



e-ISSN: 2319-8753 | p-ISSN: 2347-6710

IJRSET

International Journal of Innovative Research in
SCIENCE | ENGINEERING | TECHNOLOGY

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 12, Issue 5, May 2023

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 8.423

9940 572 462

6381 907 438

ijirset@gmail.com

www.ijirset.com

Detection of Diabetic Retinopathy Using CNN

Dr. Gopalakrishna K¹, Sankalp Jain², Singh Anuj Chandrajeet³, Harsha P⁴, Rahul Yalavatti⁵

Professor, Department of Electronics and Communication Engineering, Jain University, Bangalore, Karnataka, India¹

U.G. Students, Department of Electronics and Communication Engineering, Jain University, Bangalore, Karnataka, India²⁻⁵

ABSTRACT:Diabetes Mellitus (DM) is a chronic condition characterized by elevated blood sugar levels and potential complications like heart disease, kidney failure, vision loss, and limb amputations. Efficient management and monitoring are vital to minimize pregnancy complications and long-term health risks. This study proposes a machine learning-based predictive model for identifying diabetic retinopathy by employing data mining techniques. Deep Convolutional Neural Networks (CNNs) are utilized to extract features from fundus images, specifically focusing on microaneurysms. By enhancing the accuracy of the CNN model through feature extraction, precise diagnosis of diabetes can be achieved using pre-processed images. This approach enables early detection and timely intervention, leading to improved patient outcomes and reduced healthcare costs.

KEYWORDS:Diabetes Mellitus, Deep Convolutional Neural Network.

I. INTRODUCTION

Diabetes Mellitus is a rapidly growing disease that affects people of all ages, including young individuals. As a college student, it's important to understand how the body normally functions without this disease in order to comprehend the development and progression of diabetes.

Our bodies obtain sugar or glucose primarily from carbohydrate foods like bread, pasta, rice, fruits, starchy vegetables, and dairy products. Glucose is produced during the breakdown of these foods and is then transported through the bloodstream to provide energy to cells and the brain. Insulin, a hormone produced by beta cells in the pancreas, plays a crucial role in this process. It acts as a key that unlocks the doors of cells, allowing glucose to enter and provide energy to the body.

However, in the case of diabetes, there are two main problems. First, there may be insufficient production of insulin by the pancreas. Second, the body may become resistant to the effects of insulin, resulting in ineffective utilization of insulin. These issues lead to a build-up of glucose in the bloodstream, which is known as hyperglycaemia. This accumulation of high blood sugar levels is what causes the development of diabetes mellitus. Figure 1 differentiates between Healthy and Diabetic eye.

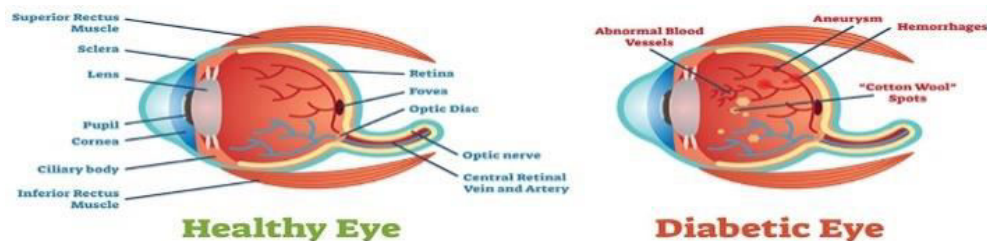


Fig. 1. Healthy and Diabetic eye
Source: Retina Specialists Of Michigan

Without proper management, diabetes can lead to various long-term health issues. These include heart disease, kidney failure, nerve damage, and vision loss. It is crucial to effectively manage diabetes through proper diet, exercise, medication, and regular monitoring of blood sugar levels to prevent these complications.



II. RELATED WORK

In research paper [1], it emphasizes the importance of pre-processing techniques to enhance image features and reduce distortions, enabling better segmentation of the region of interest. Pre-processing, particularly using the HE technique, plays a crucial role in achieving superior results compared to the original image. Data augmentation methods such as cropping, padding, zooming, rolling, and flipping are employed to train large neural networks, effectively increasing the diversity of available data. Clustering, a machine learning algorithm, is used to partition datasets into subsets, ensuring that information within a cluster is related to each other but distinct from elements in other clusters. The recognition rate of RF (Random Forest) reaches 96.62%, demonstrating a strong and consistent performance compared to SVM (Support Vector Machine).

In research paper [2], a deep learning algorithm was utilized to detect referable diabetic retinopathy (rDR) in retinal fundus photographs. The algorithm was trained and validated using 118,419 fundus images obtained from EyePACS. Two separate datasets were used for validation (9963 images in the first and 1748 in the second). The algorithm exhibited a sensitivity of 90.3% and 87% respectively and a specificity of 98.1% and 98.5% for detecting diabetic retinopathy.

In research paper [3], various Machine Learning techniques were utilized. Feature Transformation (FT) methods like Robust Scaler, Standard Scaler, and Min-Max Scaler were employed, along with Extra Trees (ET) and Feature Selection Techniques (FST's). High-quality datasets were prepared using these techniques. Six classifiers (ET, RF, DT, LR, GNB, and KNN) were applied to select the best transformed dataset. ET performed the best on the Z-Score transformed dataset, achieving an accuracy of 99.06%, ROC AUC of 99.97%, F1-score of 98.53%, precision of 98.77%, and recall of 99.02%.

In research paper [4], a computationally efficient deep learning CNN based on DenseNet-121 architecture was employed, utilizing transfer learning. The DenseNet-121 model was trained using Kaggle's training data, achieving an accuracy of 98.49% and a loss of 0.0417 after 25 epochs for the training set. The validation accuracy for the validation data reached 95.64% with a loss of 0.1563.

In research paper [5], the authors investigated the data using seven machine learning algorithms, including k Nearest Neighbours, Support Vector Machines, Decision Trees, Random Forest, Gradient Boosting, Neural Network, and Naive Bayes. They employed an Ensemble model.

Classifier - Performance	Practice Fusion	Pima Indians
Accuracy	86.0%	<u>89.1%</u>
Precision	24.2%	<u>76.9%</u>
Negative Prediction	<u>99.2%</u>	95.8%
Sensitivity	88.4%	<u>90.9%</u>
Specificity	84.7%	<u>88.4%</u>
F1-Score	38.0%	<u>83.3%</u>

Table 1 – Results from research paper [5]

Compared to previous works on the Pima Indians dataset with an accuracy below 80%, their Ensemble model achieved an accuracy of 89% for the same dataset, as shown in Table 1. Additionally, their Ensemble model achieved an accuracy of 85% on Practice Fusion, demonstrating the novelty of their approach in this domain.

III. METHODOLOGY

In order to improve the accuracy of diabetes detection, a machine learning technique is being utilized that involves a pre-existing classification model. This model combines classification and clustering methods using Deep Convolutional Neural Network algorithms. The dataset used for this purpose is sourced from the Kaggle repository and focuses on predicting the presence of diabetes based on specific diagnostic measurements. To ensure the dataset's reliability and diversity, specific criteria were established to select instances from a larger database. The algorithm is trained using supervised learning techniques, where the dataset is divided into three sets: train, test, and val. These sets include both input data and corresponding desired output. This enables the CNN model to learn from the data and

generate accurate predictions for new cases when fed into the predictive model. As a college student, understanding and applying these techniques can contribute to advancements in healthcare and disease detection.

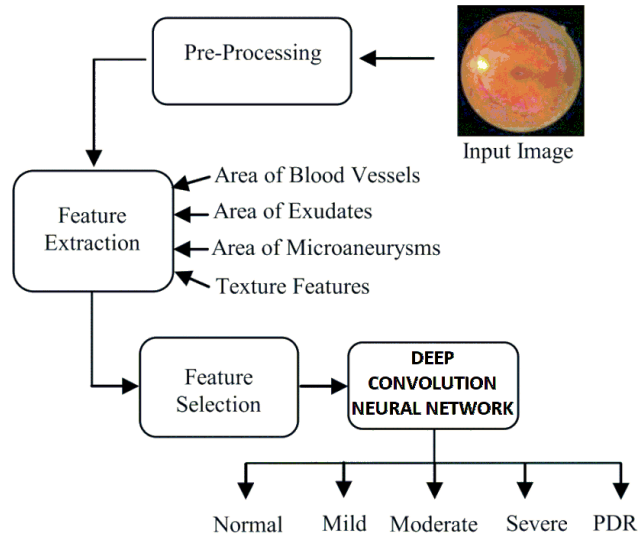


Fig. 2. Block Diagram of model
Figure 2 describes the methodology used in this project.

The dataset utilized for testing in this study was obtained from Kaggle and consisted of more than 3,500 retinal images exhibiting different degrees of retinopathy. These images were of high resolution, with approximately 6 million pixels per image, and were processed using a powerful Graphics Processing Unit (GPU). The researchers opted to use the Keras deep learning package due to its well-documented nature and efficient computational capabilities. This choice enabled real-time feedback, with the classification of an image taking just 0.06 seconds. As a college student, understanding the selection of appropriate datasets and utilizing efficient tools like Keras can contribute to effective analysis and faster outcomes in various research fields, including medical imaging.

Pre-processing methods were used to correct variances in pixel intensity values caused by ethnicity, age differences, and other things, in the fundus photography. Colour normalization was implemented using the OpenCV package, and the images were resized to 224x224 pixels to reduce memory usage while retaining essential features for identification. The CNN was first pre-trained on 2,452 images to quickly achieve initial classification results without wasting excessive training time. After 25 epochs of training we achieved the accuracy of 68%. To mitigate severe overfitting in a dataset where the majority of images are classified as having no signs of diabetic retinopathy (DR), real-time class weights were implemented. The class weights were updated for every batch during back-propagation, based on the ratio of images classified as having no signs of DR, reducing the risk of overfitting to a specific class.

Automated screening systems for diabetic retinopathy utilize fundus imaging to detect specific abnormalities like microaneurysms, exudates, cotton wool spots, and haemorrhages. These signs, including dark red round spots (microaneurysms), bright yellowish-white lesions (exudates), white patches (cotton wool spots), and blood accumulation (haemorrhages), are targeted for detection using a unique feature vector. Figure 3 in the research paper provides examples of these common signs associated with diabetic retinopathy [6].

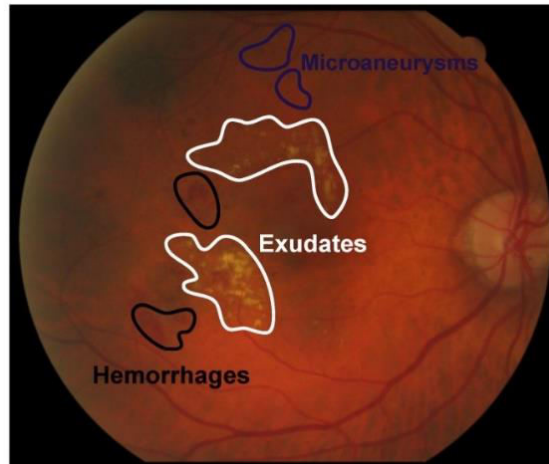


Fig. 3. Fundus images of exudates, microaneurysms and haemorrhages.

IV. EXPERIMENTAL RESULTS

When conducting experiments, it is crucial to focus on minimizing errors by maintaining a balanced distribution of training and testing datasets. If the results of the experiments outperform previous works, it may be necessary to assess the model's performance using additional datasets. Previous studies have been limited by factors such as restricted datasets and methodological constraints. This review specifically emphasizes the limitations of the widely used early-stage diabetes prediction dataset, which only includes nine attributes. Considering the severity of diabetes as a life-threatening disease in today's world, there is a significant need to expand the parameters for research and development efforts.

```
[8]: loss, acc = model.evaluate_generator(test_batches, verbose=1)
      print("Loss: ", loss)
      print("Accuracy: ", acc)

/tmp/ipykernel_32/1501885792.py:1: UserWarning: `Model.evaluate_generator` is deprecated and will be removed in a future version. Please use `Model.evaluate`, which supports generators.
      loss, acc = model.evaluate_generator(test_batches, verbose=1)
35/35 [=====] - 3s 84ms/step - loss: 0.5988 - acc: 0.6506
Loss: 0.5988208651542664
Accuracy: 0.6505914330482483
```

Fig. 4. Output of Loss and Accuracy of Detection of DR

Up until now, our focus has been on utilizing a basic methodology in Machine Learning to work with an early-stage diabetes risk prediction dataset. The accuracy achieved by the Convolutional Neural Network algorithm using Machine Learning is 0.65%. Currently, we are placing emphasis on identifying additional parameters that can aid in the early-stage detection of diabetes.

We obtained an accuracy of 65% in our custom dataset by utilizing Convolutional Neural Network (CNN). Real time diagnosis results are shown below:

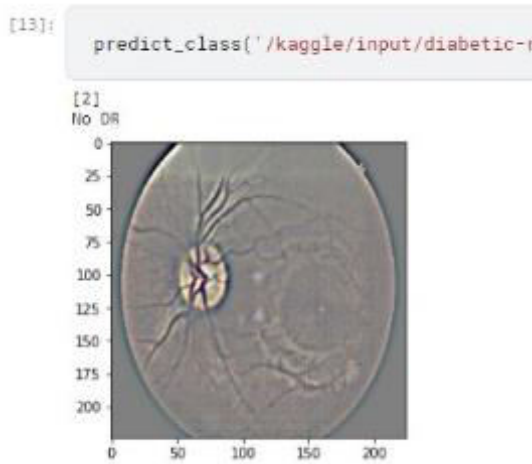


Fig. 5. Detects No_DR

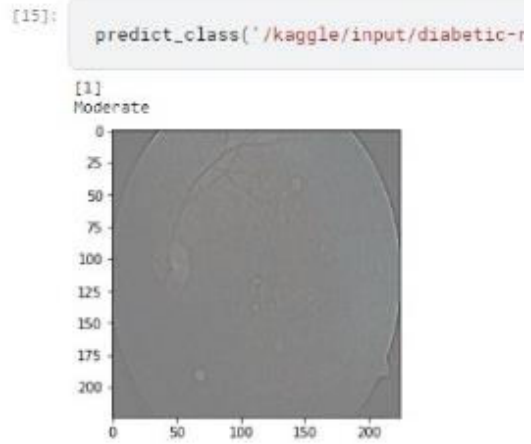


Fig. 7. Detects Moderate DR

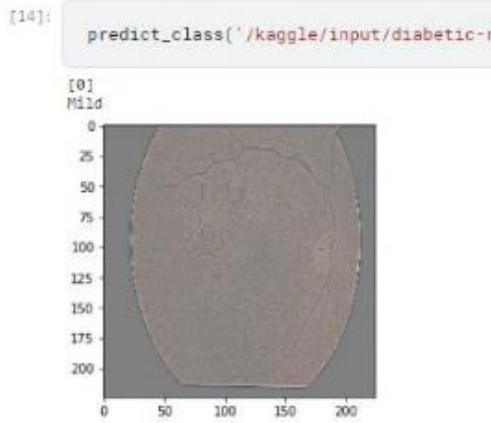


Fig. 6. Detects Mild DR

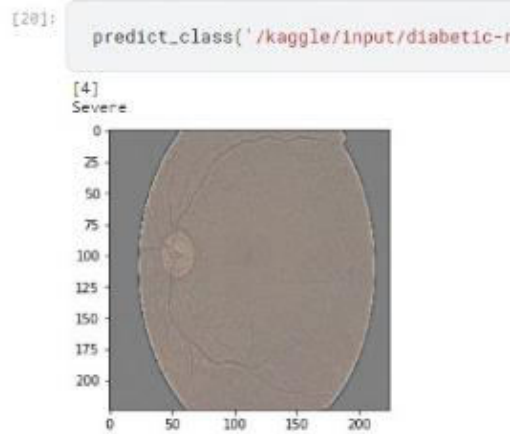


Fig. 8. Detects Severe DR

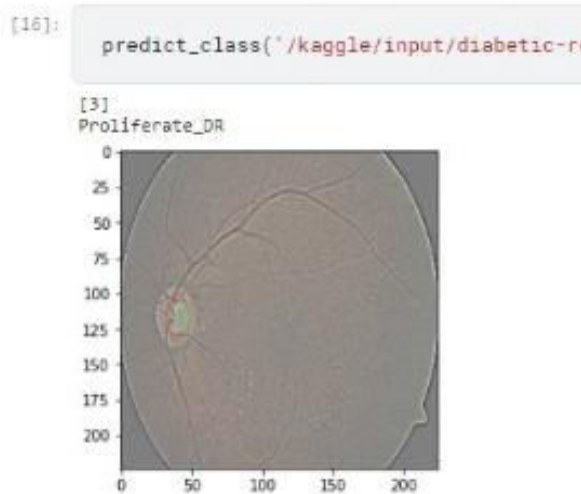


Fig. 9. Detects Proliferate DR

V. FUTURE SCOPE

- Developing efficient systems involves the integration of real-world datasets for analysis.
- It is crucial to address limitations and challenges in order to foster problem-solving and advance research endeavours.

VI. CONCLUSION

Relying solely on a single algorithm or method is insufficient for conducting precise studies. The accurate detection of diabetic retinopathy is of significant importance in the field. By utilizing advanced techniques such as computer-aided diagnosis systems and Convolutional Neural Networks (CNNs), the detection accuracy is improved, enabling early identification and personalized treatment approaches. Recognizing the importance of accurate detection can inspire college students, like ourselves, to delve deeper into research and contribute to advancements in this field.

When the accuracy of detection exceeds 60%, it suggests a high likelihood of having Diabetic Retinopathy. On the other hand, if the accuracy falls below 50%, there is a lower chance of being affected by DR. Early detection is crucial for maintaining good health and avoiding the risks associated with diabetes.

REFERENCES

- [1] A. Soni and A. Rai, "A Novel Approach for the Early Recognition of Diabetic Retinopathy using Machine Learning," 2021 International Conference on Computer Communication and Informatics (ICCCI), 2021, pp. 1-5, doi: 10.1109/ICCCI50826.2021.9402566.
- [2] E. Vocaturo and E. Zumpano, "The contribution of AI in the detection of the Diabetic Retinopathy," 2020 IEEE International Conference on Bioinformatics and Biomedicine (BIBM), 2020, pp. 1516-1519, doi: 10.1109/BIBM49941.2020.9313541.
- [3] S. M. Mahedy Hasan, M. F. Rabbi, A. I. Champa and M. A. Zaman, "A Machine Learning-Based Model for Early Stage Detection of Diabetes," 2020 23rd International Conference on Computer and Information Technology (ICCIT), 2020, pp. 1-6, doi: 10.1109/ICCIT51783.2020.9392715.
- [4] A. Elzennary, M. Soliman and M. Ibrahim, "Early Deep Detection for Diabetic Retinopathy," 2020 International Symposium on Advanced Electrical and Communication Technologies (ISAECT), 2020, pp. 1-5, doi: 10.1109/ISAECT50560.2020.9523650.
- [5] R. Akula, N. Nguyen and I. Garibay, "Supervised Machine Learning based Ensemble Model for Accurate Prediction of Type 2 Diabetes," 2019 SoutheastCon, 2019, pp. 1-8, doi: 10.1109/SoutheastCon42311.2019.9020358.
- [6] Colomer A, Igual J, Naranjo V, "Detection of Early Signs of Diabetic Retinopathy Based on Textural and Morphological Information in Fundus Images. Sensors (Basel)," 2020 Feb 13;20(4):1005. doi: 10.3390/s20041005, PMID: 32069912; PMCID: PMC7071097.
- [7] Arshroop Singh Saini and CRO Roop, "DL-Diabet Retinopathy", Kaggle.
- [8] Colomer A, Igual J, Naranjo V, "Detection of Early Signs of Diabetic Retinopathy Based on Textural and Morphological Information in Fundus Images. Sensors (Basel)," 2020 Feb 13;20(4):1005. doi: 10.3390/s20041005, PMID: 32069912; PMCID: PMC7071097.



INNO SPACE
SJIF Scientific Journal Impact Factor
Impact Factor: 8.423



ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

 **9940 572 462**  **6381 907 438**  **ijirset@gmail.com**



www.ijirset.com

Scan to save the contact details