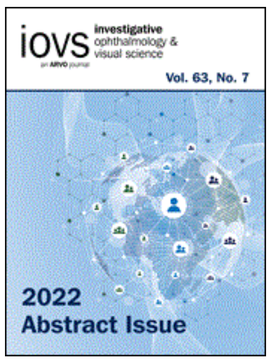

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Anterior Eye Segment Imaging System for Teleophthalmology

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Abstract

Purpose : Teleophthalmology increases access to ophthalmic care, lowers screening barriers, and facilitates follow-ups. However, there is a need to develop better systems to evaluate diverse conditions remotely. This study aims to compare a portable anterior eye segment imaging system with the current standards method for ophthalmology examination.

Methods : The new imaging system consisted of two IMX219 Arducam autofocus sensors (Arducam, China, Nanjing) for Raspberry Pi V2 camera module connected to a Raspberry Pi Zero W (Raspberry Pi Foundation, UK, Cambridge) that clips to a HoloLens 2 (Microsoft, Redmond, WA). Twenty subjects from the Bascom Palmer Eye Institute clinic participated in the study. Anterior eye segment videos were recorded with the new system and a 720p FaceTime HD camera (Apple, Cupertino, CA). Afterward, an ophthalmologist evaluated the videos using a clinical eye examination form. This questionnaire assessed the presence of pathologies for the different eye structures and graded video quality based on identifying emergent findings. The video evaluations were compared with the standard slit-lamp clinical evaluation performed during the patient's visit.

Results : Thirty-five eyes were evaluated. The percentage sensitivity and specificity were 31.4% and 81.1%, respectively, for the HoloLens-RBPi videos and 13.7% and 39.9% for the web camera videos. Ocular structures such as the cornea, anterior chamber, iris, and lens were better evaluated with the HoloLens-RBPi videos (specificity 50%-88.5%, sensitivity 18.2%-40%). Conjunctiva and sclera had the highest sensitivity percentage for both modalities (73.3% HoloLens-RBPi and 66.7% Web Camera). The average grade for the HoloLens-RBPi videos was 3.17, and the web camera videos averaged 1.35 out of a 5 point scale.

Conclusions : Specificity percentages were higher than sensitivity percentages in both imaging modalities, indicating that video evaluations are less accurate for pathologies screening. Nevertheless, HoloLens-RBPi evaluations were statistically significantly better than the webcam evaluations. This study presented an alternative system to assess eye conditions for telemedicine, a system that provides more details than the current standard for eye evaluation performed through a webcam. Further developments will include improving camera and illumination quality, obtaining fundus images, automating camera positioning, and creating a program to access livestream images.

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