Diabetic Retinopathy Detection Using Deep Learning

A web-based deep learning application for early detection of **Diabetic Retinopathy (DR)** from retinal fundus images using a pre-trained **Xception CNN model**.

Overview

Diabetic Retinopathy is a diabetes-related eye disease that can lead to vision loss if not detected early. This project provides an automated screening system that analyzes retinal fundus images and predicts the presence of Diabetic Retinopathy. The model is deployed using a Flask web application, making it easy to use for demonstration and academic purposes.

Key Features

- Automated detection of Diabetic Retinopathy from fundus images
- Deep Learning model based on Xception architecture
- Simple and clean Flask web interface
- Image upload and prediction functionality
- User authentication support
- Optional PostgreSQL database integration

Tech Stack

- **Language:** Python 3.9 / 3.10
- **Deep Learning:** TensorFlow, Keras
- **Image Processing:** OpenCV, Pillow
- **Web Framework:** Flask
- **Database:** PostgreSQL (psycopg2)
- **Tools:** VS Code, Jupyter Notebook

Model Details

- **Architecture:** Xception (Transfer Learning)
- **Input Size:** 299 × 299 × 3
- **Model File:**`Updated-xception-diabetic-retinopathy.h5`
- **Task:** Binary / multi-class classification (depending on training)

A pre-trained model is used. Training is optional unless customization is required.

Project Structure

```
project-folder/
├── app.py
├── model/
│   └── Updated-xception-diabetic-retinopathy.h5
├── static/
│   ├── css/
│   └── images/
├── templates/
│   ├── login.html
│   ├── register.html
│   └── index.html
├── requirements.txt
```

Installation & Setup

1. Clone the Repository

```
git clone <repository-url>
cd project-folder
```

2. Create Virtual Environment (Recommended)

```
python -m venv venv
venv\Scripts\activate
```

3. Install Dependencies

```
pip install -r requirements.txt
```

4. Run the Application

```
python app.py
```

Open browser and visit: `http://127.0.0.1:5000/`

How It Works

1. User uploads a retinal fundus image
2. Image is preprocessed to match model input
3. Model predicts Diabetic Retinopathy status
4. Final diagnosis is displayed on the UI

Results

- Fast and reliable predictions
- Works best with clear, high-quality fundus images
- Suitable for academic and demonstration purposes

Limitations

- Depends on image quality
- Not a replacement for professional medical diagnosis
- Model performance depends on training data

Future Improvements

- Multi-class severity classification
- Explainable AI (Grad-CAM)
- UI/UX enhancements
- Cloud deployment

Disclaimer

This project is intended for **educational and research purposes only** and should not be used as a standalone medical diagnostic tool.
