Comparing the Efficiency of Novel Point-Of-Care, Low-Cost Neural Networks in Identifying Specific Stages of Diabetic Retinopathy Across a Limited Retinal Dataset

Dhruv, Aum (School: Fort Myers High School)
Harty, Nicholas (School: Fort Myers High School)

Diabetic retinopathy is a complication, caused by a history of diabetes, that slowly deteriorates a person's vision and severely impacts those in low-income areas due to a lack of available testing. The preventable nature of these complications led to the researchers' study of the accuracy of convolutional neural network algorithms compared to k-nearest neighbors algorithm, over different training sample sizes, in identifying specific stages of DR in retinal images. To study such differences, the investigators developed these two closed algorithms through TensorFlow API to serve as an accessible web utility. After preliminary setup, the researchers began training the algorithm with samples at increments and testing their accuracy via their developed online/public platform. The experimentation produced accuracies categorized by DR severity and NN algorithm. In both algorithms, there was a general increase in accuracy as the training sample size increased. The CNN algorithm produced greater accuracy across higher training sample sizes (n=375) compared to KNN, which produced greater accuracy across lower training sample sizes (n=250), supporting the investigators' hypothesis. For each training sample size, a two-way ANOVA generated p-values less than the significance level of 0.05. The null hypothesis—no statistical significance between the algorithm type and its average accuracy across training sample sizes—was rejected. Researchers concluded it was a statistically significant relationship, proving that the algorithm type played a role in its accuracy. These results coincide with the global ophthalmic community that seeks widespread testing on behalf of those in low-income areas who are most at risk for DR.

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