Automated Diagnosis of Diabetic Retinopathy Severity in Color Fundus Images Using a Novel Synthesis of Biological and Data Driven Approaches

Shah, Manan

Gargeya, Rishab

Diabetic retinopathy (DR) is one of the leading causes of preventable blindness globally. Current screening for DR is based on manual grading of severity, leading to undiagnosed and untreated disease where screening specialists are not easily available. The goal of this work is to develop a computer-aided algorithm for the automated gradation and detection of retinopathy severity extracted from color retinal scans. Current automated algorithms for DR detection only focus on deriving features related to specific biological characteristics in retinal images. These methods, however, do not generalize to real-world clinical datasets, and are evaluated on few (~300) high quality images. We hypothesize that data-driven analysis of retinal images in large, heterogeneous datasets combined with biological feature extraction methods will greatly enhance automated classification accuracy and strengthen the clinical value of such tools. We trained and tested our model on 88,702 varied fundus images in which disease acuteness was assessed by a retina specialist on a scale of 0 through 4. Our methods for data-driven analysis include convolutional neural networks and intensive regression models. Biological feature extraction methods include mathematical morphology and Gabor filter banks. The quadratic weighted kappa between predicted and actual classes was 0.72 and the model's AUROC was 0.89 (with the overall ensemble slightly improving results), indicating excellent agreement between predictions and the gold standard. Our model performed as well as the average inter-rater agreement between optometrists and ophthalmologists in clinical settings, indicating its widespread viability as an efficient and reliable tool for DR severity gradation.

Awards Won:

Third Award of $1,000