RetinaVision: Clinically Validated Deep Learning Models for Detection of Retinitis Pigmentosa and Overlapping Retinal Pathologies Using Fundus Images

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Retinal diseases are the major causes of permanent vision loss worldwide, affecting tens of millions of people and making early, accurate detection essential for timely intervention and preservation of visual function. However, many of these patients lack consistent access to ophthalmologists or retinal specialists in underserved areas, delaying diagnosis and worsening outcomes. Existing machine learning studies have either focused on retinitis pigmentosa (RP) in isolation, or rarely analyzed retinitis pigmentosa (RP) in targeted multi-retinal pathology settings specifically designed around diseases that can be commonly misdiagnosed. This project addresses these clinical and research gaps by evaluating overlapping features between RP and similar retinal pathologies, which include retinal detachment, macular scars, central serous chorioretinopathy, diabetic retinopathy and healthy controls. By utilizing standard fundus photography, this approach emphasizes accessibility and cost-efficiency in terms of clinical implementation. ResNet-50, EfficientNet-B0, and custom Multi-Scale CNN models were trained with identical data and were evaluated using model metrics and feature analysis. The ResNet-50 achieved 93.12% overall accuracy, the EfficientNet-B0 achieved 92.42%, and the Multi-Scale CNN achieved 86.3%. Model results were quantitatively and qualitatively validated with retinal specialists' diagnoses, demonstrating agreement in key disease features and differentiation between similar retinal conditions. Collectively, this study demonstrates the ability to reliably differentiate retinitis pigmentosa from clinically similar retinal diseases, maintain diagnostic robustness and improve screening accessibility, and identify features consistent with clinical evaluation.

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