International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 09 Issue: 05 | May 2022 www.irjet.net p-ISSN: 2395-0072

# A REVIEW PAPER ON THE DETECTION OF DIABETIC RETINOPATHY

**Revathy A[1], Hema S[2]**

*[1]PG Student Dept of Electronics & communication Engineering LBSITW, Kerala, India*
*[2]Assistant Professor, Dept of Electronics & Communication Engineering, LBSITW, Kerala, India*

---***---

**Abstract -** *Diabetic retinopathy (DR) is a major issue in the medical field. DR can damage the blood vessels in the tissue at the retina. In severe cases, DR leads to vision loss. Early detection is very important in the case of diabetic retinopathy but it is a major challenge in the medical field. The two types of DR are non-proliferative diabetic retinopathy (NPDR) and proliferative diabetic retinopathy (PDR). Blurred vision, sudden vision and flashes are the main symptoms of DR. This paper focuses on the different techniques used in the detection of diabetic retinopathy. Automated detection help to detect diabetic retinopathy easily compared to manual detection.*

***Key Words*: Non-proliferative diabetic retinopathy, Proliferative diabetic retinopathy**

## 1. INTRODUCTION

Diabetic retinopathy (DR) is a retinal disease caused due to the excess sugar level in the blood. In severe cases, it may lead to sudden vision loss. So early detection and treatment are very important in the case of diabetic retinopathy. According to the WHO, there are 31.7 million people affected by diabetes in India and it is expected to rise to 79.4 million by 2.30. National Diabetes and diabetic retinopathy survey - 2019, says that the prevalence of diabetes is 11.8% in the last four years from 2015 to 2019 [1]. When detecting diabetic retinopathy in a clinal way requires more time and effort. But when choosing the automated detection of diabetic retinopathy it is less time consuming compared to the clinical method. The main symptoms of DR are blurred vision, floaters and flashes and vision loss. Blood vessels, optic disc and macula are the main components of a healthy retina any changes in these components occur in eye disease. Diabetic retinopathy has two stages non-proliferative diabetic retinopathy (NPDR) and proliferative diabetic retinopathy (PDR).Microaneurysms(Mas), hemorrhage (H), hard exudates (HE) and soft exudates are the different signs of NPDR. According to the presence and quantity of these lesions, NPDR is again classified into mild, moderate and severe. The microaneurysm is considered the early stage of DR. These appear as tiny red dots. The next stage of DR is hemorrhages. Dot hemorrhages are the bright red dot and the blot hemorrhages are larger blood lesions. Hemorrhages lead to blurred vision. Exudates are considered the third stage of the DR. The leakage of lipids and proteins from damaged blood is called exudates. Depending on their edge, energy and threshold exudates are classified into hard and soft. Hard exudates appeared as bright yellow colour and soft exudates are the severe stage of exudates appear as grey-white colour. It is also referred to as a cotton wool spot. In the case of diabetic retinopathy, early detection is very important. Analysing the fundus image manually is a difficult task, so choosing automated detection is better than manual detection.

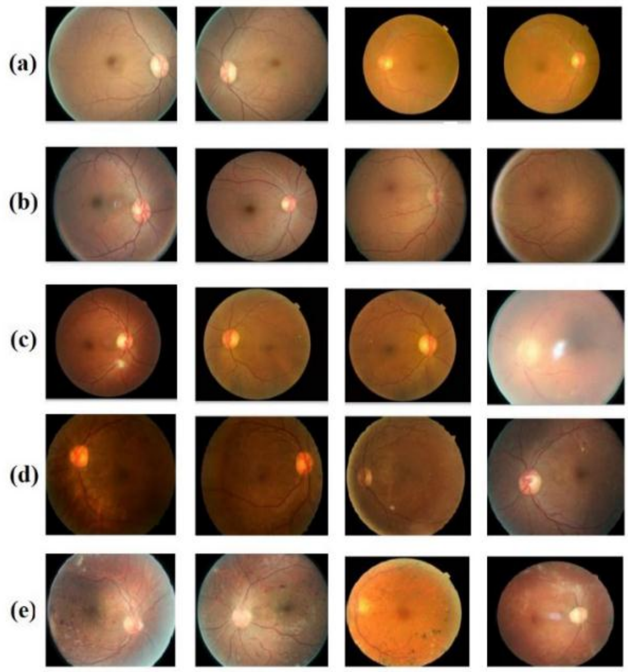


Fig 1: Different stages of diabetic retinopathy [2] : (a) Normal; (b) Mild; (c) Moderate; (d) Severe; (e) PDR

**Table 1**: Features different types diabetic retinopathy [3]

| Existence of standard features | Types of DR |
|---|---|
| The new blood vessels formation with all the retinal abnormalities | PDR |
| Retinal abnormal features in four quadrants | Severe NPDR |
| Numerous signs of Hemorrhages, Exudates, and Microaneurysms | Moderate NPDR |
| Signs of Microaneurysms | Mild NPDR |

## 2. REVIEW OF DIFFERENT PAPERS

K.Shankar et al. [2] propose a model named Hyperparameter Tuning Inception-v4 (HPTI-v4) for the detection and classification of diabetic retinopathy. Here in the preprocessing stage, the contrast level of the image increased with help of the contrast limited adaptive histogram equalization (CLAE) model. Histogram based segmentation is used for the segmentation of preprocessed images. Here the hyperparameter optimization is done with help of Bayesian optimization. The hyperparameter chosen is an epoch, learning rate and momentum. The multilayer perceptron (MLP) is used for the classification. This method gives better accuracy. Here the accuracy is 99.49%, sensitivity is 98.83% and specificity is 99.68%. This method can be improved by adding the classification model

P. Saranya et al. [1] introduce an automated system for detecting non-proliferative diabetic retinopathy using a convolutional neural network. Here two datasets used are MESSIDOR and IDRiD. First, the upsample and downsample the for the balance of the data for avoiding the bias. For avoiding misleading results optic disc removal is also done. Then the image is preprocessed to obtain a better result. The preprocessing involves the four steps Canny edge detection, resizing, interpolation and normalization. The convolutional neural network (CNN) is used for the classification of different levels of diabetic retinopathy. The accuracy of the MESSIDOR dataset is 96.3% and IDRiD is 90.29%. To improve the accuracy of the model VGG16, Inception V3 can be used to train diabetic retinopathy.

D. K. Prasad etal [4] propose a morphological operation and segmentation process for detecting blood vessels, exudates and microaneurysms. In pre-processing contrast, enhancement is done with help of histogram equalisation and for better performance, cany edge detection is for detecting edges. Morphological operation threshold-based segmentation process used for the extracting blood vessels, exudates and microaneurysms. For selecting appropriate features Haar wavelet transform and principal component analysis (PCA) are used. One Rule and Backpropagation neural network (BPNN) classifier are used for the classification of diabetic retinopathy. The accuracy of the One Rule classifier is 97.75% and BPNN is 93.8%. In future for identify the severity of the multistage classification can be implemented in this model.

K.Shankar et al. [5] developed an automated detection and classification of fundus diabetic retinopathy images using a synergic deep learning model. Here preprocessing is used for removing unwanted noise on the edges. After the preprocessing segmentation is done with the help of histogram equalization. This process helps to extract useful regions from the image. The Synergic deep learning (SDL) model is used for the classification of the image. The performance parameter obtained in the model are accuracy is 99.28, sensitivity is 98.54 and specificity is 99.38. The model can be improved by adding filters before processing and adding AlexNet and the inception technique for hyperparameter tuning.

Abhishek Samanta et al. [6] propose Automated detection of diabetic retinopathy using convolutional neural networks on a small dataset. Here in preprocessing stage contrast limited adaptive histogram equalisation (CLAHE) is used to enhance the image.DenseNet121 was used for the classification. Because of the skewness of the data accuracy is not used here. So here use Cohen's Kappa(k). It is the relative accuracy concerning the nearby classes. The kappa score is 0.8836 for validation data and 0.9809 for training data. In this model F1 score for the mild DR is 0.64 and 0.74 for the moderate DR. In this model to get a more effective result semantic segmentation can be used.

C. Harshitha et al. [7] develop a system for predicting different stages of diabetic retinopathy using deep learning. The dataset contains the images in a different dimension. So it converts into 256X256. CNN model is used for the prediction. Accuracy is 73% for the 15 epochs and 79% for 50 epochs. The better accuracy of 86% occurs when a limited number of neurons is used.

Juan wang et al. [8] propose a simultaneous diagnosis of severity and features of diabetic retinopathy using deep learning. for diagnosing DR severity and DR related feature in the fundus image here use a hierarchical multi-task deep learning framework. It contains one backbone and heads. Squeeze-and-excitation (SE) network is the backbone. It is used for extracting features of the image. The heads are two independent forward neural networks, one for the detection of related features and the other for the severity diagnosis process. This model is analysed based on Cohen's kappa coefficient and ROC curve. The limitation of this model is it contains only a 2% mild NPDR image for training. In future, it can be improved by adding more mild NPDR images in the dataset.

Lam C et al. [9] propose automated detection of diabetic retinopathy using deep learning. In preprocessing stage contrast enhancement is done by using CLAHE. The data augmentation process help to reduce overfitting. A deep learning GPU training system (DIGITS) with prebuilt convolutional neural networks for the image classification. Transfer learning-based approaches used with pre-trained AlexNet and GoogLeNet architecture from ImageNet. For improving the model detection mild disease can be added in future.

García Gabriel et al. [10] propose the detection of diabetic retinopathy based on a convolutional neural network. In preprocessing stage image is rescaled into 256X256.Detection of exudates, microaneurysm and hemorrhages based on CNN architecture.VGG16noFC$_2$ gives better performance with accuracy. In future, the model is improved by the fusion of two networks using a fully connected layer.

## 3. CONCLUSIONS

The early detection of diabetic retinopathy is one of the challenging problems in the medical field. But early detection is very important in the case of diabetes. In severe cases, diabetic retinopathy leads to vision loss. The microaneurysm is the early sign of diabetic retinopathy. When compared to manual detection , automatic detection of diabetic retinopathy is superior and takes less time. Automatic detection is less expensive. This paper presents a different technique for the detection of diabetic retinopathy.

## REFERENCES

[1] Saranya, P., Prabakaran, S. Automatic detection of non-proliferative diabetic retinopathy in retinal fundus images using convolution neural network. *J Ambient Intell Human Comput* (2020). https://doi.org/10.1007/s12652-020-02518-6

[2] K. Shankar, Y. Zhang, Y. Liu, L. Wu and C. -H. Chen, "Hyperparameter Tuning Deep Learning for Diabetic Retinopathy Fundus Image Classification," in IEEE Access, vol. 8, pp. 118164-118173, 2020, doi: 10.1109/ACCESS.2020.3005152.

[3] M. I. Razzak, S. Naz, and A. Zaib, "Deep learning for medical image processing: Overview, challenges and the future," in Classification in BioApps. Springer, 2018, pp. 323–350.

[4] D. K. Prasad, L. Vibha and K. R. Venugopal, "Early detection of diabetic retinopathy from digital retinal fundus images," 2015 IEEE Recent Advances in Intelligent Computational Systems (RAICS), 2015, pp. 240-245, doi: 10.1109/RAICS.2015.7488421.

[5] K. Shankar, Abdul Rahaman Wahab Sait, Deepak Gupta, S.K. Lakshmanaprabu, Ashish Khanna, Hari Mohan Pandey, Automated detection and classification of fundus diabetic retinopathy images using synergic deep learning model, Pattern Recognition Letters Volume 133, 2020, Pages 210-216,ISSN0167-8655, https://doi.org/10.1016/j.patrec.2020.02.026.

[6] Abhishek Samanta, Aheli Saha, Suresh Chandra Satapathy, Steven Lawrence Fernandes, Yu-Dong Zhang,Automated detection of diabetic retinopathy using convolutional neural networks on a small dataset,PatternRecognition Letters,Volume 135, 2020, Pages 293-298, ISSN0167-8655, https://doi.org/10.1016/j.patrec.2020.04.026.

[7] C. Harshitha, A. Asha, J. L. S. Pushkala, R. N. S. Anogini and K. C, "Predicting the Stages of Diabetic Retinopathy using Deep Learning," 2021 6th International Conference on Inventive Computation Technologies (ICICT), 2021, pp. 1-6, doi: 10.1109/ICICT50816.2021.9358801.

[8] J. Wang, Y. Bai and B. Xia, "Simultaneous Diagnosis of Severity and Features of Diabetic Retinopathy in Fundus Photography Using Deep Learning," in IEEE Journal of Biomedical and Health Informatics, vol. 24, no. 12, pp. 3397-3407, Dec. 2020,

doi: 10.1109/JBHI.2020.3012547.

[9] Lam C, Yi D, Guo M, Lindsey T. Automated Detection of Diabetic Retinopathy using Deep Learning. *AMIA Jt Summits Transl Sci Proc*. 2018;2017:147-155. Published 2018 May 18.

[10] García Gabriel, Jhair Gallardo, Antoni Mauricio, Jorge López, and Christian Del Carpio. "Detection of diabetic retinopathy based on a convolutional neural network using retinal fundus images." In *International Conference on Artificial Neural Networks*, pp. 635-642. Springer, Cham, 2017.

## BIOGRAPHIES

Revathy A is a student . Currently pursuing M.Tech in (Signal processing) at LBS Institute of Technology for Women, Poojappura, APJ Abdul Kalam Technological University , Trivandrum Kerala

Prof. Hema S , ( Electronics and communication) Assistant Professor at LBS Institute of Technology for women Poojappura, APJ Abdul Kalam Technological University, Trivandrum, Kerala