IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 1, January 2026
Impact Factor: 7.67

Diabetic Retinopathy Detection

Charmi S[1], Harshitha K S[2], Lekhana G[3], Manasvi B S[4], Yathish Aradhya B C[5]
[1,2,3,4]B.E. Scholars, Department of Computer Science and Engineering
[5]Professor, Department of Computer Science and Engineering
Kalpataru Institute of Technology, Tiptur, Karnataka, India

Abstract: *"Diabetic retinopathy is a major complication of diabetes and a leading cause of preventable vision loss. It is caused by prolonged high blood sugar, which damages the retina's blood vessels. This damage leads to fluid leakage and retinal swelling. In its early stages, the condition often because its initial stages often present no warning signs, routine eye screenings are vital. If the condition remains untreated, it can advance to more severe, vision-threatening complications. These changes pose a high risk of permanent blindness. Due to the growing prevalence of diabetes, early detection through systematic screening is a critical public health priority. Timely identification allows for interventions and management strategies that can effectively prevent severe vision loss.".*

Keywords: Deep Learning, CNN, Daibetic Retinopathy, Medical data analysis

I. INTRODUCTION

Diabetic retinopathy, a serious microvascular consequence of diabetes, poses a substantial worldwide health burden, severely impacting an individual's vision and their broader physical and mental health. Epidemiological studies reveal that roughly a third of the over 460 million people globally with diabetes develop this condition. The disease progresses as prolonged high blood sugar damages the retina's delicate blood vessels, a process that can result in visual disability and permanent blindness without timely diagnosis and care.

Traditional diagnosis relies on trained ophthalmologists manually inspecting retinal fundus images, a process that creates significant inefficiencies in healthcare systems. This reliance presents numerous obstacles to widespread screening, such as the uneven geographical distribution of specialists, high costs, and slow diagnosis and treatment timelines. These issues are especially more often in remote and low-resource settings with few eye specialists, leading to poor screening rates and avoidable vision impairment for many diabetic patients.

Advancements in artificial intelligence, mainly deep learning, are opening new paths for transforming how medical images are analyzed and diagnosed. CNN model, have proven highly effective at interpreting intricate visual information, often matching the accuracy of human proficient in reading medical images. This progress offers a practical path toward automating disease detection and addressing the shortcomings of conventional screening.

Although numerous studies have investigated computer-aided diagnostic systems for diabetic retinopathy, their real-world readiness varies. While prior research confirms the basic viability of automated detection, ongoing hurdles include ensuring models perform consistently across diverse populations and medical equipment, optimizing computational demands, and integrating solutions into varied clinical workflows. This underscores the necessity for more resilient and flexible systems. Our study seeks to construct and rigorously evaluate a dedicated deep learning framework for the automated identification of diabetic retinopathy(DR) from retinal images. The approach involves a systematic process that includes advanced image preprocessing, strategic data augmentation techniques, and a clear CNN architecture. The goal is to build a reliable binary classification tool that differentiates healthy retinal tissue from tissue showing signs of diabetic retinopathy, with a strong focus on practical clinical use.

II. LITERATURE SURVEY

Diabetic Retinopathy (DR) is a diabetes-induced retinal disorder and a major cause of vision loss, necessitating early and accurate detection. Initial automated DR detection methods employed handcrafted feature extraction with classical classifiers such as Support Vector Machines, which suffered from limited scalability and robustness . The introduction

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 1, January 2026
Impact Factor: 7.67

of Convolutional Neural Networks (CNNs) significantly improved DR detection by enabling end-to-end learning from fundus images . CNN-based approaches demonstrated effective DR stage classification and lesion detection, including exudates, with higher accuracy than traditional techniques.

Transfer learning was adopted to overcome limited labeled datasets and reduce training complexity, resulting in improved generalization. Compact and modified CNN architectures were proposed to enhance performance and support deployment in resource-constrained environments. Hybrid deep learning models combining CNNs with recurrent networks further improved diagnostic capability by capturing spatial and contextual information. Several studies validated the effectiveness of deep CNNs on large retinal datasets for reliable DR diagnosis. Survey and comparative studies emphasized the superiority of deep learning methods while identifying challenges such as class imbalance and computational cost .

Despite high accuracy, CNN training on large-scale medical image datasets remains computationally expensive. To address this limitation, Yathish Aradhya B. C. and Gowramma [1] proposed a progressive sampling algorithm based on Rademacher averages. The algorithm incrementally increases training data size until optimal learning performance is achieved. This approach significantly reduces computational overhead while maintaining model accuracy. Progressive sampling is particularly suitable for large-scale data-intensive applications. Integrating progressive sampling with CNN-based DR detection offers a scalable and efficient solution for real-world automated screening systems.

III. METHODOLOGY

This Jupyter notebook details the development of a deep learning system designed to automate the detection of Diabetic Retinopathy, a serious eye condition associated with diabetes. The project's core objective is to create a CNNs capable of classifying retinal images into two distinct categories: those showing signs of the disease and those that are normal. This binary classification task represents a practical application of artificial intelligence aimed at assisting in early medical diagnosis.

The workflow follows a complete and structured machine learning pipeline, beginning with data acquisition and preprocessing. The initial dataset, containing 3,662 retinal images, undergoes a crucial preparation phase where each image is center-cropped to a square and change size to a uniform 150x150 pixel resolution. This standardization ensures consistency for the model. The data is then strategically split into training, validation, and test sets, which is essential for training the model on one group of data, tuning it on another, and providing an unbiased evaluation of its final performance on a third, unseen set. To enhance the model's strongness and ability to generalize, the project employs data augmentation techniques during training. This involves artificially expanding the training dataset by creating improved versions of the images through rotations, zooms, and shifts. The goal of the project is a custom-built sequential CNN model.

This architecture uses a series of convolutional and pooling layers to gradedly extract features from the images are then passed through fully connected layers with dropout regularization to stop overfitting. The model undergoes training over 20 epochs, with mechanisms in place to save the best- performing version and halt training if progress plateaus. The results from this process are highly promising. The model illustrates a strong learning capability, achieving a validation accuracy of nearly 91.8%, indicating that it can correctly identify diabetic retinopathy in the vast majority of cases it was tested on. The accompanying loss and accuracy graphs confirm that the model learned effectively without succumbing to significant overfitting. In conclusion, this notebook successfully demonstrates a standard and effective deep-learning approach for medical image analysis, resulting in a robust prototype that could serve as a foundation for future diagnostic tools.

IV. DATASET DECSRIPTION

The dataset used in this study consists of retinal fundus images curated from the Kaggle Diabetic Retinopathy dataset, which was organized into three subsets: training, validation, and testing. Each subset contained two categories corresponding to binary classification:

0 — No Diabetic Retinopathy

1 — Diabetic Retinopathy Present

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 1, January 2026
Impact Factor: 7.67

Preprocessing: To standardize the input images and increase dataset variability, extensive preprocessing and augmentation techniques were applied using Keras' ImageDataGenerator.

Rescaling: All images were normalized by dividing pixel values by 255: norm=I/200 This ensured all values fell within[0,1], improving training stability Image resizing: Every image was resized to 150 × 150 pixels, as required by the CNN model. This reduced computational complexity while preserving essential diagnostic features.

Data Augmentation: The training images underwent aggressive augmentation including rotation (15°), horizontal flipping, zoom (0.2), width and height shifts (0.1), and shear distortion (0.1). These transformations improved the robustness of the model and reduced overfitting. Validation and Test Preprocessing: Only rescaling (1/255) was applied to the validation and test images, without augmentation, ensuring true, unbiased evaluation.

V. RESULTS

The above model is giving the accuracy of about 91.8% percent for 2 class classification.The snapshots of results are as follows:

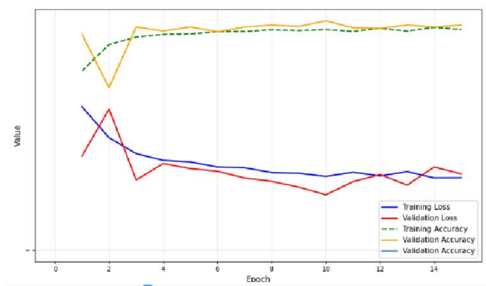

Fig1: Training and validation loss and accuracy

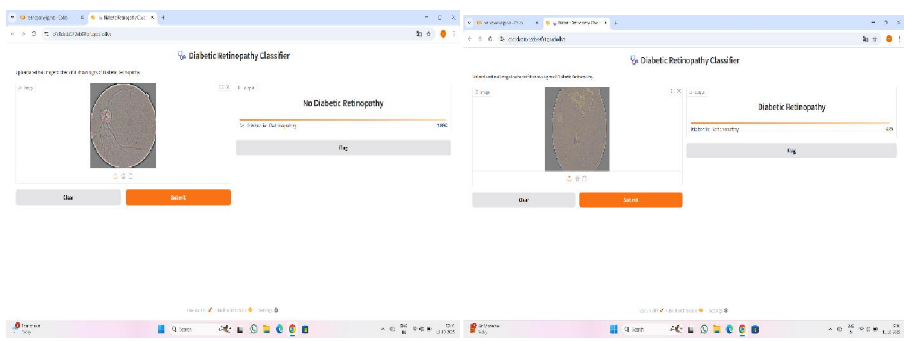

Fig 2: Results

VI. CONCLUSION

Diabetic retinopathy remains a major concern in diabetic eye care, and AI-based screening offers a strong pathway for earlier and more reliable detection. By combining different medical data sources with advanced deep learning methods, future systems can provide more accurate assessments of retinal changes. The development of lightweight models that run on portable devices can also improve screening accessibility, especially in underserved regions. Enhancing the interpretability of AI outputs will be essential for gaining clinician trust, while personalized prediction tools can help forecast disease progression and guide targeted follow-up. Overall, continuous improvements in AI, paired with better access and clinical integration, have the potential to significantly strengthen DR detection and reduce preventable vision loss.

IJARSCT

International Journal of Advanced Research in Science, Communication and Technology

International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal

ISSN: 2581-9429

Volume 6, Issue 1, January 2026

Impact Factor: 7.67

REFERENCES

[1] Y. A. B. C. and Y. P. Gowramma, “Progressive sampling algorithm with Rademacher averages for optimized learning of big data: A novel approach,” International Journal of Computer Applications, vol. 175, no. 15, pp. 37–40, 2020.

[2] Sharma, Hare Shyam and Singh, Ajit and Chandel, Amit Singh and Singh, Pravendra and Sapkal, Prof. Ashwini, Detection of Diabetic Retinopathy Using Convolutional Neural Network (May 17, 2019). Proceedings of International Conference on Communication and Information Processing (ICCIP) 2019, Available at SSRN: https://ssrn.com/abstract=3419210 or http://dx.doi.org/10.2139/ssrn.3419210

[3] aeri, M., Manwal, M., & Gupta, S. (n.d.). ―Analysis Of Various Diabetic Retinopathy Detection Techniques‖ (2020).

[4] Ramaiyan, P., Abinaya, * K, Meenalaxmi, P. S., Vignesh, T. A., Kuralamuthan, D., & Students, # R Poonguzhali. ―DETECTION AND CLASSIFICATION OF DIABETIC RETINOPATHY USING MACHINE LEARNING-A SURVEY Internet of Things View project Machine Learning View project DETECTION AND CLASSIFICATION OF DIABETIC RETINOPATHY USING MACHINE LEARNING-A SURVEY‖ (2020).

[5] Shyam Sharma, H., Singh, A., Singh Chandel, A., Singh, P., &Sapkal, A. (2019). ―International Conference on Communication and Information Processing Detection of Diabetic Retinopathy using Convolutional Neural Network‖. https://ssrn.com/abstract=3419210

[6]https://ujjwalkarn.me/2016/08/11/intuitive-explanation convnets/?fbclid=IwAR0S2Lw6ntGyl3KxyPYZQBnCQRHT5 0t5GQG6OV NEpy5MXcC0s11LY kDUzY.

[7]https://en.wikipedia.org/wiki/Rectifier(neuralnetworks)

[8] Zheng, Zejia, Zhu Li, and Abhishek Nagar. ”Compact Deep Neural Networks for Device-Based Image Classification.” Mobile Cloud Visual Media Computing. Springer, Cham, 2015. 201-217.

[9] Carrera, Enrique V., Andrs Gonzlez, and Ricardo Carrera. ”Automated detection of diabetic retinopathy using SVM.” 2017 IEEE XXIV International Conference on Electronics, Electrical Engineering and Computing (INTERCON). IEEE, 2017.

[10]Roy, Arisha, et al. ”Filter and fuzzy c means based feature extraction and classification of diabetic retinopathy using support vector machines.” 2017 International Conference on Communication and Signal Processing (ICCSP). IEEE, 2017.

[11] "Image classification using deep convolutional neural networks to diagnose diabetic retinopathy," Wan, Shaohua, Yan Liang, and Yin Zhang. 274-282 in Computers and Electrical Engineering 72 (2018).

[12] R. Amalia, A. Bustamam, and D. Sarwinda. "Detection and description creation of diabetic retinopathy using convolutional neural network and long short-term memory." Journal of Physics: Conference Series, Vol. 1722, No. 1, IOP Publishing, 2021.

[13] "Diabetic Retinopathy Detection Using Convolutional Neural Network—A Study," Wahid, Farha Fatina, and G. Raju. Data Science and Security (2021): 127-133.

[14] Khan, Sharzil Haris, Zeeshan Abbas, and SM Danish Rizvi are among the participants. "Diabetic retinopathy picture classification using modified CNN architecture." 2019 Amity International Artificial Intelligence Conference (AICAI). 2019 IEEE.

[15] "Detection of diabetic retinopathy using deep convolutional neural networks," Darshit Doshi et al. Las Vegas, Nevada hosted the 2016 International Conference on Computing, Analytics, and Security Trends. (CAST). The IEEE, 2016.

[16] Khan, Sharzil Haris, Zeeshan Abbas, and SM Danish Rizvi are among the participants. "Diabetic retinopathy picture classification using modified CNN architecture." 2019 Amity International Artificial Intelligence Conference (AICAI). 2019 IEEE.

DOI: 10.48175/IJARSCT-30762