GDGOC PIEAS AI/ML Hackathon 2025

Diabetes Detection through Retinopathy

Team Members

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Diabetic Retinopathy Detection Using Deep Learning

1. Introduction

Diabetic Retinopathy (DR) is a serious eye disease caused by diabetes and is one of the leading reasons for vision loss worldwide. Early detection of DR can help prevent blindness; however, manual diagnosis requires expert ophthalmologists and is time-consuming.
This project aims to develop an **AI-based image classification model** that automatically detects different stages of Diabetic Retinopathy from retinal fundus images using **deep learning**.

2. Problem Statement

The goal of this project is to classify retinal images into **five severity levels of Diabetic Retinopathy** using a convolutional neural network (CNN). The system should provide accurate predictions and include explainability to understand the model's decisions.

3. Dataset Description

The dataset is obtained from Kaggle and consists of **retinal fundus images** organized into folders. Each folder represents a class label.

Classes

- No DR (Healthy)
- Mild DR
- Moderate DR
- Severe DR
- Proliferative DR

Data Type

- Image data (JPEG/PNG)
- Folder-based labeling

4. Data Preprocessing

To improve model performance, the following preprocessing steps were applied:

- Image resizing to a fixed input size
- Normalization of pixel values
- Data augmentation techniques:
    - Horizontal flipping
    - Rotation
    - Zooming

These steps help reduce overfitting and improve generalization.

5. Model Architecture

A **Convolutional Neural Network (CNN)** was used for classification. The model includes:

- Convolutional layers for feature extraction
- Batch Normalization to stabilize learning
- Max Pooling layers
- Dropout layers to prevent overfitting
- Fully connected dense layers
- SoftMax output layer for multi-class classification

The model was trained from scratch without using pretrained weights.

6. Training Methodology

- Optimizer: Adam
- Loss Function: Categorical Cross-Entropy
- Epochs: Limited with Early Stopping

- Validation split used for performance monitoring

Early stopping was applied to avoid overfitting and selecting the best model.

7. Evaluation Metrics

The model was evaluated using the following metrics:

- Accuracy
- Precision
- Recall
- F1-Score

A classification report was generated to analyze class-wise performance.

8. Model Explainability (Grad-CAM)

To ensure transparency, **Grad-CAM (Gradient-weighted Class Activation Mapping)** was implemented.
Grad-CAM highlights important regions in retinal images that influence the model's predictions, making the system more interpretable and suitable for medical analysis.

9. Results and Discussion

The trained model demonstrated reasonable performance in classifying retinal images into different DR stages. The use of data augmentation and regularization techniques helped improve accuracy and reduce overfitting. Grad-CAM visualizations confirmed that the model focuses on relevant retinal regions.

10. Conclusion

This project demonstrates that deep learning can effectively assist in the early detection of Diabetic Retinopathy. The proposed model provides accurate classification and medical explainability. Future work may include training on larger datasets and experimenting with more advanced architecture.

11. Disclaimer

This project is developed for **academic and hackathon purposes only** and is **not intended for real-world medical diagnosis**.