Advancing Diabetic Retinopathy Detection: An Ensemble Deep Learning Approach for Enhanced Classification Accuracy, Sirisha Daggubati

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Abstract

Diabetic retinopathy (DR) is a leading cause of preventable blindness in diabetic patients, necessitating timely screening and grading of retinal images to mitigate vision loss. This paper presents a three-stage ensemble of deep convolutional neural network (CNN) models for accurate DR detection and grading using fundus images. Each input image is divided into two patches and processed through four pre-trained CNN models (Xception, ResNet-50, InceptionV3, Xception). In the first stage, shallow and dense layer features from these models are integrated to capture significant DR information.

In the second stage, an artificial neural network (ANN) classifier is trained using fused probability vectors from the two patches. The final stage combines the outputs of individual CNN models to produce the final decision, leveraging an ensemble technique. This multi-level deep learning approach, which merges detailed local patch features with the holistic context of the entire fundus image, achieves superior classification accuracy.

The proposed method was evaluated against three classification schemes using a dataset of 1890 APTOS images, demonstrating the highest accuracy with 94.3% classification accuracy via tenfold cross-validation. This underscores its effectiveness in DR grading. The study highlights the significant roles of both local and global features in DR classification, setting the stage for further advancements in automated DR screening. Future work will explore more sophisticated neural network architectures and detailed classification of proliferative DR (PDR) images, aiming for a comprehensive and precise automatic DR grading system.

Keywords: *Diabetic retinopathy, Ensemble, Shallow and dense layer features, Pre-trained CNN models*