RetinoScan: A Portable Fundus Imaging Device With Integrated Machine Learning for Automated Diabetic Retinopathy Detection

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Diabetic Retinopathy (DR) is a serious complication associated with diabetes that can lead to vision loss in middle-aged and older adults. Caused by chronic high blood sugar levels, poor glycemic control, and related metabolic issues, DR impacts 30% to 40% of the 537 million diabetic adults, according to the International Diabetes Federation. While timely screening and intervention can prevent up to 95% of cases, DR screening methods are constrained by high setup costs and a shortage of qualified ophthalmologists. As a result, over 433 million diabetic adults from low and middle-income countries have restricted access to specialized eye care. My project aims to develop a portable fundus imaging device that leverages deep learning algorithms for automated DR severity classification. A dataset of 3700 annotated retinal images was used to train the model. A Swin-L Transformer, a type of hierarchical Vision Transformer, enables the model to capture intricate features of the fundus and classify images into five levels of DR: No DR, Mild DR, Moderate DR, Severe DR, and Proliferative DR. Furthermore, it includes a Raspberry Pi 5 for processing, a high-resolution camera with a NeoPixel ring for image capture, a printed prototype made of PLA (Polylactic Acid) for portability, and a Gradio user interface to provide an interactive platform for data evaluation. With a 90% accuracy, the device has validated its potential for clinical application. Diabetic patients should make eye screenings a regular part of their healthcare routine to prevent blindness. My device enhances accessibility to DR screening, particularly in remote areas, by reducing dependence on trained eye specialists. This improves overall patient outcomes and reduces healthcare disparities.

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