

Diabeto Care: Smart Detection and Support for Diabetes

Girija Rokade¹, Kalyani Kharade², Pratiksha Sonawane³, Arpita Biradar⁴

Department of Computer Engineering, Sinhgad Academy of Engineering, Pune

Abstract - Diabetic Retinopathy (DR) is one of the most common and severe complications of diabetes mellitus, leading to irreversible vision loss if not diagnosed at an early stage. Traditional manual screening methods are time consuming, error-prone, and require expert ophthalmologists. To overcome these challenges, this project proposes an automated system for the detection and classification of Diabetic Retinopathy using deep learning and image processing techniques. Retinal fundus images are pre-processed and analyzed using Convolutional Neural Networks (CNN) to identify abnormal features such as microaneurysms, hemorrhages, and exudates. The system provides accurate and reliable predictions, thereby assisting doctors in early diagnosis and treatment. This approach not only reduces the burden on healthcare professionals but also offers a cost effective, scalable solution for large-scale screening, ultimately helping to prevent blindness in diabetic patients.

Key Words: Diabetes Mellitus, Early Detection, Deep Learning, Image Processing.

1. INTRODUCTION

Diabetic Retinopathy (DR) is a common microvascular complication of diabetes that can lead to partial or complete vision loss if untreated. It occurs when high blood sugar levels damage the small blood vessels in the retina, causing leakage, swelling, or abnormal vessel formation. Early detection and intervention are critical to prevent irreversible vision impairment. Traditional manual diagnosis through retinal examinations is often slow and subject to human error. Automated detection systems using image processing and deep learning, particularly Convolutional Neural Networks (CNNs), provide efficient analysis of retinal images, classify DR severity, and support ophthalmologists in timely decision-making. These systems enhance accuracy, accessibility, and speed of diabetic retinopathy screening, improving patient outcomes.

2. LITERATURE REVIEW

Diabetic Retinopathy (DR) detection has improved with machine learning and deep learning techniques. In 2018, SVM-based methods using texture features achieved around 90% accuracy and helped in detecting retinal abnormalities. A 2022 review highlighted AI approaches like Machine Learning, Deep Learning, GANs, and

Transfer Learning, focusing on challenges such as data imbalance and explainability.

Recent studies used advanced models like CNNs, Vision Transformers, and Neural Networks for better DR classification using fundus image datasets. Deep learning models, especially multi-layer perceptrons and CNN-based architectures, achieved very high accuracy (up to 99%) in diabetes prediction and DR grading.

Modern approaches also include Bayesian deep learning models that improve reliability by estimating uncertainty. Additionally, machine learning algorithms like Random Forest and Decision Trees have shown effective performance in diabetes prediction using datasets like PIMA.

3. PROPOSED SYSTEM ARCHITECTURE

The Diabeto Care system integrates machine learning, cloud computing, and IoT devices into a single web based healthcare platform. It enables early prediction, continuous monitoring, and doctor-patient communication through.

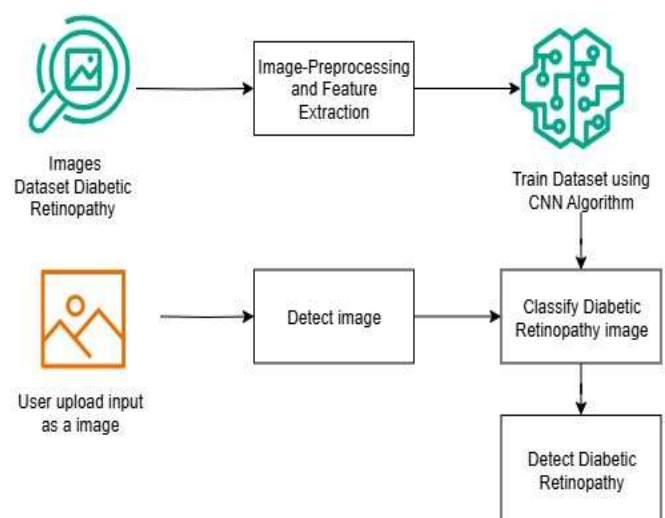


Figure 1: System Architecture Diagram

3.1 System Features

The Diabeto Care: Smart Detection and Support System for Diabetes includes several integrated features that work together to create an intelligent, user-friendly, and effective healthcare solution for diabetes management. The system begins with User Registration and Login, allowing patients, doctors, and administrators to securely access the platform using role-based authentication, which ensures that each user only has access to the features relevant to their role. Once logged in, patients can proceed to the Health Data Input module, where they can manually enter their health parameters such as glucose levels, body mass index (BMI), and blood pressure, or automatically upload data from connected IoT devices.

The next major feature is the ML-Based Risk Prediction system. This component uses trained machine learning models to analyze patient data and classify their condition into categories like "Normal," "Prediabetic," or "Diabetic." This helps in identifying potential risks early and provides doctors with insights for timely intervention. The IoT Integration feature allows continuous monitoring of critical parameters such as glucose level and heart rate using smart sensors. These sensors send real-time data to the cloud, enabling continuous tracking without manual input from the user.

To promote healthy living, the Diet and Lifestyle Support feature provides personalized recommendations on diet, exercise routines, and medication schedules based on the user's health data and risk level. This helps patients adopt a more balanced and controlled lifestyle to manage diabetes effectively. The Alert and Notification System ensures that both patients and doctors are informed immediately if abnormal readings or high-risk conditions are detected. Notifications are sent via SMS or email to prompt quick action, which can prevent emergencies.

Finally, the Doctor Dashboard offers healthcare professionals a comprehensive view of patient data, including health history, risk classification, and treatment progress. Doctors can monitor multiple patients remotely, analyze trends, and adjust treatment plans accordingly. Overall, the system features work in harmony to offer smart detection, personalized support, and continuous care, making Diabeto Care a powerful tool for modern diabetes management preparation. The system also provides users with updates on organ delivery status and medical approval progress.

DiabetoCare: Smart Detection and Support System for Diabetes

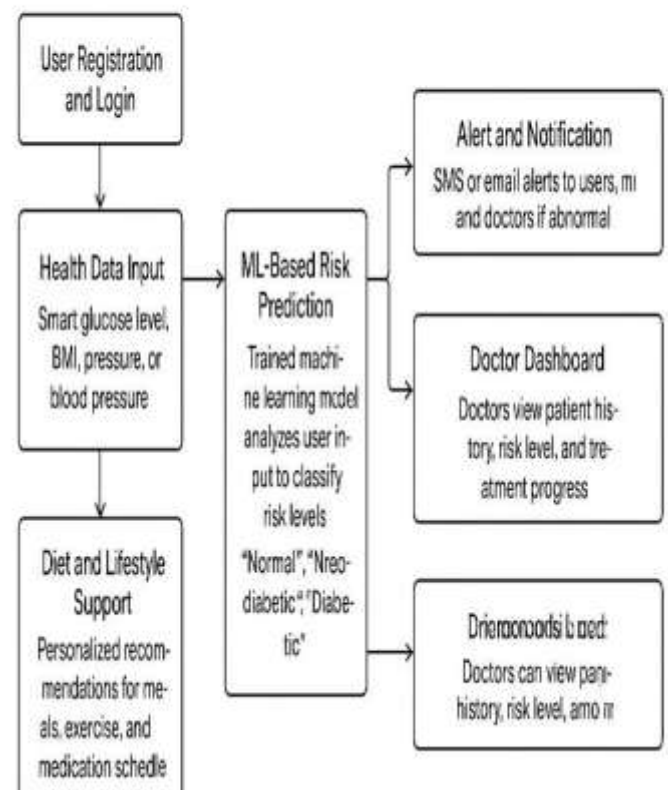


Figure 2: System Feature Diagram

4. METHODOLOGY

The methodology of Diabeto Care: Smart Detection and Support System for Diabetes describes the systematic process used to design, develop, and evaluate the system for effective diabetes detection and management.

The process begins with data collection, where patients' health information is gathered through IoT-enabled devices such as glucose monitors, heart rate sensors, and blood pressure monitors. Additionally, users can manually input health parameters like BMI and diet details through the mobile or web interface. This collected data is securely transmitted to the cloud for further processing.

Next, in the data preprocessing phase, the raw data is cleaned, normalized, and filtered to remove any noise or incomplete records. This ensures that only high-quality data is used for analysis. After preprocessing, the machine learning model is trained using a large dataset of diabetes-related parameters. The model learns

patterns and correlations between input features and diabetes conditions, allowing it to classify users as “Normal,” “Prediabetic,” and “Diabetic.”

Once trained, the model is integrated into the system for real-time prediction and monitoring. When a user uploads or generates new health data, the system analyzes it and instantly predicts the risk level. In case of abnormal readings, the alert and notification module automatically sends warnings to the user and their assigned doctor via SMS or email.

The system also provides personalized recommendations related to diet, exercise, and lifestyle modifications to help patients manage their health effectively. A doctor dashboard enables healthcare professionals to monitor patient progress, analyze risk trends, and suggest treatment adjustments.

Finally, the evaluation phase measures the system’s performance using metrics such as accuracy, precision, and recall to ensure reliable predictions. Continuous feedback from users and doctors helps improve the system and update the machine learning model for better future results.

In summary, the Diabeto Care methodology integrates IoT, machine learning, and cloud computing to provide an intelligent, data-driven solution for early detection and continuous management of diabetes.

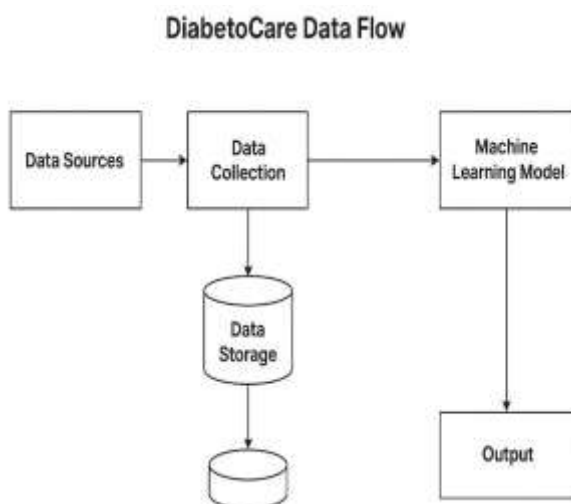
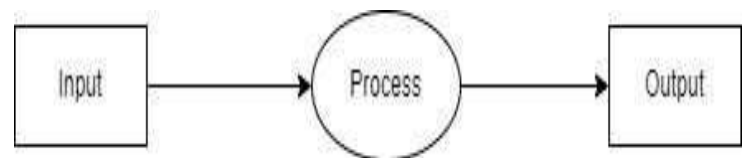


Figure 3: Data Flow Diagram

1.Data Flow and Processing

In Data Flow Diagram, we Show that flow of data in our system in DFD0 we show that base DFD in which rectangle present input as well as output and circle show our system , In DFD1 we show actual input and actual output of system input of our system is text or image and output is rumor detected like wise in DFD 2 we present operation of user as well as admin.



5. Experimental Setup And Evaluation

1.Dataset and Sources: Use a combination of public and collected clinical data: standardized public datasets (e.g., Pima Indians Diabetes dataset or other clinical glucose/BP cohorts) augmented with anonymized sensor logs and user-entered records from pilot users. Record features such as fasting glucose, post-prandial glucose, BMI, age, blood pressure, heart rate, medication, and lifestyle entries. Ensure all patient data has informed consent and is de-identified.

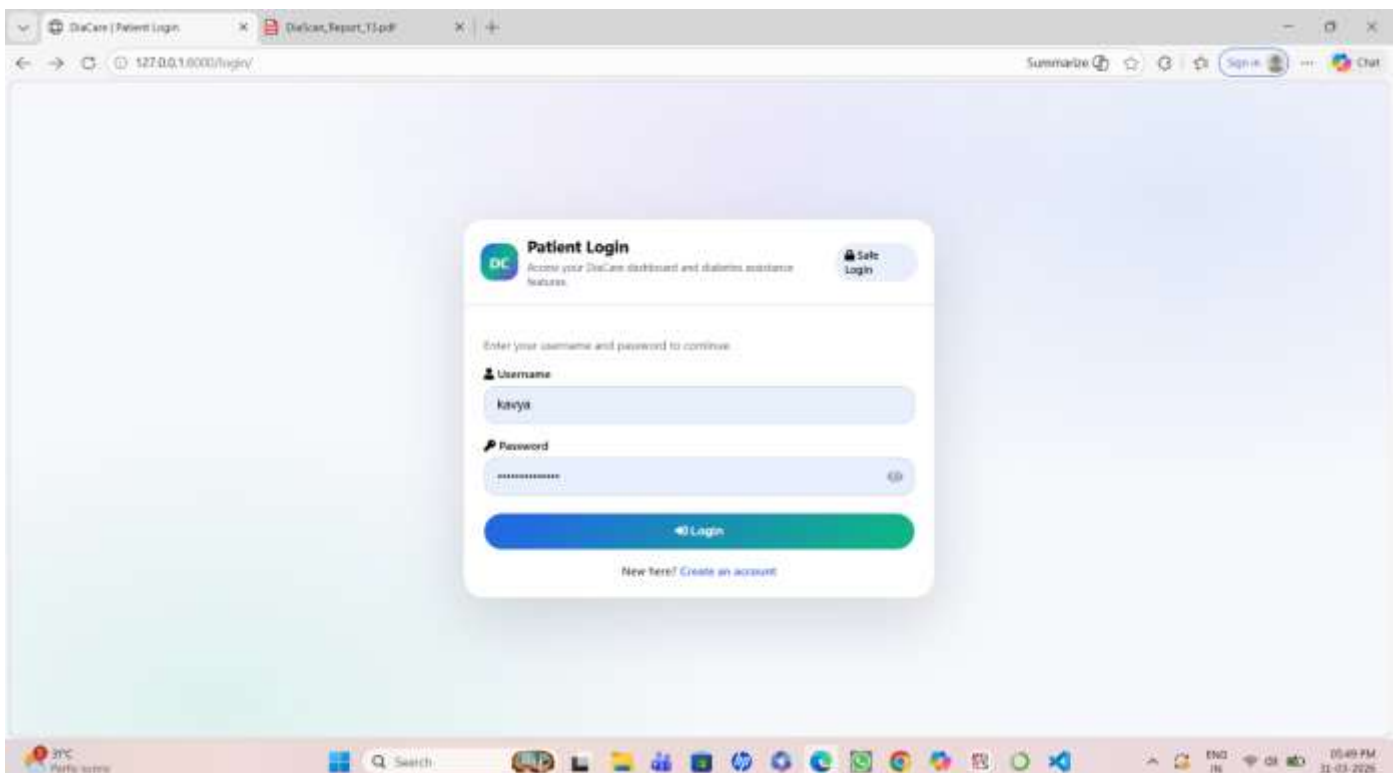
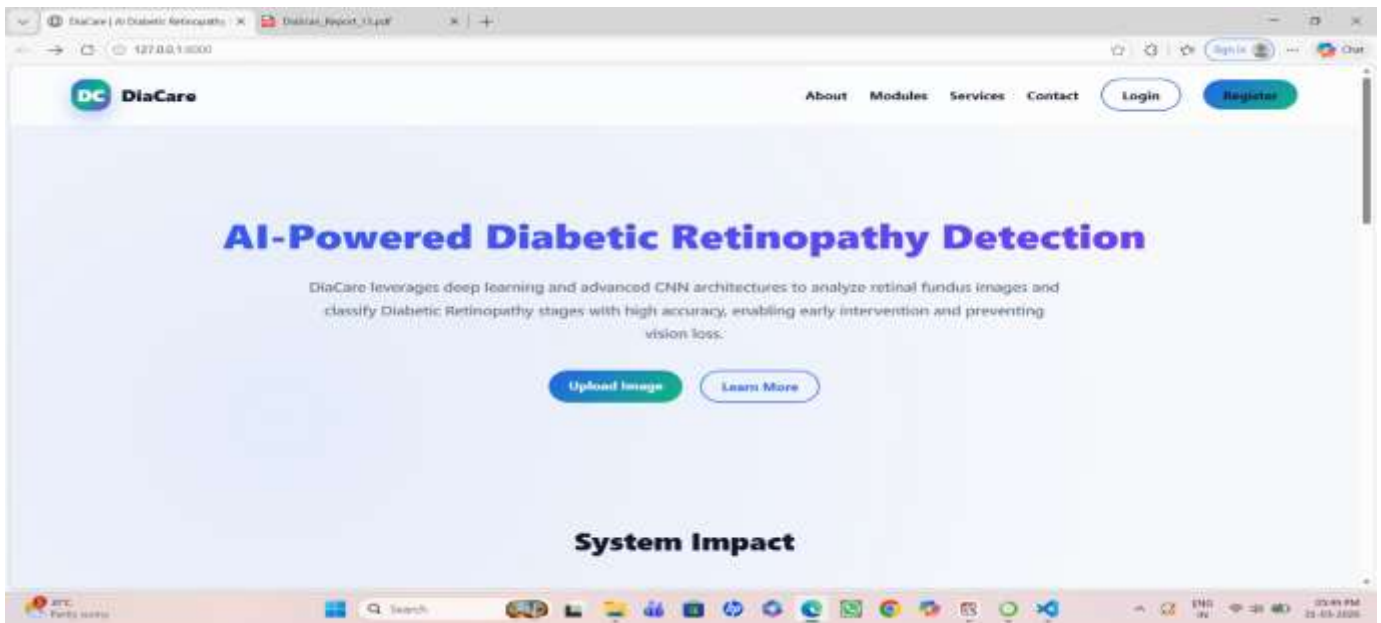
2.Hardware & Software Environment: Train models on a workstation or cloud GPU instance (e.g., NVIDIA GPU with ≥ 8 GB VRAM) and run experiments in Python using libraries such as scikit-learn, XG Boost, or TensorFlow/Py Torch. Use Pandas/NumPy for preprocessing, and ML flow or similar for experiment tracking. Containerize services for reproducibility (Docker) and version-control code and data pipelines.

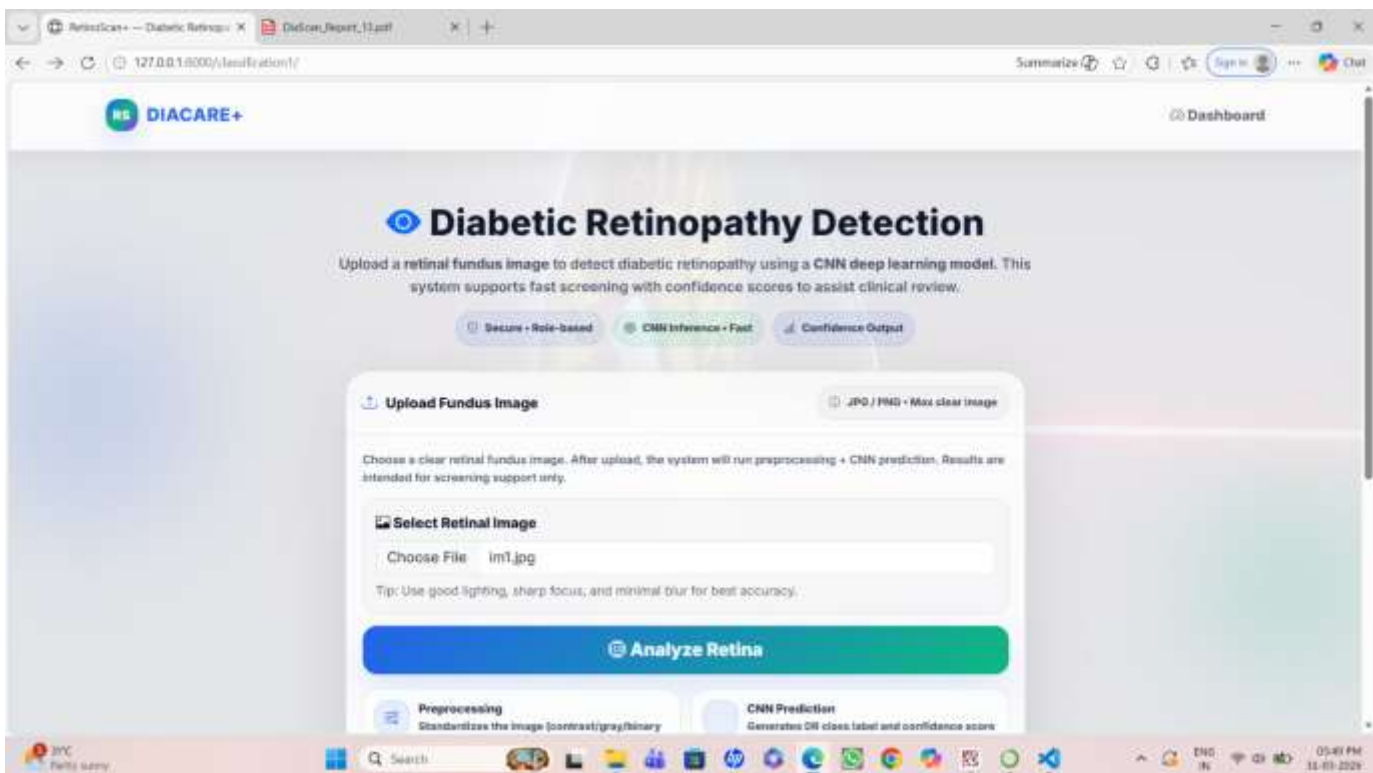
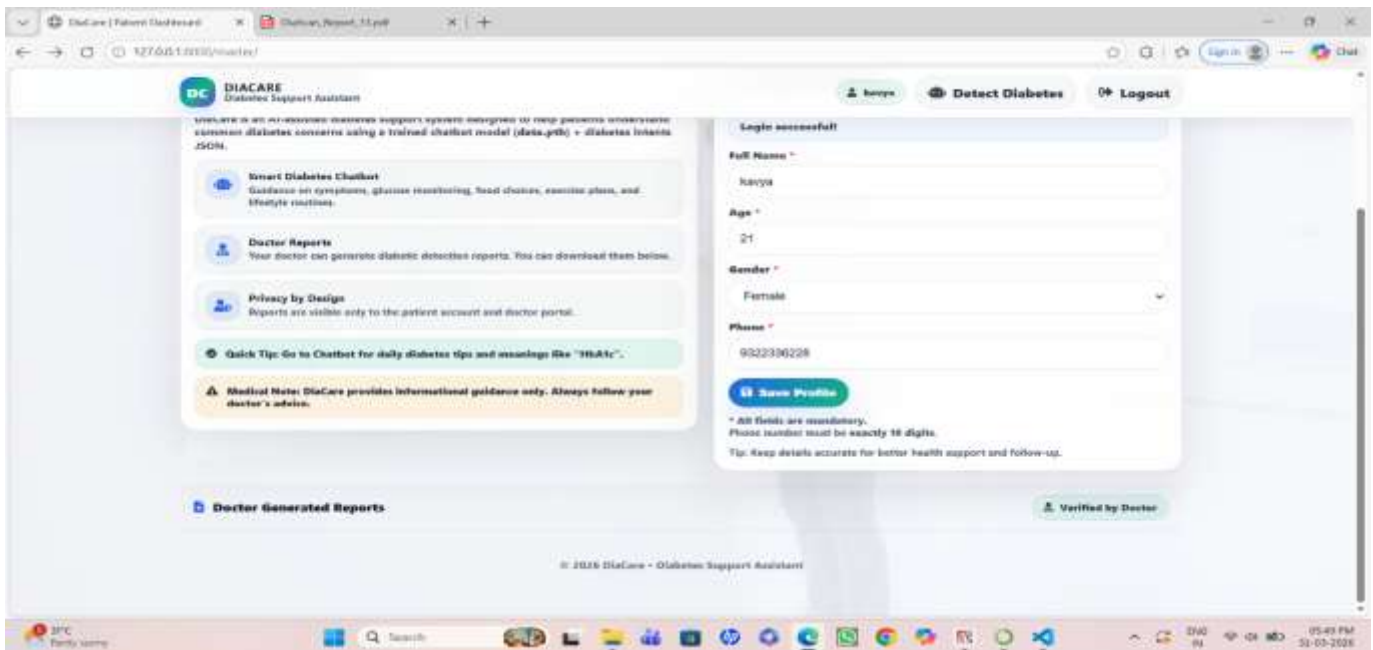
3.Data Preparation & Splits: Clean and preprocess data by handling missing values (imputation or removal), encoding categorical variables, and normalizing or standardizing continuous features. Create a training/validation/test split — recommended 70% train, 15% validation, 15% test — or use stratified k-fold cross-validation ($k=5$) to preserve class balance and robustly estimate performance. If time-series sensors are used, split by user or time to avoid data leakage.

4.Modeling & Training Details: Evaluate several candidate models: logistic regression (baseline), decision tree / random forest, XG Boost/ Light GBM, and neural networks for complex patterns or time-series RNN/1DCNN models for sequential glucose traces. Tune hyperparameters using grid or Bayesian search on the validation set. Use early stopping and regularization to avoid overfitting. Log model versions, hyperparameters, and random seeds.

5.Evaluation Metrics: Report classification metrics appropriate for medical screening and imbalanced data:

- Primary: Sensitivity (Recall for diabetic class), Specificity, and Area Under ROC (AUC-ROC).
- Secondary: Precision, F1-score, accuracy, and confusion matrix.
- Calibration: Brier score and reliability plot to check probability estimates.
- Use class-wise metrics (Normal / Prediabetic / Diabetic) and macro-averaged scores when classes are imbalanced.





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Database Structure Browse Data Edit Diagram Execute SQL

Table: auth_user Filter in any columns

ID	password	last_login	is_superuser	username	last_name	email	is_staff
ID	password	last_login	is_superuser	username	last_name	email	is_staff
1	pbkdf2_sha256\$60000\$8858086WJSM\$CWF	2025-11-04 06:21:08.841331	0	Triya		triya@gmail.com	0
2	pbkdf2_sha256\$60000\$8858086WJSM\$CWF	2025-11-04 05:37:26.841037	0	Riya		riya@gmail.com	0
3	pbkdf2_sha256\$60000\$8858086WJSM\$CWF	2025-11-04 05:39:01.644625	0	Shweta		shweta@gmail.com	0
4	pbkdf2_sha256\$60000\$8858086WJSM\$CWF	2025-11-02 06:49:44.323763	0	Geetika		geetika@gmail.com	0
5	pbkdf2_sha256\$60000\$8858086WJSM\$CWF	2025-11-02 12:04:03.612636	0	Prityanka		prityanka@gmail.com	0
6	pbkdf2_sha256\$60000\$8858086WJSM\$CWF	2025-11-21 07:23:53.828022	0	Prityanka1		prityanka1@gmail.com	0
7	pbkdf2_sha256\$60000\$8858086WJSM\$CWF	2025-12-02 08:54:11.603451	0	Shrutham		shrutham@gmail.com	0
8	pbkdf2_sha256\$60000\$8858086WJSM\$CWF	2025-12-25 08:34:46.242020	0	Geetika2296		geetika2296@gmail.com	0
9	pbkdf2_sha256\$60000\$8858086WJSM\$CWF	2025-12-25 08:37:08.345704	0	Geetika4		geetika4@gmail.com	0
10	pbkdf2_sha256\$60000\$8858086WJSM\$CWF	2025-12-27 10:39:28.483888	0	Malyani		malyanipratiha011@gmail.com	0
11	pbkdf2_sha256\$60000\$8858086WJSM\$CWF	2025-12-31 12:13:15.798958	0	Kavya		malyanipratiha011@gmail.com	0

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Database Structure Browse Data Edit Diagram Execute SQL

Table: auth_user Filter in any columns

SQL: SELECT * FROM auth_user

Results: 11 rows

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Database Structure Browse Data Edit Diagram Execute SQL

Table: auth_user Filter in any columns

SQL: SELECT * FROM auth_user

Results: 11 rows

6. Conclusion

Diabetic Retinopathy is a leading cause of preventable blindness, and its early detection is essential for saving vision. Traditional manual diagnosis is time-consuming and prone to human error, highlighting the need for automated solutions. Convolutional Neural Networks (CNNs) provide a powerful deep learning approach for analyzing retinal images, detecting abnormalities, and classifying the severity of DR with high accuracy. The proposed web-based system makes screening faster, more reliable, and accessible, supporting ophthalmologists in clinical decision-making while improving patient care. With further advancements and integration into healthcare systems, CNN-based DR detection can significantly reduce diabetes-related vision loss worldwide.

7. Future Scope

The Diabetic Retinopathy Detection system can be further improved and expanded in several ways. More advanced deep learning models, such as hybrid CNNs or transformer-based architectures, can be integrated to enhance accuracy and robustness. The system can be extended to detect other eye diseases like glaucoma and cataracts, providing a comprehensive eye-care solution. Integration with mobile and cloud platforms can enable real-time diagnosis and remote accessibility for patients in rural areas. The inclusion of explainable AI techniques will help doctors better understand the decision-making process of the model, improving trust and adoption. Additionally, incorporating large-scale datasets from diverse populations will improve generalization and global applicability. In the future, the system can be linked with electronic health records (EHRs) for complete patient monitoring and personalized treatment planning.

8. References

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