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A Thorough Analysis of Deep Learning-Based Early Melanoma Detection

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Abstract: *Melanoma is one of the most aggressive and life-threatening forms of skin cancer, posing a major challenge to global healthcare due to its rapid progression and high mortality rates when diagnosis is delayed. Conventional diagnostic methods primarily depend on clinical observation and dermatologist expertise, which can often be subjective and inconsistent. In recent years, deep learning—particularly Convolutional Neural Networks (CNNs)—has shown strong potential to enhance diagnostic accuracy by automatically identifying subtle variations in dermoscopic images that may not be easily recognized by the human eye. This study presents a CNN-based framework for the early detection of melanoma using transfer learning with the ResNet50 architecture. The research employs the HAM10000 dataset, which contains over 10,000 dermoscopic images representing seven different skin lesion categories. Prior to training, the dataset undergoes normalization and data augmentation to improve image quality and model generalization. The ResNet50 network is fine-tuned by replacing its fully connected layers with custom dense, dropout, and sigmoid layers, optimized using the Adam optimizer and binary cross-entropy loss function. The proposed approach delivers a reliable, non-invasive, and efficient diagnostic support system to assist dermatologists in early melanoma recognition. By combining transfer learning and augmentation, the model improves classification accuracy and reduces dependency on manual feature extraction. Overall, this work highlights the promise of deep learning in dermatological diagnostics and lays the groundwork for future research on explainable models and clinical validation in real-world medical settings.*

Keywords: Convolutional neural networks (CNNs), deep learning, image classification, skin cancer detection, melanoma, and the HAM10000 dataset

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