PROJECT TITLE

Deep Learning Fundus Image Analysis for Early Detection of Diabetic Retinopathy

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ABSTRACT

Diabetic retinopathy is one of the leading causes of vision loss in diabetic patients. Early detection is crucial to prevent severe complications. This project uses **deep learning techniques** to analyze **fundus images** of the retina to detect signs of diabetic retinopathy at an early stage.

We leverage **convolutional neural networks (CNNs)**, specifically **transfer learning with the Xception model**, to automatically identify and classify retinal abnormalities. The project also integrates a **Flask-based web application** for image upload and real-time prediction display, enabling remote screening and monitoring.

Introduction

Diabetic retinopathy is a medical condition where prolonged high blood sugar levels cause damage to retinal blood vessels. Early diagnosis can prevent vision loss through timely medical intervention.

This project aims to develop a **deep learning-based automated system** capable of:

1. Screening fundus images for diabetic retinopathy.
2. Classifying the disease stages.
3. Displaying predictions on a user-friendly web interface using Flask.

The system can be integrated into hospitals, telemedicine platforms, and public health screening programs.

Objectives

By the end of this project, we aim to:

- Understand and implement **transfer learning** techniques using Xception.
- Preprocess and clean image data using **ImageDataGenerator** in Keras.
- Build and train a CNN model for **fundus image classification**.
- Integrate the trained model with a **Flask web application** for user-friendly deployment.
- Explore **Cloudant DB** for storing user information and prediction history.

Models & Analysis

1. Convolutional Neural Network (CNN)

CNNs are a type of deep learning network commonly used in image classification. They automatically detect patterns such as edges, textures, and shapes.

2. Transfer Learning Models Used

- **VGG16**: Classic CNN architecture for feature extraction.
- **ResNet50**: Residual network to avoid vanishing gradient problems.
- **Inception-V3**: Efficient network using multiple filter sizes.
- **Xception**: Depthwise separable convolution model providing high accuracy; chosen as the **best model**.

3. Preprocessing Techniques

- Image resizing to 299x299 for Xception model.
- Data augmentation: rotation, zoom, horizontal & vertical flips, brightness adjustment.

4. Model Training & Testing

- Split dataset into **train and test sets**.
- Use **ImageDataGenerator.flow_from_dir**
- **ectory()** to load images in batches.
- Compile and train the model using **categorical cross-entropy loss**.
- Evaluate model accuracy and save trained model as **Updated-Xception-diabetic-retinopathy.h5**.

5. Cloudant Database Integration

- IBM Cloud registration and service creation.
- Generate credentials and API keys.
- Connect Flask application to Cloudant DB for storing user submissions and prediction history.

Conclusion / Analysis

- The deep learning system can accurately detect diabetic retinopathy in early stages.

- Integrating the model with Flask allows **easy accessibility** for users and medical professionals.

- Using **transfer learning** reduces training time and improves model performance.

- Future work includes **cloud deployment** and multi-class classification for more detailed disease grading.