e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
( Peer-Reviewed, Open Access, Fully Refereed International Journal )
Volume:06/Issue:10/October-2024 Impact Factor- 8.187 www.irjmets.com

# SCREENING AND EARLY DETECTION OF DIABETIC RETINOPATHY

**Supriya Samant[*1], Vedika Gavali[*2], Asawari Kumbhar[*3], Pragati Gurav[*4], Prof. Sonali Patil[*5]**

[*1,2,3,4,5]Department Of Computer Science & Engineering Sharad Institute Of Technology College Of Engineering, Ichalkaranji, Maharashtra, India.

## ABSTRACT

Diabetic retinopathy (DR) is a leading cause of blindness among individuals with diabetes, resulting from damage to the retina's blood vessels. Detection of DR should be done early to prevent severe vision loss. To automate the screening system for detecting DR into five stages, this project is developed using Convolutional Neural Networks (CNNs). The model analyzes retinal images and classifies them into five categories: No DR, Mild, Moderate, Severe, and Proliferative DR. By training the model on a diverse dataset of retinal images, the system can identify early signs of the disease with high accuracy. An accuracy matrix is used to assess the model's effectiveness. The system also includes database to manage patient information, reports, and appointment scheduling, enhancing data accessibility for healthcare providers. This solution offers a cost-effective and scalable approach to screening, enabling timely diagnosis and treatment of DR. Ultimately, this tool has the potential to improve patient care by facilitating early intervention and reducing the incidence of vision loss among diabetic patients.

**Keywords:** Diabetic Retinopathy, Convolutional Neural Networks, Detection, Retinal Images, Accuracy.

## I. INTRODUCTION

Diabetic retinopathy (DR) is a eye disease that damages the blood vessels of the eye retina in diabetic patients. Diabetic Retinopathy Detection helps to detect the stages of DR. As diabetes becomes more common, so does the incidence of DR. The condition develops when prolonged high blood sugar levels damage the tiny blood vessels in the retina, causing them to swell, leak, or grow abnormally, potentially leading to impaired vision. The risk of DR increases with the length of time a person has diabetes and poor control of blood sugar levels. If it is not treated, this can worsen the condition of retina, which can cause permanent vision loss.

Detecting diabetic retinopathy early is essential to preventing severe complications, but a major challenge is the slow and often asymptomatic progression of the disease in its early stages. However, conventional screening techniques can be both time-intensive and costly, particularly in regions with limited access to specialized healthcare services.

Advances in science and technology, especially in artificial intelligence (AI), machine learning(ML) and deep learning enhances in building models for medical diagnosis. Convolutional Neural Networks (CNNs), a specific type of AI model, have shown great potential in classifying images, including those used in medical image analysis. CNNs can detect intricate patterns in retinal images that might be missed by the human eye, making them ideal for automated screening of diabetic retinopathy. By training a CNN on a large set of retinal images, the model can learn to distinguish between different stages of DR and classify new images accordingly, assisting healthcare professionals in identifying at-risk patients and prioritizing treatment.

In addition, integrating this AI-based system with a database for managing patient records, reports, and appointments can streamline the diagnostic process. The model classifies the stages into five categories No DR, Mild DR, Moderate DR, Severe DR, Proliferative DR. The goal of this project is to develop a CNN-based model for detecting diabetic retinopathy and complement it with a database system for managing patient data and appointments. This approach aims to provide an affordable, scalable solution that can be widely used to improve early detection and intervention for diabetic retinopathy.

## II. METHODOLOGY

This project adopts a detailed and systematic approach to develop a comprehensive system for early detection of diabetic retinopathy (DR). The system integrates a Convolutional Neural Network (CNN) model for DR detection with a robust database for patient management, ensuring both accuracy and efficiency in diagnosis.

e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
( Peer-Reviewed, Open Access, Fully Refereed International Journal )
Volume:06/Issue:10/October-2024 Impact Factor- 8.187 www.irjmets.com

### Data Collection and Preprocessing

A dataset of retinal images representing various stages of diabetic retinopathy was collected from publicly available sources. The images were subjected to preprocessing to prepare them for model training. Key preprocessing steps included:

- **Resizing:** All retinal images were adjusted to the same dimensions to ensure uniformity and compatibility with the CNN model, allowing it to process images consistently across the dataset.
- **Normalization:** The pixel values of each image were scaled between 0 and 1 to standardize input data, facilitating efficient processing by the CNN model.
- **Data Augmentation:** Various augmentation techniques, including rotation, flipping, and zooming, were applied to diversify the training dataset. This step helps prevent overfitting and improves the model's ability to generalize to new data by exposing it to varied image orientations and conditions.

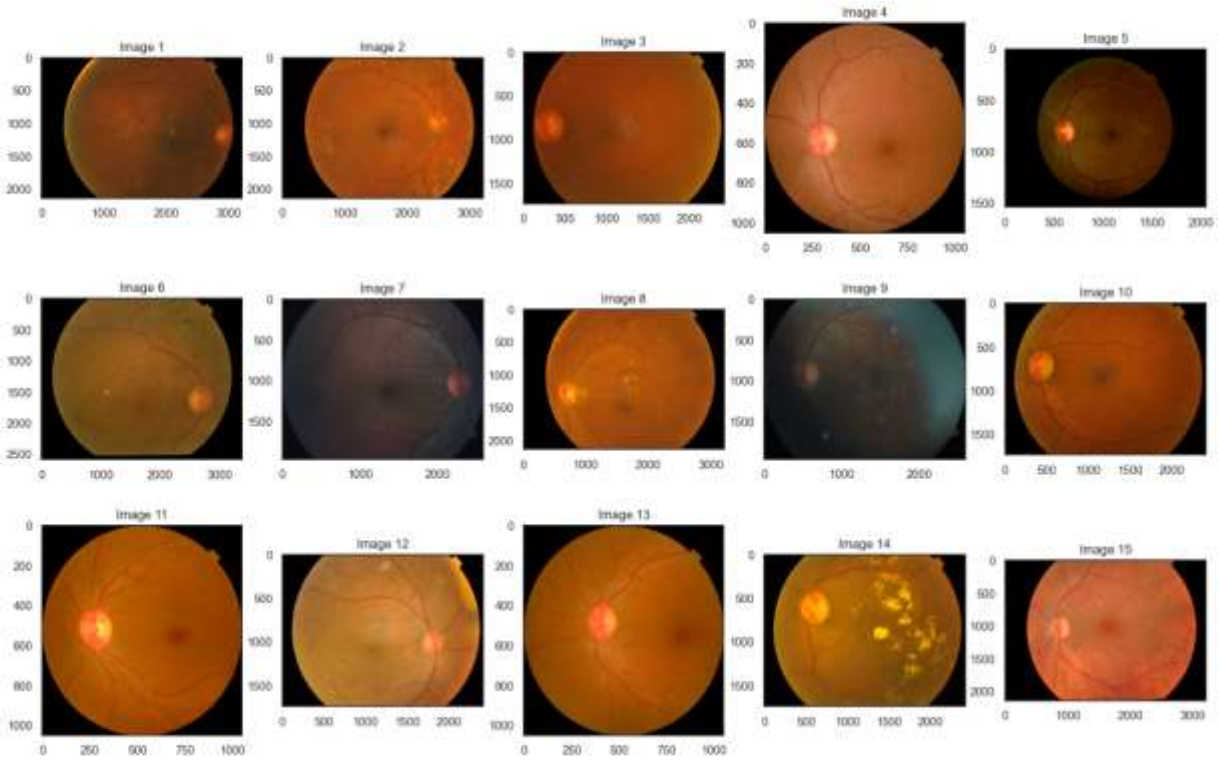


**Figure 1:** Training Retina Images.

### CNN Model Architecture Development

A Convolutional Neural Network (CNN) was chosen for its ability to efficiently handle image classification, particularly with medical images. The architecture was designed with several important considerations:

- **Layers:** The network incorporates multiple convolutional layers to capture essential features from the retinal images, followed by pooling layers to reduce the spatial dimensions of the data while retaining crucial information.
- **Dropout and Regularization:** To avoid overfitting, dropout layers were implemented along with L2 regularization during training.

### Model Training and Testing

The dataset was divided into training, validation, and testing to develop the model.

- **Epochs and Batch Size:** The model underwent multiple training iterations (epochs), utilizing mini-batches to adjust the model weights incrementally for improved accuracy and generalization.
- **Performance Metrics:** A confusion matrix was generated to analyze the model's classification accuracy for different stages of diabetic retinopathy, highlighting any patterns of misclassification that may need improvement.

**Database Design and Implementation**

A relational database was designed to manage patient data, including personal details, medical history, retinal images, and appointment records. The database schema was structured as follows:

- **Patient Details Table:** Contains basic information like patient ID, name, age, contact details, and diabetes history.
- **Retinal Image Records Table:** Stores retinal images along with their respective classifications (DR stage) as generated by the CNN model.
- **Appointments Table:** Manages patient appointments, including the date, time slot, and doctor's notes.
- Each table was linked by unique patient IDs, ensuring consistency across patient records and easy access for healthcare providers.

**System Integration**

The integration of the CNN model with the database created a unified platform, enabling smooth communication between the two components:

- **Image Classification:** When a retinal image is uploaded, the CNN model processes it and classifies the image based on the diabetic retinopathy stage. The result of the classification and the corresponding patient details with examined report is automatically stored in the database.
- **Data Access:** Healthcare professionals can access patient data, which includes both the classification results and the patient's medical history. The system supports real-time updates and ensures efficient data retrieval, allowing for timely decision-making in patient care.

**Model Evaluation and Performance Metrics**

The model's performance was assessed using various metrics to ensure its accuracy and reliability in real-world applications:

- **Accuracy:** This metric indicates the percentage of images the model classified correctly out of all the images in the test dataset.
- **Confusion Matrix:** A confusion matrix was used to visualize how well the model differentiated between different stages of diabetic retinopathy, highlighting any areas of misclassification and allowing for further fine-tuning of the model.

## III. MODELING AND ANALYSIS

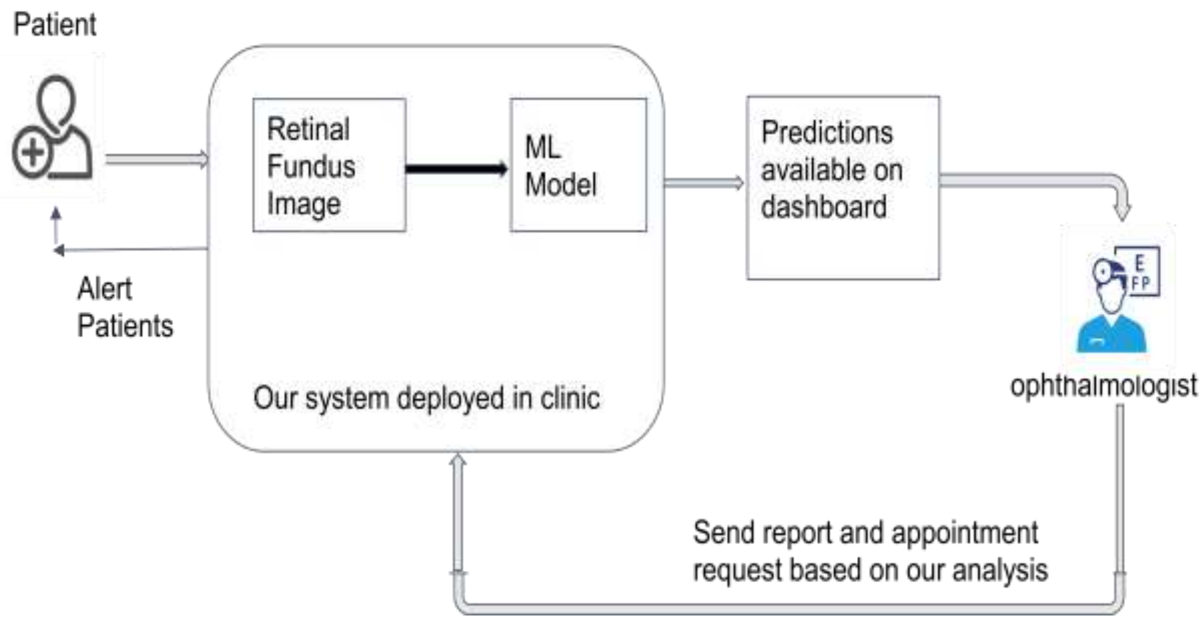


**Figure 2:** Architecture Diagram.

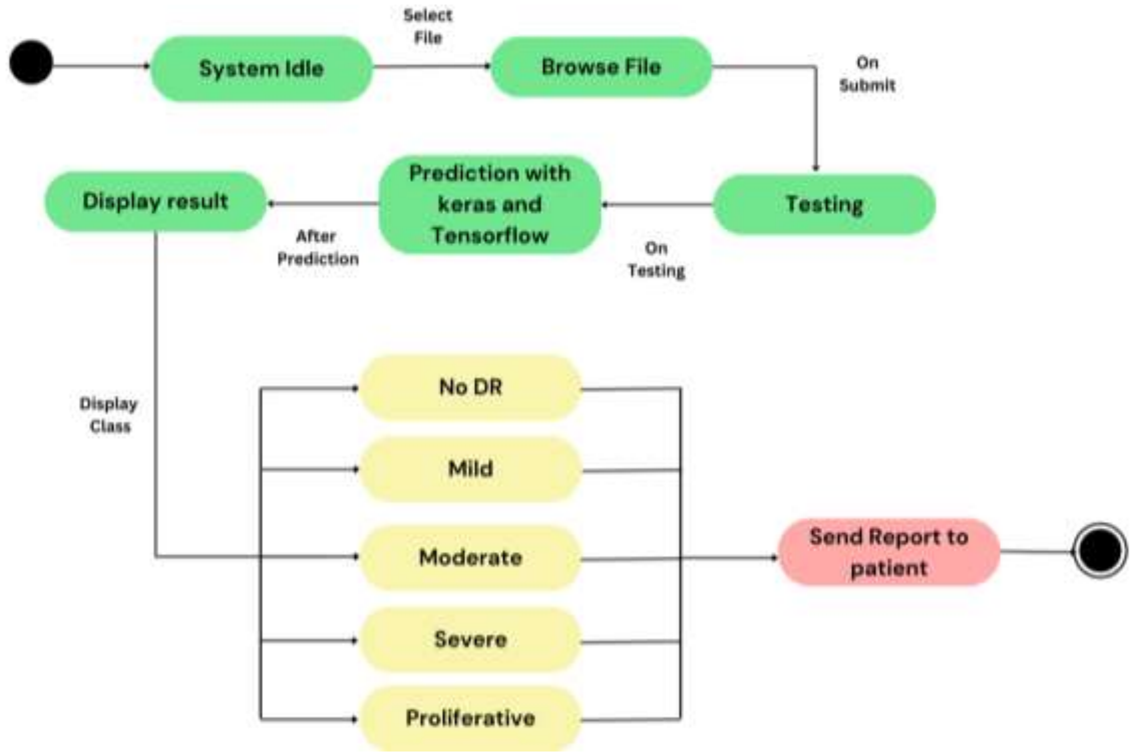


**Figure 3:** Activity Diagram

## IV. RESULTS AND DISCUSSION

The diabetic retinopathy detection model showed promising results, achieving high accuracy in classifying retinal images across different stages of the disease. Precision was particularly strong for advanced stages, indicating the model's ability to identify severe cases needing urgent attention. However, recall for early stages was lower, suggesting a need for improvement in detecting mild cases. The confusion matrix revealed that most errors occurred between similar stages, such as mild and moderate DR. Overall, this CNN-based system demonstrates potential as a scalable solution for early DR detection, improving healthcare efficiency, especially in underserved regions. Further refinements are necessary for enhanced performance.

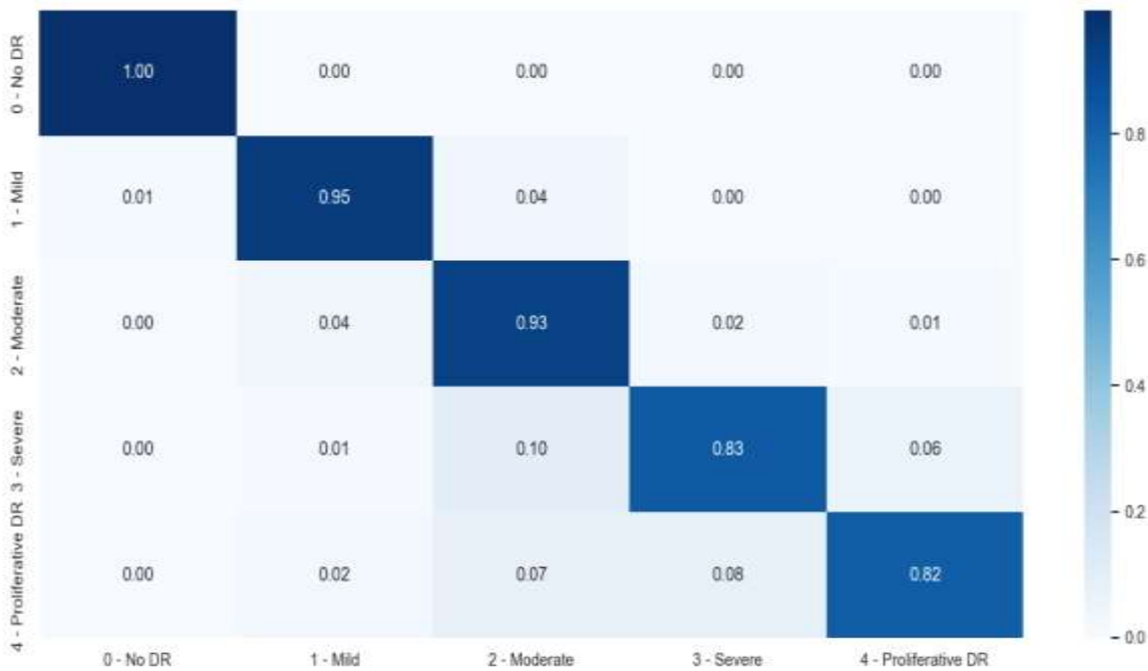


**Figure 4:** Confusion Matrix

## V. CONCLUSION

In conclusion, early detection of diabetic retinopathy (DR) is vital to preventing severe complications, but the slow progression and lack of noticeable symptoms in the early stages make timely diagnosis challenging. Implementing a system that integrates deep learning-based image classification with a robust patient management database offers a promising solution. Retinal images can be processed and classified in real time, enabling healthcare professionals to focus on patients who require urgent care. Moreover, the integration of a database to store patient information, screening results, and medical history ensures streamlined data management. The use of CNN models allows for automated screenings, reducing the dependency on highly trained staff and making the technology accessible in resource-constrained environments. By providing an affordable, scalable solution, the system could improve the accessibility of early diagnosis and treatment, ultimately reducing the risk of vision loss in diabetic patients and improving long-term patient outcomes. With continuous advancements in AI technology and further refinement of the model, this system holds the potential to revolutionize DR screening and management on a global scale.

## VI. REFERENCES

[1] Klein, R., Klein, B. E. K., & Linton, K. L. P.(1992). "Prevalence of Diabetic Retinopathy in an American Population: The Beaver Dam Eye Study." Archives of Ophthalmology, 110(3), 227-232.

[2] Fong, D. S., Gardner, T. W., & Huang, E. (2003). "Diabetic Retinopathy." Diabetes Care, 26(9), 2548-2559.

[3] Liu, Y., & Zhang, L.* (2017). "The Role of Optical Coherence Tomography in the Diagnosis and Management of Diabetic Retinopathy." Journal of Diabetes Research, 2017, Article ID 1625290.

[4] Cheung, N., Mitchell, P., & Wong, T. Y. (2010). "Diabetic Retinopathy." The Lancet, 376(9735), 124-136.

[5] Bressler, N. M.* (2004). "Diabetic Retinopathy." New England Journal of Medicine, 350(1), 32-41.

[6] Early Treatment Diabetic Retinopathy Study Research Group.* (1991). "Photocoagulation for Diabetic Retinopathy." Archives of Ophthalmology, 109(12), 1606-1614.

[7] Wong, T. Y., & Simo, R.* (2012). "Diabetic Retinopathy: Progress and Perspectives." Circulation Research, 110(9), 1341-1355.

[8] Zhang, X., & Saaddine, J. B.* (2010). "The Prevalence of Diabetic Retinopathy Among Adults in the United States." Archives of Ophthalmology, 128(2), 200-207.