Diagnosis of Various Diseases Using Neural Network Classification Based on Retinal Fundus Images

Gupta, Aneesh (School: Oregon Episcopal School)

Glaucoma and diabetic retinopathy are two of the leading causes of blindness in the United States today. Yet fifty percent of people with glaucoma are unaware that they have the condition and early detection of people with diabetic retinopathy could reduce risk of blindness by up to ninety-five percent. Thus, quick and accurate detection of these diseases would be very valuable in reducing blindness caused by them. Machine learning based detection models have been shown to be more successful than humans at detecting eye diseases. A machine learning system infers the modeling function from a training dataset. This project developed machine learning based detection models to diagnose a patient as having glaucoma, diabetic retinopathy, or neither in their eyes. Feature analysis was performed on the DRIONS-DB dataset, which contains retinal fundus images of the three different groups as well as data from the HRF Image Database. Different classification neural networks and linear classifiers were investigated to develop seven diagnosis models. Prediction accuracy of my models was compared using a testing dataset, disjoint from the training dataset. The accuracy, sensitivity, f score, and informedness were used as performance metrics. The majority of the models predicted with greater than 0.95 f score for both glaucoma and diabetic retinopathy, well above the medical threshold of 0.90. The models presented here diagnosed these diseases using only retinal fundus images in under a second and could be used in smartphone app to allow for continuous monitoring of eye diseases.