GlaucoScreen: A Novel Deep Learning-Based System for Glaucoma Detection and Progression Monitoring

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Glaucoma, an eye disease that causes damage to the optic nerve, is the second-leading cause of blindness worldwide. Swift diagnosis and treatment of glaucoma is crucial to prevent any glaucoma-induced vision loss; however, this is not usually achievable in developing countries due to their lack of medical personnel and resources. This research aims to solve this through GlaucoScreen, an inexpensive, accessible system for both reliable glaucoma detection and accurate real-time progression monitoring. The first component of the GlaucoScreen system is the smartphone attachment. This attachment allows for the cheap and precise capture of a retinal fundus. The retinal fundus image (RFI) is then uploaded onto the mobile application to be processed by three different deep learning models. First, in order to reduce the computation needed by subsequent models and emphasize diagnostic features, the optic disk region of the RFI is localized and segmented out by the optic disk segmentation model. This model, employing the U-Net architecture, has an intersection-over-union score of 95.11%. The segmented optic disk image is then analyzed by the glaucoma detection model, which has an accuracy of 98.68%, and finally the progression categorization model, which has an accuracy of 95.88%. The glaucoma detection model utilizes a novel convolutional neural network architecture, while the progression categorization model utilizes the InceptionV3 architecture. GlaucoScreen is unique in that it monitors the progression state of glaucoma, which is crucial for its treatment, while also providing a cost-effective method of retrieving RFIs. Through GlaucoScreen, anyone from anywhere around the world will have access to quality glaucoma care.

Awards Won:

The University of Texas at Dallas: Scholarship awards of $5,000 per year, renewable for up to four years