Diabetic Retinopathy Detection

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ABSTRACT

Diabetic retinopathy (DR) is a leading cause of vision impairment, resulting from prolonged diabetes. Early detection is crucial to prevent irreversible damage, but manual diagnosis by ophthalmologists is time-consuming and prone to human error. This project proposes an automated approach for DR detection using deep learning, specifically the ResNet50 model, to classify retinal fundus images into different stages of diabetic retinopathy. The model was trained on a publicly available dataset such as Kaggle's APTOS, leveraging transfer learning to enhance accuracy. Preprocessing techniques, including image augmentation and normalization, were applied to improve robustness. The ResNet50 architecture, known for its deep residual connections, effectively addressed vanishing gradient problems and improved feature extraction.

Keywords — *Diabetic Retinopathy, Deep Learning, Retinal Fundus Images, Convolutional Neural Networks (CNN), Automated Diagnosis, Medical Image Analysis, Early Detection, Computer-Aided Diagnosis (CAD)*

1. INTRODUCTION

The motivation behind this project stems from the critical need for early and accurate detection of diabetic retinopathy (DR), a leading cause of blindness among diabetic patients. Manual diagnosis by ophthalmologists is time-consuming, subjective, and often inaccessible in low-resource regions. With the increasing global prevalence of diabetes, there is an urgent demand for an automated, cost-effective solution that can assist in mass screening and reduce diagnostic delays. Leveraging deep learning for DR detection can enhance efficiency, minimize human error, and improve patient outcomes by enabling timely intervention.

2. PROBLEM STATEMENT

Diabetic retinopathy (DR) is a leading cause of preventable blindness worldwide, particularly among diabetic patients. Current diagnostic methods rely heavily on manual examination of retinal fundus images by ophthalmologists, which is time-consuming, subjective, and often inaccessible in resource-limited regions. This project aims to develop an automated deep learning-based system for accurate and efficient DR detection, reducing diagnostic delays and improving early intervention outcomes.

3. LITERATURE REVIEW

Farrikh Alzami, 2019 described a system for diabetic retinopathy grade classification based on fractal analysis and random forest using MESSIDOR dataset. Their system segmented the images, then computed the fractal dimensions as features. They failed to distinguish mild diabetic retinopathy to severe diabetic retinopathy.

[Qomariah 2019] proffered an automated system for classification of Diabetic Retinopathy and normal retinal images using concurrent neural network (CNN) and support vector machine (SVM). Features comprised of exudates, haemorrhage and microaneurysms. The author partitioned the proposed system into 2 parts: the first part composed with feature extraction based on neural networks and the second part performed classification using SVM.

[Sangwan, 2015] described a system that identifies different stages of diabetic retinopathy based on blood vessels, haemorrhage and exudates. The features are extracted using image pre-processing and they are fed into the neural network.

SVM based training provided into the data and classify the images into three categories as mild, moderate non proliferative diabetic retinopathy and proliferative diabetic retinopathy. But the system could not give expected results if the exudate areas in the fundus images exceeds that of an optical disc size.

4. METHODOLOGY

[1] Frontend: Developed using HTML, CSS, JavaScript.
[2] Backend: Built using Python with Flask.
[3] Database: MySQL, enabling scalable, secure data storage.
[4] Functional Modules:

User Interface Module: Simple web interface for doctors and technicians.
Image Upload and Preprocessing Module: Supports DICOM, JPEG, and PNG image formats.
DR Classification Module: ResNet50 model is fine-tuned for 5 DR levels (ICDR standard).
Diagnostic Report Module: Generates reports in PDF or HTML format.
Alerting Module: Sends alerts for serious DR cases (SMS/Email).
User Management Module: Uses OAuth2 login with multi-factor authentication (MFA).

5. System Architecture Diagram

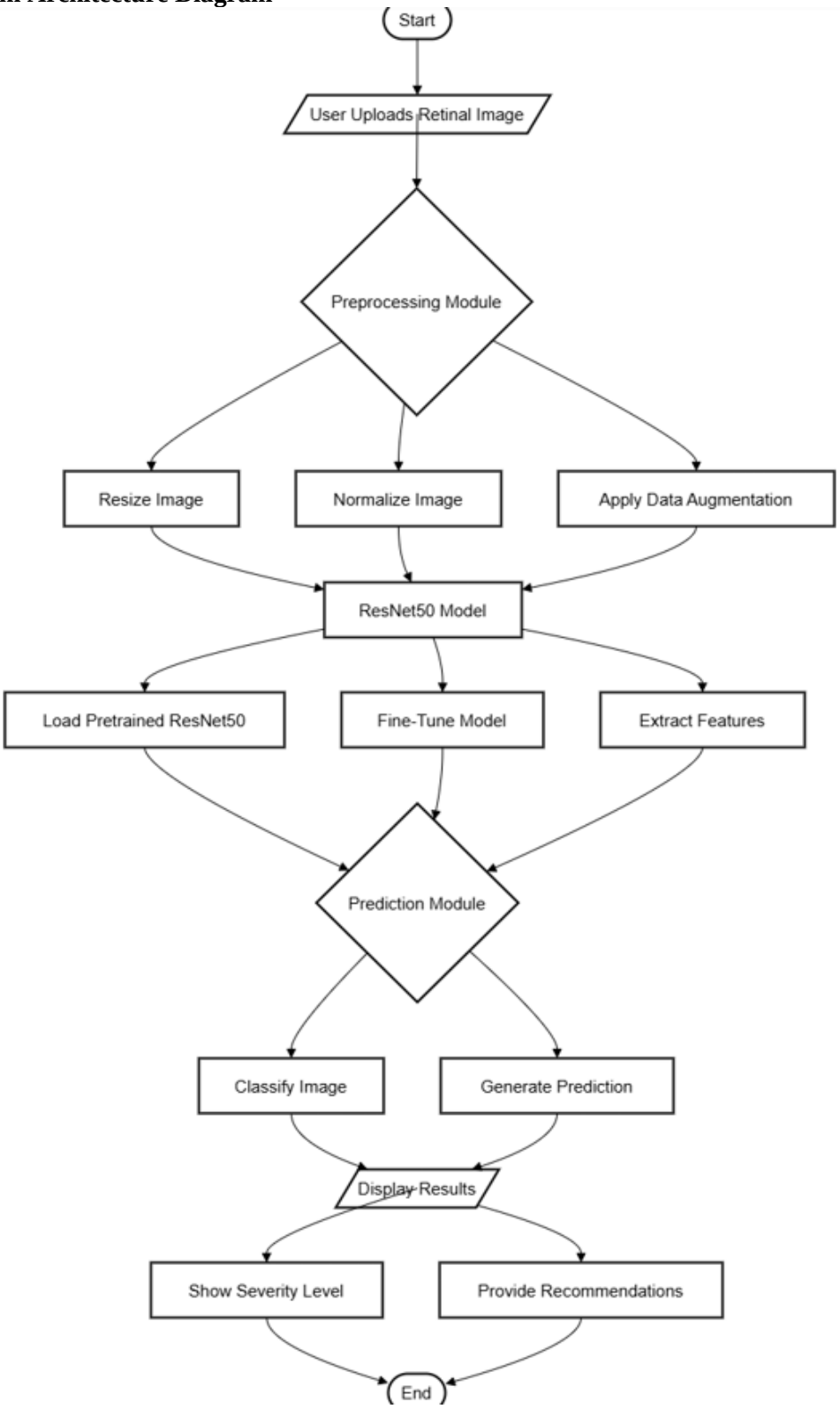

Fig 1: System Architecture Diagram

6. CONCLUSION

The *Automated Diabetic Retinopathy Detection System* is a major step forward in eye care. It uses deep learning, especially a fine-tuned ResNet50 model, to detect diabetic retinopathy (DR) from retinal images accurately and quickly

7. REFERENCES

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