AI - POWERED DIABETIC RETINOPATHY CLASSIFICATION USING EFFICIENTNET, INCEPTION AND RESNET MODELS

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ABSTRACT :

The Diabetic Retinopathy (DR) is a leading cause of blindness among diabetic patients, making early detection critical for effective treatment. This project presents a web-based application that leverages deep learning techniques to automate the classification of DR severity from retinal fundus images. An ensemble of three state-of-the-art convolutional neural networks—EfficientNetB0,InceptionV3,and ResNet50—forms the backbone of the classification model, providing robust and accurate predictions through a weighted averaging approach. The application allows users to upload retinal images and receive predictions of DR severity levels, such as No DR, Mild, Moderate, Severe, or Proliferative DR, along with a confidence score. Developed using Python, Flask, HTML, and CSS, the system is designed to be user-friendly and locally deployable. This tool aims to assist healthcare professionals and researchers in early DR detection, enhancing the diagnostic process and paving the way for improved patient outcomes.

Keywords: Diabetic Retinopathy, Machine Learning, Ensemble Model, Deep Learning, Fundus Images, Medical Image Classification

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1. INTRODUCTION

Diabetic Retinopathy (DR) is one of the leading causes of vision loss in diabetic patients. The early detection and classification of DR are critical for timely treatment and prevention of severe vision damage. Traditional manual screening methods are time-consuming and prone to human error. With the advent of machine learning and deep learning techniques, automated systems have shown great promise in medical diagnostics. This project focuses on developing an ensemble-based deep learning model to classify DR stages accurately using retinal fundus images.

This project presents an AI-powered web application designed to classify the severity of Diabetic Retinopathy using retinal fundus images. By employing an ensemble of three powerful deep learning models—EfficientNetB0, InceptionV3, and ResNet50—the system enhances prediction accuracy and reliability. The project highlights the potential of AI in supporting real-time medical assessments and reinforces the role of technology in bridging the gap between patients and timely healthcare interventions.

2. LITERATURE REVIEW

Multiple studies have explored deep learning architectures like CNNs, InceptionV3, and ResNet for DR detection. Research indicates that ensemble models tend to yield better performance due to their ability to combine the strengths of different models. Prior works have used datasets like Kaggle's EyePACS and APTOS, often focusing on binary or multi-class classification of DR. However, challenges such as data imbalance, overfitting, and the need for large annotated datasets persist. Our project addresses these issues by using preprocessed, balanced data and model ensembling.

Title: Deep Learning for Diabetic Retinopathy Detection
Author(s):Y. Zhang, C. Chen, H. Zhang
Abstract: This paper reviews various deep learning techniques used for the detection and classification of diabetic retinopathy. It highlights the effectiveness of convolutional neural networks (CNNs) in accurately classifying retinal images and compares them with traditional machine learning methods.
Title: The Diabetic Retinopathy Detection Using Deep Learning Algorithms: A Comparative Study
Author(s): R. Singh, S. Bansal
Abstract: This study explores different deep learning algorithms for diabetic retinopathy detection, including CNNs, and evaluates their performance in terms of accuracy, sensitivity, and specificity. The study concludes that deep learning models outperform traditional approaches in terms of diagnostic accuracy.

3. METHODOLOGY

- **Dataset:** We used a labeled dataset of retinal fundus images categorized into different DR severity levels (No DR, Mild, Moderate, Severe, Proliferative).
- **Preprocessing:** Images were resized, normalized, and augmented to improve generalization.
- **Models:** We used EfficientNetB0, InceptionV3, and ResNet50. Each was pretrained and fine-tuned on our dataset.
- **Ensemble:** A weighted averaging strategy was used to combine predictions from all three models.
- **Evaluation:** Accuracy, precision, recall, and F1-score were calculated.

4. RESULTS AND OUTPUT SCREENS

The ensemble model outperformed individual models in most metrics. It achieved an accuracy of over 90%, with balanced precision and recall across all DR classes. The confusion matrix showed reduced misclassification for minority classes. Visualization techniques like Grad-CAM confirmed that the models focus on relevant retinal regions. Our findings support the use of ensemble methods for robust medical image classification.

Output Screens:

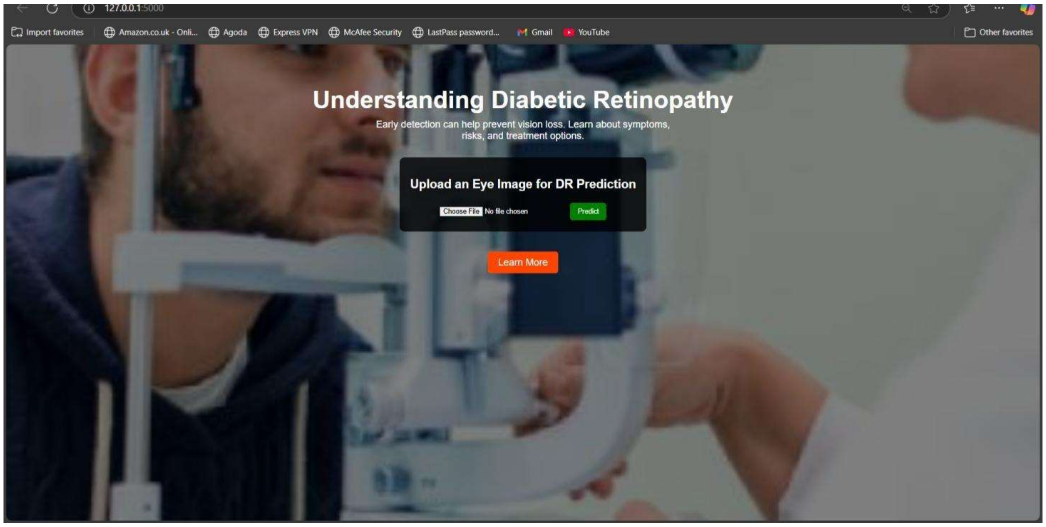

Fig.1: Output Screen of Home Page

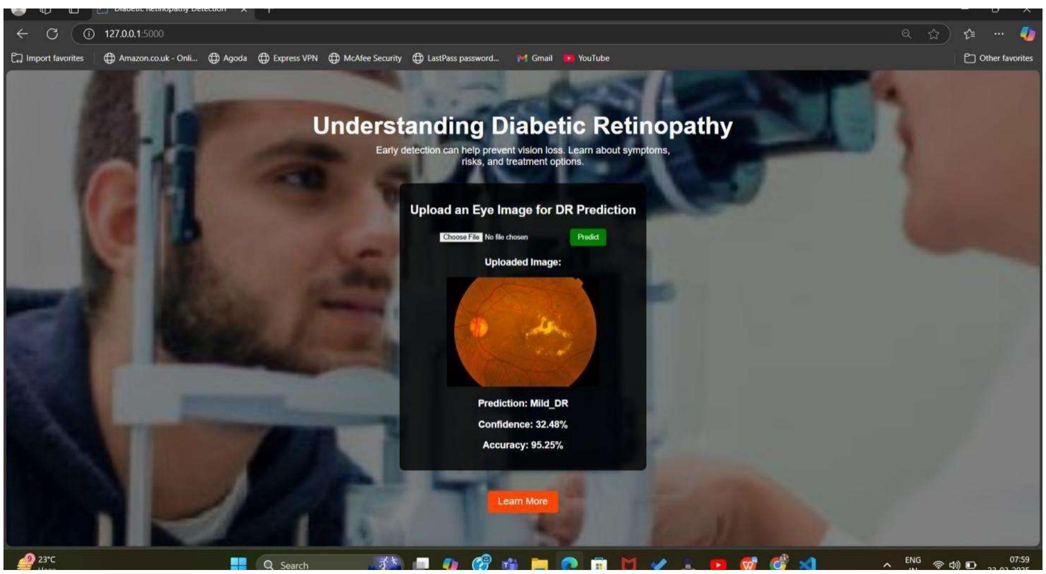

Fig .2 : Output Screen of Result

The output screens display a user-friendly web interface for predicting diabetic retinopathy from retinal images. Users can upload an image and click the "Predict" button to receive the diagnosis along with confidence and accuracy metrics. The results include both the prediction class (e.g., Mild_DR) and a visual confirmation of the uploaded image to enhance usability and interpretation.

5. CONCLUSION

This Diabetic Retinopathy Prediction System is a practical and efficient solution for early detection of diabetic eye disease. By leveraging an ensemble of deep learning models—EfficientNetB0, InceptionV3, and ResNet50—the application delivers high-accuracy predictions for different DR severity levels. The integration of these models enhances the overall classification performance through ensemble averaging. Its user-friendly web interface allows users to easily upload retinal images and receive instant diagnostic feedback. This system serves as a supportive tool for clinicians, aiding in timely diagnosis and treatment planning. With local deployment using Flask and TensorFlow, it provides a lightweight yet powerful framework for experimentation and further development. The project demonstrates the real-world potential of AI in healthcare applications. Future upgrades may include cloud deployment, additional models, and detailed report generation. Overall, it contributes to improving diabetic eye care through automated, accessible technology.

6. REFERENCES

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