ICAISC-2025

International Conference on Recent Advancements in Artificial Intelligence and Soft Computing

DeepSightDR

Deep learning powered diabetic retinopathy detection

Automated Diagnosis for Accessible Healthcare

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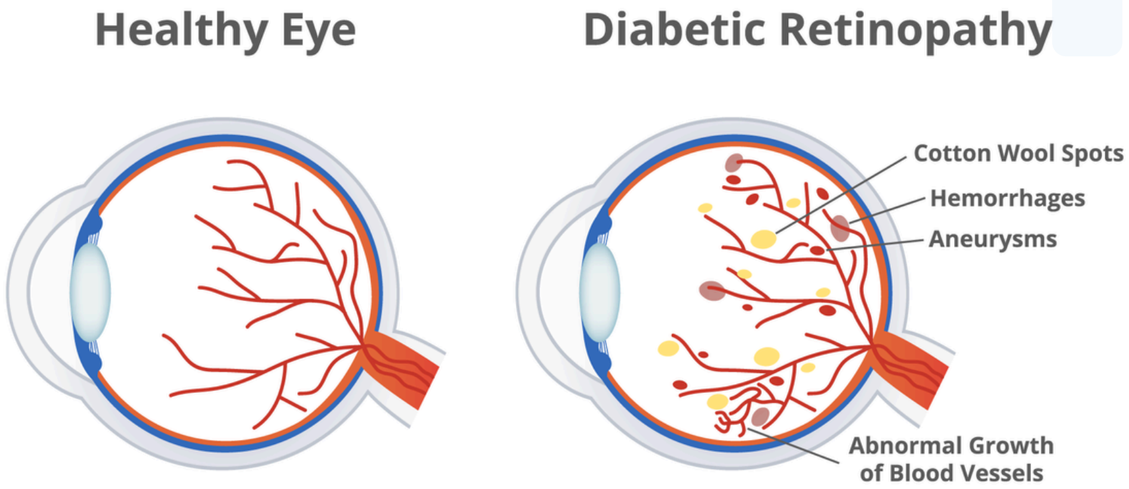
Agenda

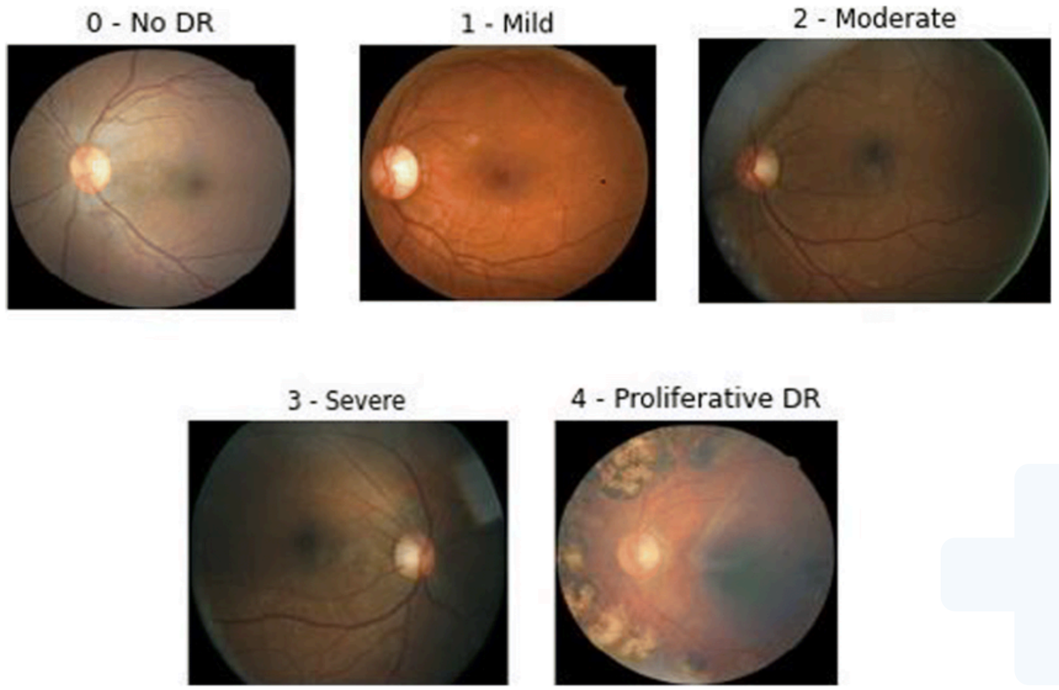
Problem Statement

- Diabetic Retinopathy (DR) is a leading cause of blindness, affecting 1/3 of preventable cases (WHO, 2023).
- Challenges: Manual diagnosis is time-consuming, subjective, and inaccessible in low-resource areas.
- Key Question: How can AI improve early detection and scalability?

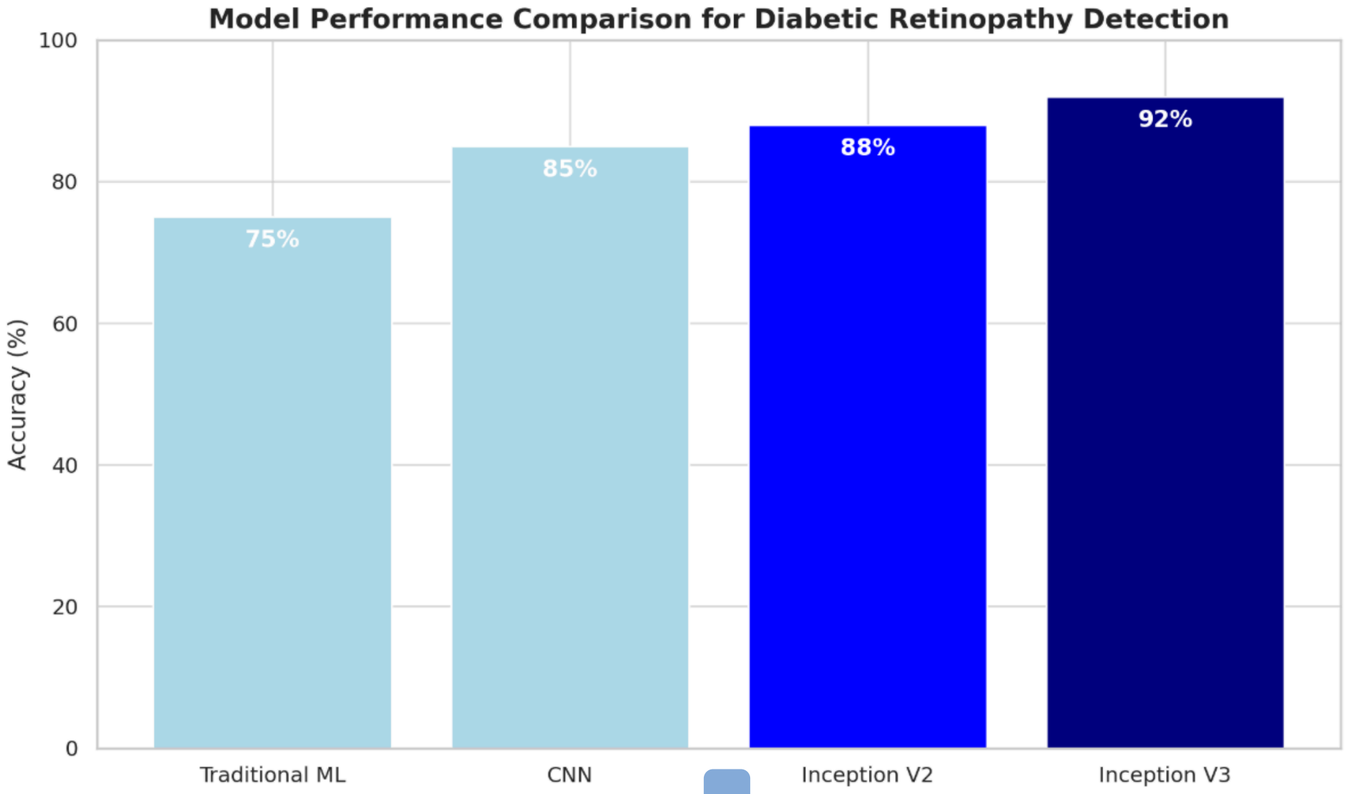


Project Objective

- To develop an automated DR detection system using CNNs (Inception v2/v3).
- Classify retinal fundus images into 5 severity levels: No DR, Mild, Moderate, Severe, Proliferative DR.
- Developed and trained using Google Colab for efficient model building.



Why Deep Learning?



Note: This graph is made from sample data

CNNs outperform traditional methods (e.g., SVM, k-NN) in medical image classification.

Inception v2/v3 excel in feature extraction with minimal labeled data via transfer learning.

Benefits: Accuracy, scalability, and potential for real-time diagnosis.

Methodology Overview

6 System Implementation

Deploying the system using Google Colab

5 Performance Evaluation

Assessing model accuracy and reliability

4 Image Classification

Classifying images to diagnose DR

3 Training Strategy

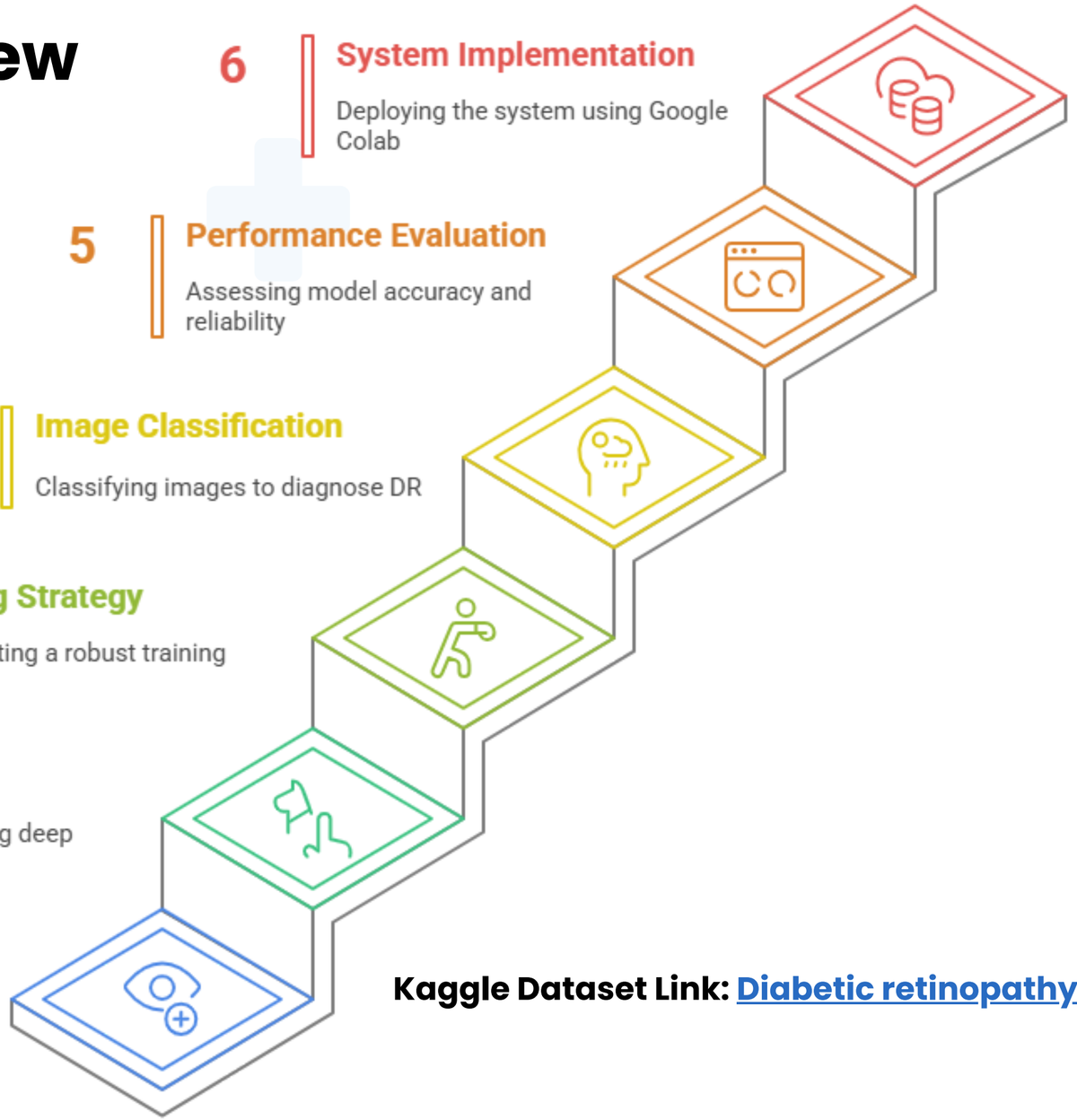
Implementing a robust training approach

2 Model Selection

Choosing and fine-tuning deep learning models

1 Data Collection

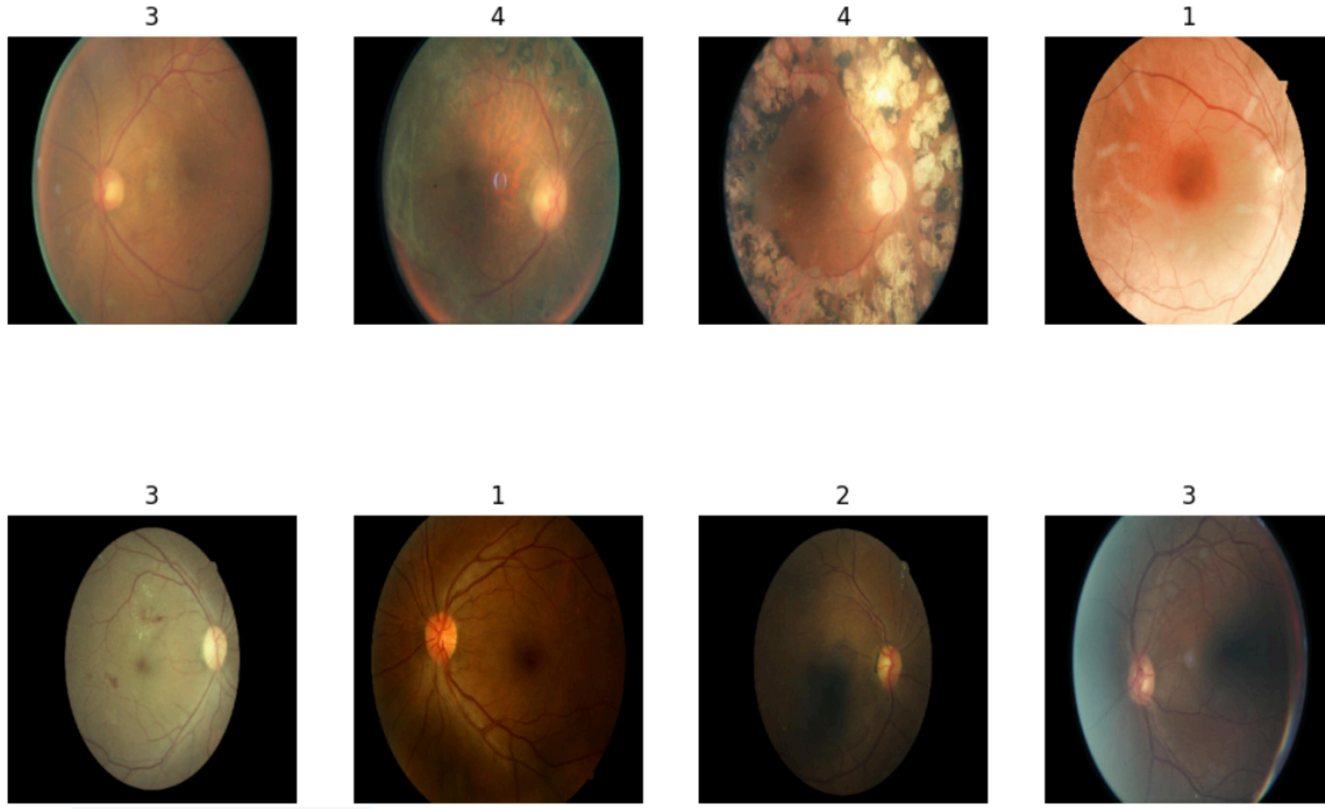
Gathering and preprocessing retinal images for analysis



Kaggle Dataset Link: [Diabetic retinopathy detection 2023]

Data Collection & Preprocessing

- Dataset: 2000 training, 500 validation high-resolution fundus images.
- Preprocessing: Resize to 299x299, apply CLAHE for contrast, use data augmentation (rotation, flipping).
- Address class imbalance with GAN-based synthetic data.



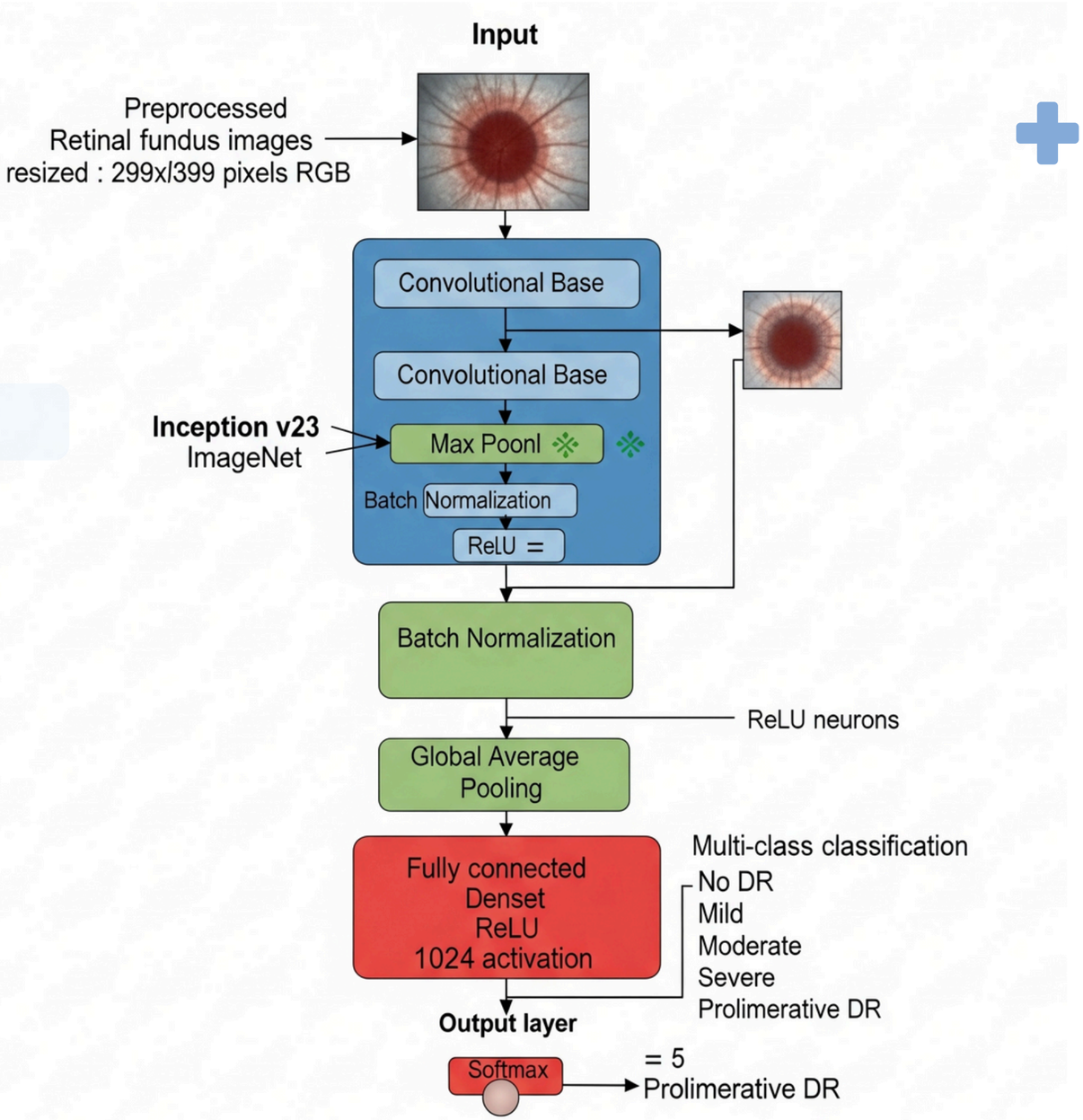
Note: Class 0 - No DR Class 1 - Mild Class 2 - Moderate Class 3 - Severe Class 4 - Proliferative DR

Model Architecture

Inception v2/v3 with transfer learning from ImageNet.

Layers: Global average pooling, 1024-neuron dense layer (ReLU), 5-neuron softmax output.

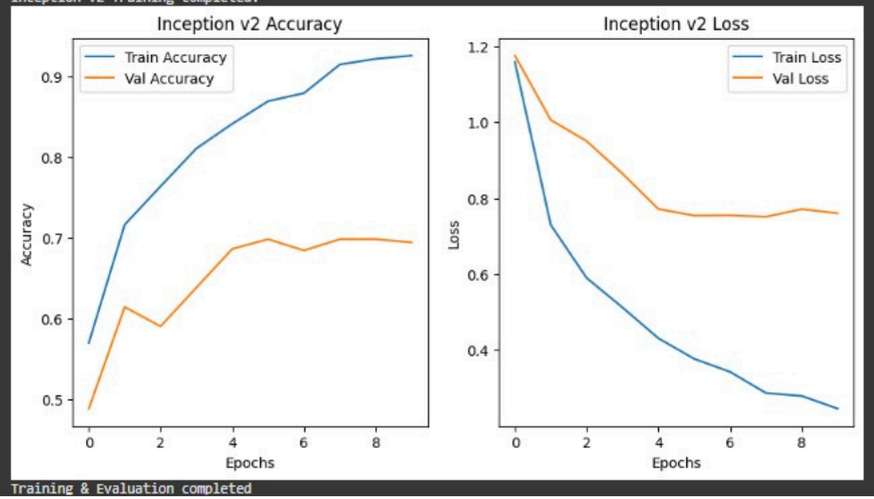
Training: 70% train, 20% validation, 10% test; Adam optimizer, early stopping.



Inception v2/v3-based CNN for Diabetic Retinopathy Classification

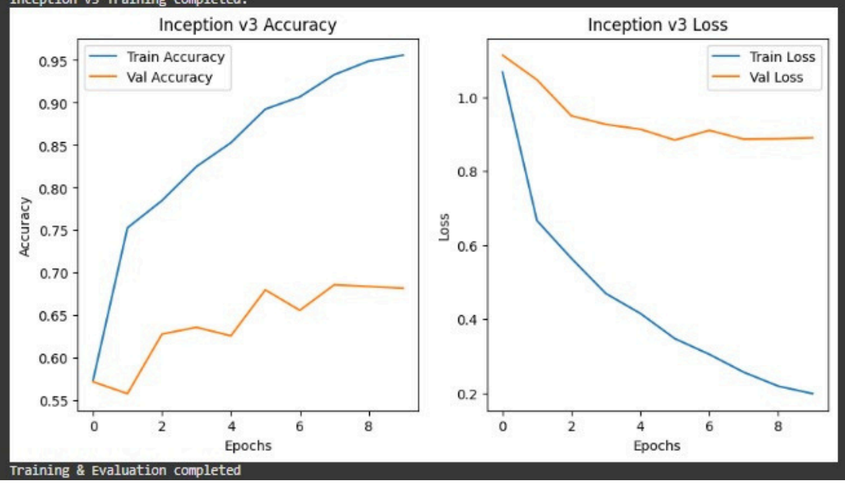
Results and Future Enhancements

```
Training Inception v2...
Epoch 1/10
63/63 ━━━━━━━━━━━━━━━━━━━━ 74s 734ms/step - accuracy: 0.4770 - loss: 1.4221 - val_accuracy: 0.4880 - val_loss: 1.1755
Epoch 2/10
63/63 ━━━━━━━━━━━━━━━━━━━━ 26s 384ms/step - accuracy: 0.7201 - loss: 0.7280 - val_accuracy: 0.6140 - val_loss: 1.0061
Epoch 3/10
63/63 ━━━━━━━━━━━━━━━━━━━━ 42s 390ms/step - accuracy: 0.7537 - loss: 0.6109 - val_accuracy: 0.5900 - val_loss: 0.9505
Epoch 4/10
63/63 ━━━━━━━━━━━━━━━━━━━━ 26s 380ms/step - accuracy: 0.8154 - loss: 0.4883 - val_accuracy: 0.6380 - val_loss: 0.8649
Epoch 5/10
63/63 ━━━━━━━━━━━━━━━━━━━━ 27s 396ms/step - accuracy: 0.8587 - loss: 0.4068 - val_accuracy: 0.6860 - val_loss: 0.7718
Epoch 6/10
63/63 ━━━━━━━━━━━━━━━━━━━━ 28s 411ms/step - accuracy: 0.8652 - loss: 0.3755 - val_accuracy: 0.6980 - val_loss: 0.7545
Epoch 7/10
63/63 ━━━━━━━━━━━━━━━━━━━━ 40s 389ms/step - accuracy: 0.8941 - loss: 0.3245 - val_accuracy: 0.6840 - val_loss: 0.7552
Epoch 8/10
63/63 ━━━━━━━━━━━━━━━━━━━━ 27s 398ms/step - accuracy: 0.9274 - loss: 0.2700 - val_accuracy: 0.6980 - val_loss: 0.7514
Epoch 9/10
63/63 ━━━━━━━━━━━━━━━━━━━━ 41s 400ms/step - accuracy: 0.9305 - loss: 0.2669 - val_accuracy: 0.6980 - val_loss: 0.7715
Epoch 10/10
63/63 ━━━━━━━━━━━━━━━━━━━━ 27s 399ms/step - accuracy: 0.9395 - loss: 0.2195 - val_accuracy: 0.6940 - val_loss: 0.7607
Inception v2 Training completed.
```




```
Training & Evaluation completed
```

```
Training Inception v3...
Epoch 1/10
/usr/local/lib/python3.11/dist-packages/keras/src/trainers/data_adapters/py_dataset_adapter.py:122: UserWarning: Your `PyDataset` class sh
  self._warn_if_super_not_called()
63/63 ━━━━━━━━━━━━━━━━━━━━ 1049s 15s/step - accuracy: 0.4897 - loss: 1.2932 - val_accuracy: 0.5720 - val_loss: 1.1142
Epoch 2/10
63/63 ━━━━━━━━━━━━━━━━━━━━ 22s 315ms/step - accuracy: 0.7490 - loss: 0.6746 - val_accuracy: 0.5580 - val_loss: 1.0475
Epoch 3/10
63/63 ━━━━━━━━━━━━━━━━━━━━ 42s 325ms/step - accuracy: 0.7817 - loss: 0.5649 - val_accuracy: 0.6280 - val_loss: 0.9500
Epoch 4/10
63/63 ━━━━━━━━━━━━━━━━━━━━ 22s 317ms/step - accuracy: 0.8599 - loss: 0.4264 - val_accuracy: 0.6360 - val_loss: 0.9269
Epoch 5/10
63/63 ━━━━━━━━━━━━━━━━━━━━ 40s 315ms/step - accuracy: 0.8528 - loss: 0.4172 - val_accuracy: 0.6260 - val_loss: 0.9137
Epoch 6/10
63/63 ━━━━━━━━━━━━━━━━━━━━ 23s 341ms/step - accuracy: 0.8956 - loss: 0.3409 - val_accuracy: 0.6800 - val_loss: 0.8845
Epoch 7/10
63/63 ━━━━━━━━━━━━━━━━━━━━ 40s 315ms/step - accuracy: 0.9115 - loss: 0.2939 - val_accuracy: 0.6560 - val_loss: 0.9106
Epoch 8/10
63/63 ━━━━━━━━━━━━━━━━━━━━ 23s 336ms/step - accuracy: 0.9427 - loss: 0.2501 - val_accuracy: 0.6860 - val_loss: 0.8870
Epoch 9/10
63/63 ━━━━━━━━━━━━━━━━━━━━ 23s 333ms/step - accuracy: 0.9513 - loss: 0.2171 - val_accuracy: 0.6840 - val_loss: 0.8881
Epoch 10/10
63/63 ━━━━━━━━━━━━━━━━━━━━ 22s 326ms/step - accuracy: 0.9522 - loss: 0.1998 - val_accuracy: 0.6820 - val_loss: 0.8906
Inception v3 Training completed.
```

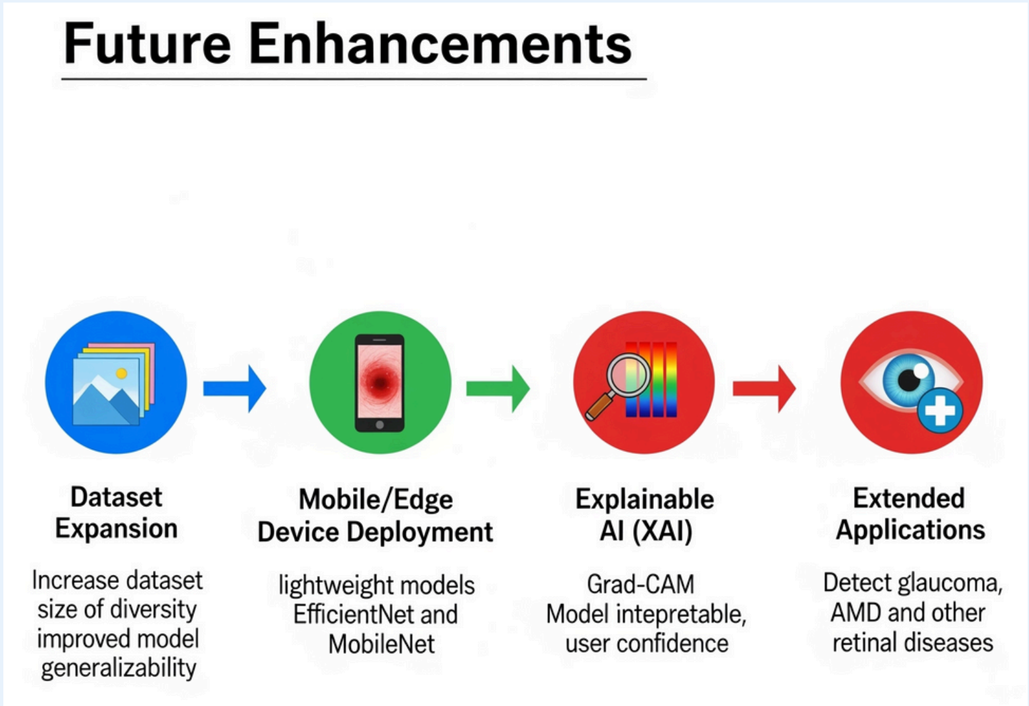



```
Training & Evaluation completed
```

Source: Google Colab

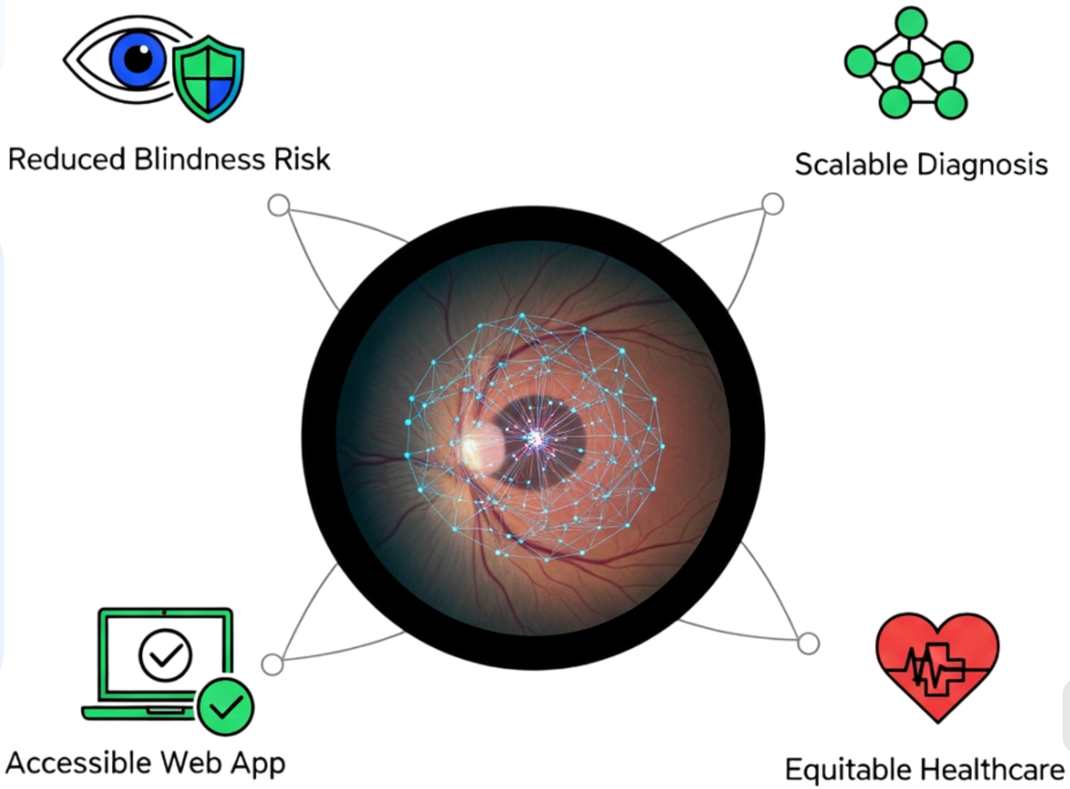
Results and Future Enhancements

- **Results:** Inception v3 outperformed baseline CNN and Inception v2 in classifying diabetic retinopathy, achieving high accuracy, precision, recall, F1-score, and ROC-AUC. Stable generalization with minimal overfitting, validated on 2000 training and 500 validation fundus images.
- **Impact:** Enables early DR detection, reducing blindness risk and ophthalmologist workload, especially in low-resource settings.
- **Future Potential:** Expand dataset for better generalizability, integrate lightweight models (e.g., EfficientNet, MobileNet) for mobile/edge devices, enhance interpretability with XAI (Grad-CAM), and extend to glaucoma and AMD detection.



Conclusion

- Automated DR detection reduces blindness risk and ophthalmologist workload.
- Inception v2/v3 CNNs enable accurate, scalable diagnosis across five severity levels.
- AI-driven diagnostics pave the way for equitable, efficient eye care globally.



Empowering Global Eye Care with AI

THANK YOU
FOR YOUR ATTENTION

ANY QUESTIONS?