ABSTRACT

PRETRAINED CONVOLUTIONAL NEURAL NETWORK ARCHITECTURES FOR DIAGNOSING RETINAL DISEASES ON OPTICAL COHERENCE TOMOGRAPHY SCANS

Proposed by

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In Indonesia, retinal diseases such as Diabetic Macular Edema (DME), Drusen Macular Degeneration (DMD), and Choroidal Neovascularization (CNV) are prevalent and can lead to blindness if not detected early. However, accurate early detection remains a challenge due to difficulties in achieving high-performing classification models. Convolutional Neural Networks (CNN) are frequently used to assist in diagnosing these diseases, but preprocessing methods and the choice of CNN architectures can significantly impact their performance.

To address this issue, the research proposes a novel preprocessing structure combined with advanced pre-trained CNN models. Using the "Labelled Optical Coherence Tomography (OCT) and Chest X-Ray Images for Classification" dataset, which includes over 109,312 OCT images across four categories (DME, DMD, CNV, and Normal), models such as ResNet50, InceptionV3, and DenseNet121 were employed. The study also explores an ensemble of ResNet50 and InceptionV3 to improve classification accuracy. The models were trained using K-fold cross-validation, and performance metrics such as accuracy, precision, recall, and F1-score were used for evaluation.

The results demonstrated that the ensemble model outperformed individual models, achieving the highest accuracy of 94.6% and an F1-score of 94.5% using only a subset of the dataset. The inclusion of preprocessing techniques, such as median speckle denoising filters, further enhanced the model's performance. These findings suggest that an effective preprocessing pipeline and ensemble model can significantly improve the classification of retinal diseases while maintaining high accuracy and efficiency.

Keywords: Retinal Diseases, Convolutional Neural Networks, OCT, Preprocessing Method, Pretrained Models, Ensemble Model, Sampling

INTISARI

ARSITEKTUR CONVOLUTIONAL NEURAL NETWORK YANG TELAH DILATIH UNTUK MENDIAGNOSIS PENYAKIT RETINA PADA PEMINDAIAN OPTICAL COHERENCE TOMOGRAPHY

Diusulkan oleh

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Di Indonesia, penyakit retina seperti Diabetic Macular Edema (DME), Drusen Macular Degeneration (DMD), dan Choroidal Neovascularization (CNV) umum terjadi dan dapat menyebabkan kebutaan jika tidak terdeteksi sejak dini. Namun, deteksi dini yang akurat masih menjadi tantangan karena kesulitan dalam mencapai model klasifikasi yang berkinerja tinggi. Convolutional Neural Networks (CNN) sering digunakan untuk membantu mendiagnosis penyakit-penyakit ini, tetapi metode praproses data dan pilihan arsitektur CNN dapat secara signifikan mempengaruhi kinerjanya.

Untuk mengatasi masalah ini, penelitian ini mengusulkan struktur praproses data yang baru, dikombinasikan dengan model CNN pretrained yang canggih. Menggunakan dataset "Labeled Optical Coherence Tomography (OCT) and Chest X-Ray Images for Classification", yang mencakup lebih dari 109,312 gambar OCT dalam empat kategori (DME, DMD, CNV, dan Normal), penelitian ini menggunakan model seperti ResNet50, InceptionV3, dan DenseNet121. Penelitian ini juga mengeksplorasi model ensemble yang menggabungkan ResNet50 dan InceptionV3 untuk meningkatkan akurasi klasifikasi. Model dilatih menggunakan validasi silang K-fold, dan metrik kinerja seperti akurasi, presisi, recall, dan F1-score digunakan untuk evaluasi.

Hasilnya menunjukkan bahwa model ensemble mengungguli model individu, dengan akurasi tertinggi sebesar 94,6% dan F1-score sebesar 94,5% menggunakan hanya sebagian dataset. Penerapan teknik pra pemrosesan data, seperti filter penghilangan bintik median (median speckle denoising), juga meningkatkan kinerja model. Temuan ini menyarankan bahwa pipeline praproses yang efektif dan model ensemble dapat secara signifikan meningkatkan klasifikasi penyakit retina sambil mempertahankan akurasi dan efisiensi yang tinggi.

Keywords: Penyakit Retina, Convolutional Neural Networks, Optical Coherence Tomography, Metode Prapemrosesan, Model Pretrained, Model Ensemble, Sampling