Research & Technology (IJERT), vol. 9, 2020.**

16. **Ling Dai, Liang Wu, Huating Li, Chun Ca, Qiang Wu, Hongyu Kong , Ruhan Liu, Xiangning Wang, Xuhong Hou, Yuexing Liu, Xiaoxue Long, Yang Wen, Lina Lu, Yaxin Shen, Yan Chen, Dinggang Shen, "A deep learning system for detecting diabetic retinopathy across the disease spectrum", Nature Communications,vol. 12, 2021.**

17. **Kangrok Oh, Hae Min Kang, Dawoon Leem, Hyungyu Lee, KyoungYul Seo & SangchulYoon, "Early detection of diabetic retinopathy based on deep learning and ultra-wide-feld fundus images", scientific reports,vol. 11,2021.**

18. **Lubna Taranum M P, Rajashekar J S, "Examination of Diabetes Mellitus for Early Prediction and Automatic Detection of Exudates for Diabetic Retinopathy", International Journal of Innovative Technology and Exploring Engineering (IJITEE), vol. 9, 2019.**

19. **Omar Khaled, Mahmoud ElSahhar, Mohamed Alaa El-Dine, Youssef Talaat, Yomna M. I. Hassan,Alaa Hamdy, "Automatic Classification of Preliminary Diabetic Retinopathy Stages using CNN", (IJACSA) International Journal of Advanced Computer Science and Applications, vol. 12, 2021.**