📄 Report: Diabetic Retinopathy Detection

Hackathon Submission - 2025
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1️⃣ Introduction

Diabetic Retinopathy (DR) is a **serious eye disease** that occurs due to **diabetes** and can lead to blindness if not detected early. This project aims to **automate DR detection using AI** by classifying retinal images into **five categories**:

1. **No_DR** → No Diabetic Retinopathy
2. **Mild** → Early-stage DR
3. **Moderate** → Medium severity
4. **Severe** → High risk of vision loss
5. **Proliferative_DR** → Advanced stage, can cause blindness

2️⃣ Problem Statement

- **Current medical diagnosis of DR is time-consuming & expensive.**
- **A large number of people lack access to specialized doctors.**
- **Automated detection using AI can help in early diagnosis and treatment.**

This project develops a **deep learning model** to analyze retinal images and classify them into **DR severity levels**.

3️⃣ Dataset Used

- **Source:** Kaggle - "Diabetic Retinopathy Balanced" Dataset
- **Total Images:** `35,000+` Fundus Retinal Images
- **Classes:** `5` (No_DR, Mild, Moderate, Severe, Proliferative_DR)
- **Preprocessing:** Images were **resized to 224x224**, **normalized**, and **augmented** for better accuracy.

4️⃣ Model Architecture

The project uses a **Pre-trained Deep Learning Model (ResNet-50)** to improve accuracy while reducing training time.

🛠️ Model Details

Component	Details
Base Model	ResNet-50 (Pre-trained on ImageNet)
Custom Layers	Flatten, Dense(128, ReLU), Dense(5, Softmax)
Optimizer	Adam
Loss Function	Sparse Categorical Cross-Entropy
Batch Size	32
Image Input Size	224x224

5️⃣ Model Training

Parameter	Value
Training Epochs	`3`
Training Dataset Split	`80% Train, 20% Validation`
Training Time per Epoch	~ `2 Hours`
GPU Used (Colab Free Version)	Tesla T4

6 Results & Accuracy

Metric	Value
Final Validation Accuracy	`37.35%`
Final Validation Loss	`1.3542`
Best Performing Class	No_DR
Worst Performing Class	Proliferative_DR

7 Model Prediction Example

Test Image Input:

📌 Sample Test Image: `"dataset/test/4.png"`

🔍 Model Output:

Actual Label	Predicted Label
`Moderate_DR`	`Mild`

📌 (Error due to class imbalance & fewer training epochs.)

8 Model Explainability - Grad-CAM

To understand **how the model makes decisions**, we used **Grad-CAM (Gradient-weighted Class Activation Mapping)** to visualize important regions in the images.

🔍 Example Grad-CAM Output:

📌 Heatmap overlaid on Test Image

(Insert Grad-CAM visualization screenshot here)

✔ This helps explain which parts of the retina influenced the AI's decision.

9 Challenges Faced

1. **Low Accuracy (37.35%)** → Needs more training epochs
2. **Imbalanced Dataset** → Some classes have fewer images
3. **Colab Training Time Issues** → Free version has limited GPU access
4. **Model Explainability** → AI decisions need medical validation