SYNOPSIS

Automated Diabetic Retinopathy Prediction System

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Computer Science and Engineering

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TABLE OF CONTENT

Introduction

Background

Diabetic retinopathy is a common and serious complication of diabetes that affects the eyes, potentially leading to blindness if left untreated. It occurs when high blood sugar levels damage the blood vessels in the retina, the part of the eye that detects light and sends signals to the brain. Early detection is critical in preventing irreversible vision loss, but traditional diagnostic methods, such as fundus photography and optical coherence tomography (OCT), are often expensive, invasive, and require specialized equipment, limiting access in many regions of the world.

Motivation

The motivation for this project arises from the need to develop a non-invasive, cost-effective, and accessible diagnostic tool for diabetic retinopathy. Retina imaging presents a novel solution by capturing detailed images of the eye, which may reveal abnormalities related to blood flow and early signs of retinopathy. When integrated with AI-powered models, these retina images can be processed and analyzed to detect patterns indicative of diabetic retinopathy.

This **Automated Diabetes Prediction System** aims to harness the potential of standard retina imaging and AI to create a diagnostic tool that can provide accurate, early-stage detection of diabetic retinopathy, particularly in resource-constrained settings. By automating the diagnostic process, the tool will reduce the need for specialized healthcare professionals and expensive equipment, improving accessibility for patients in remote and underserved areas.

Objective

The primary goal of this project is to develop an automated system that utilizes retina images to predict diabetic retinopathy. The tool will employ machine learning and deep learning algorithms to analyze the retinal data, identify early indicators of retinal damage, and provide a reliable diagnosis. By creating a non-invasive and automated system, this project seeks to make diabetic retinopathy screening more efficient, scalable, and accessible.

Innovativeness and Usefulness

Innovativeness

- This project introduces an innovative approach to diagnosing diabetic retinopathy by utilizing **retina images**, which is not typically used in standard diagnostic methods for eye diseases.
- The Automated Diabetes Prediction System leverages eye images to detect retinal blood flow changes caused by diabetic retinopathy.
- By utilizing convolutional neural networks **(CNNs)** and other advanced AI algorithms for image classification and anomaly detection, this system will bring cutting-edge AI technology to a previously unexplored area of diabetic retinopathy diagnostics.

Usefulness

- **Clinical Application:** Ophthalmologists can use this model as a supportive tool for second opinions, ensuring that patients with DR are identified early for timely treatment.
- **Cost-Effectiveness:** Compared to traditional diagnostic methods, imaging equipment is relatively inexpensive.
- **Early Detection:** The system is designed to detect early signs of diabetic retinopathy before symptoms manifest, allowing for timely intervention and preventing vision loss.

Methodology

- **Data Collection:** Retinal images from Kaggle's DR dataset are categorized into five stages: Normal, Mild, Moderate, Severe, and Proliferate.
- **Preprocessing:** Images undergo preprocessing techniques such as resizing, normalization, and augmentation to enhance model training.
- **Model Development:** A deep learning model is built using a convolutional neural network (CNN) architecture. The dataset is divided into training, validation, and test sets to ensure robustness.
- **Training:** The model is trained on the labeled dataset to recognize patterns indicative of different DR stages.
- **Evaluation:** Metrics like accuracy, precision, recall, and F1-score are used to assess model performance, alongside a classification report.

Technology Used

Programming Languages

- **Python 3.9:** For model training and web development.
- **HTML/CSS:** For frontend design.

Frameworks and Libraries

- **TensorFlow 2.1.0:** Used for building and training the deep learning model.
- **Keras:** A high-level API that simplifies the implementation of neural networks.
- **Django:** Web framework used to create the backend of the application, ensuring smooth interaction between the model and users.
- **OpenCV:** For image preprocessing and augmentation.
- **NumPy, Pandas:** For data handling and manipulation.

Frontend Tools

- **HTML/CSS:** For creating and styling the user interface.
- **JavaScript:** Enhances user interaction by adding dynamic functionality.

Hardware

- **GPU:** NVIDIA GTX 1650 for faster training of the neural network.

Expected Outcome

The project aims to deliver a deep learning model that can:

- Accurately classify retinal images into the five stages of Diabetic Retinopathy.
- Be accessed via a web interface, enabling easy integration into clinical workflows.
- Provide real-time predictions with a user-friendly design, offering an accessible tool for ophthalmologists and healthcare professionals.

The **web UI** will allow users to upload retinal images, view results, and generate reports based on the model's predictions.