Retina: A Non-Invasive, Predictive Smartphone Application to Test for Cardiovascular Risk and Diabetic Retinopathy via Analysis of Cardiovascular Risk Factors and Retinal Fundus Images

Chakravadhanula , Kasyap (School: BASIS Scottsdale)

The goal of this project was to create a comprehensive test, automated and not requiring laboratory blood analysis, for the prediction of diabetic retinopathy and cardiovascular risk, utilizing machine learning on public datasets, and to implement this test on a smartphone to increase accessibility and to reduce cost and time. First, a random forest model was developed by retrospectively analyzing the influence of various risk factors on diagnosis of cardiovascular risk, with diabetic retinopathy being one, along with age, sex, smoker percentage, etc. These risk factors were chosen so that they could all be determined from the patient without the need for a blood test. Next, a deep-learning model was developed for prediction of diabetic retinopathy from retinal fundus images by using transfer learning on the InceptionV3 model and pre-processing the images via automatic vessel segmentation. Finally, the models were integrated into a mobile application for administration of the test. Model accuracy scores, as well as the receiver operating characteristic curve, the learning curve, and other gauges, were promising. This test is more resource-efficient, less time-intensive, and does not require a blood test while maintaining similar or higher accuracy levels compared to current methods. It has the potential to replace the manual method of diagnosing diabetic retinopathy, the leading cause of blindness world-wide, which is a time consuming, resource intensive process only done by medical professionals, and to remove the need for a blood test to determine cardiovascular risk with accuracy.

Awards Won:
Fourth Award of $500