Comparative Evaluation of Deep Learning Architectures for Blood Cell Image Classification

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Abstract

Accurate classification of blood cell types is a critical task in automated hematological analysis and medical diagnostics. This study presents a comparative evaluation of three deep learning architectures, ResNet18, MiniVGG, and YOLOv8, for five-class blood cell image classification. To ensure a fair and objective comparison, all models were trained under standardized conditions, including a consistent 90:10 training–validation split, controlled dataset size, and fixed training epochs. ResNet18 was trained from scratch to establish a baseline using residual learning. MiniVGG employed a compact VGG-inspired architecture with regularization to balance computational efficiency and classification accuracy. YOLOv8 leveraged a lightweight, pretrained classification backbone with integrated data augmentation strategies.

The experimental results demonstrate a clear progression in model performance. ResNet18 achieved a validation accuracy of 74.2%, with most misclassifications occurring between visually similar blood cell types. MiniVGG significantly improved performance, achieving 96.2% accuracy and a macro-average F1-score of 0.961, indicating strong and consistent predictions across all classes. YOLOv8 delivered the best results, achieving near-perfect classification performance with 99.6% accuracy and precision, recall, and F1-scores of 0.996. These findings highlight the effectiveness of modern lightweight and pretrained deep learning architectures for medical image classification, with YOLOv8 emerging as a highly robust and reliable solution for automated blood cell analysis.

Keywords

Blood cell classification, Deep learning, Medical image analysis, YOLOv8, Convolutional neural networks.