AEYE: A Novel Approach for the Detection of Diabetic Retinopathy Using a Non-Mydriatic Handheld Fundus Camera and a New Transformer

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Diabetic retinopathy (DR), a prevalent complication of diabetes, poses a significant threat to vision health, particularly in resource-limited rural settings. In 2023, a regional study in Alexandria and the northwest delta of Egypt underscores this challenge, revealing a 46.4% prevalence of DR among 10,811 screened individuals, with 82% unaware of their diagnosis. This underscores the need for accessible diagnostic tools and effective screening methods. Addressing this, this study proposes a dual approach: a non-mydriatic handheld fundus camera based on indirect ophthalmology, and a deep learning transformer model that classifies DR severity into four levels using a novel feature-extraction method for two fields of view (FOVs). The model was trained on a dataset of 3,100 two-field images. The camera's safety was verified by measuring irradiance, ensuring it could be used for 49.3 hours without retinal injury risk. The comparative test (t-test) between the proposed camera and traditional devices was >0.05. It showed no significant difference in image quality, as assessed by entropy, contrast-to-noise ratio (CNR), and peak signal-to-noise ratio (PSNR). The transformer model demonstrated an 88% average area under the receiver operating characteristic (AUROC), outperforming other models trained on the same dataset. This innovation can democratize eye care, enhancing early diagnosis and monitoring in low-to-middle-income countries, and can be used to help health convoys from the Ministry of Health and the United Nations to achieve the 3rd SDG of health and wellbeing.

Awards Won: