Abstract

Ophthalmological disorders, such as diabetic retinopathy, glaucoma, age-related macular degeneration, and cataracts, are among the leading causes of vision impairment and blindness worldwide. Early detection and accurate diagnosis are crucial for effective reatment and management of these conditions. Traditional diagnostic methods rely heavily on manual examination by ophthalmologists, which can be time-consuming, subjective, and prone to variability. This thesis explores the potential of medical image processing techniques to develop an automated, efficient, and accurate system for detecting ophthalmological disorders.

The research focuses on preprocessing, feature extraction, and classification of retinal and ocular images using advanced image processing and machine learning algorithms. Various enhancement techniques, such as contrast adjustment, noise reduction, and edge detection, are employed to improve image quality. Feature extraction methods, including texture analysis, morphological operations, and deep learning-based feature representation, are used to identify key biomarkers associated with different eye diseases. The extracted features are then analyzed using machine learning and deep learning models, such as convolutional neural networks (CNNs), support vector machines (SVMs), and random forests, to classify ophthalmological disorders with high accuracy.

The proposed framework has been validated using publicly available and clinical datasets, achieving promising results in terms of precision, recall, sensitivity, specificity, and overall classification accuracy. Comparative analysis with existing state-of-the-art methods demonstrates the effectiveness of the approach in improving diagnostic accuracy and reducing false-positive and false-negative rates.

This study contributes to the field of computer-aided diagnosis (CAD) by providing a robust, automated tool that can assist ophthalmologists in early disease detection, thereby facilitating timely treatment and improving patient outcomes. Future work will focus on further optimizing the model, integrating multi-modal maging data, and developing a real-time linical decision support system for ophthalmological disorder detection.

Keywords: Ophthalmological Disorders, Medical Image Processing, Deep Learning, Retinal Image Analysis, Computer-Aided Diagnosis, Machine Learning.

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07/11/2025

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