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Enhancing Deep Learning Models for Eye Disease Classification

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Abstract: *Recent advancements in ocular disease recognition leverage deep learning techniques to enhance diagnostic accuracy and accessibility. Convolutional neural networks (CNNs), particularly architectures like VGG-16, VGG-19, and ResNet, have proven effective in identifying conditions such as diabetic retinopathy, cataracts, glaucoma, and corneal diseases using datasets like ODIR and OCT. Studies report high accuracy, such as 97.16% in retinal disease detection with a pruned VGG-16 and 84% with a ResNet-based model for glaucoma detection. Hybrid approaches combining CNNs with traditional classifiers like random forests have improved interpretability and performance. Mobile and lightweight models have further expanded access to diagnostics in resource-constrained environments. Despite these achievements, challenges like data imbalance, overfitting, and computational inefficiencies persist, addressed through techniques such as transfer learning, advanced loss functions, and hierarchical multi-task networks. Vulnerabilities to adversarial attacks and limited generalization capabilities also underscore the need for robust and secure AI models. This survey emphasizes the potential of AI-driven ocular diagnostics to revolutionize early disease detection and management, while highlighting the need for diverse datasets, efficient architectures, and scalable solutions to ensure broader clinical applicability and improved patient care.*

Keywords: Ocular disease recognition, deep learning, convolutional neural networks (CNNs), VGG-16, VGG-19, ResNet, diabetic retinopathy, cataracts, glaucoma, corneal diseases, ODIR dataset, OCT images, hybrid models, random forests, transfer learning, hierarchical networks, data imbalance, overfitting, adversarial attacks, mobile diagnostics, lightweight models, AI-driven healthcare, automated diagnostics, scalable solutions.