ARFSNet - Deep Learning for Amblyopia Risk Factor Screening

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Amblyopia, a vision development disorder, causes more vision loss in children than all other reasons combined. Amblyopia can be treated before 10 years of age when visual pathways of the brain are still plastic. It is critical to screen and correct for risk factors of amblyopia early. Strabismus is the most common and high severity risk factor. This phase of the project developed a deep learning framework to predict strabismus from eye images captured by a smartphone. GoCheck Kids provided de-identified cycloplegic evaluations and 499 images of eyes from an iPhone based photoscreener. The cycloplegic data identified gaze type but only 190 images included deviation measurements and just 19 had manifest strabismus. There are no large strabismus data sets available to train a neural network. A novel method was developed to generate synthetic strabismus images based on mathematical models of strabismus and template orthotropic images. 34 real orthotropic images were annotated for generating synthetic images with normally distributed gaze deviations (mean, standard deviation = 8, 4 prism diopters). Data was further augmented through reflections and small random rotations for a total of 1000 images per template image. These images were used to train and evaluate convolutional neural networks to predict strabismus and generate a referral decision. A Resnet50 based network predicted strabismus within 2 prism diopters 95% of the time. Referral decisions (>8, <=8 prism diopters) based on this prediction showed 93% accuracy. A mature model implemented in a smartphone photoscreener has the potential to improve vision outcomes in underserved populations.