Speculor: A Comprehensive Teleophthalmology Platform for People Centered Eyecare

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According to the World Health Organization, there are 240 million cases of preventable blindness globally. Many eye diseases are “silent-killers” of vision and current testing methods are often inaccessible for marginalized patients. Thus, treatable diseases go undetected until it is too late. To combat this issue, this research developed an innovative system called Speculor which combined novel low-cost portable retinal imagers and smartphones with artificial intelligence algorithms. The first prototype was tested by ophthalmologists and detected clinically relevant features required for accurate diagnosis of glaucoma and age-related macular degeneration. Based on clinician feedback, two new designs were done to image un-dilated eyes using high numerical aperture optics. The low and high-end versions of the imagers cost less than $96 and $240, respectively and provide similar performance to fundus cameras costing $5000-$15000. A new transfer learning method integrating supervised learning with reinforcement learning was invented to train convolutional neural networks. The method reduced overfitting and demonstrated the best reported results in literature for the classification of the Drishti-GS and RIM-ONE-r2 glaucoma datasets with accuracy >95 % and area under the receiver-operating-curve of 0.987. Models developed had explain-ability highlighting the most important regions used for classification improving the confidence for the medical professional in the decisions made. It was also shown that it is important to extract regions of interest from the fundus image and methods requiring low computational power were developed. Speculor aims to address preventable blindness through a low-cost, portable, and highly accurate platform, allowing for people-centered eyecare.

Awards Won:

Third Award of $1,000

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