An End-to-End AI Hardware Solution for Ophthalmic Diagnostics: Retinal Vessels as a Morphological Target for Segmentation and Early Detection

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The prevalence of diseases such as diabetic retinopathy (DR), glaucoma, and age-related macular degeneration (AMD) is rapidly increasing worldwide, with over 700 million people expected to face the risk of vision impairment by 2040. Although early retinal screening has been proven to significantly reduce the risk of vision loss in diabetic patients by up to 90%, traditional fundus examinations are difficult to implement widely due to their high cost and inefficiency. To address these challenges, this study achieves the following breakthroughs through technological innovation: (i) Utilizing retinal vessel segmentation for automated DR classification and non-invasive diagnosis; (ii) Providing enhanced visualization tools for vessel segmentation to assist doctors in accurately identifying vascular abnormalities; (iii) Designing a portable fundus imaging device to reduce diagnostic costs and improve accessibility; (iv) Generating image data aligned with disease severity classification results to enhance the interpretability of AI models, making them more suitable for clinical applications.

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