A Novel Machine Learning Approach Using Convolutional Neural Networks to Identify Melanoma

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Melanoma is one of the deadliest forms of skin cancer, causing 80% of skin cancer mortalities. However, it is fully curable if diagnosed early. Diagnosis is conducted by visually examining lesions and/or their photographic images, followed by techniques such as dermascopic analysis or biopsies. Though dermascopy provides 20-25% greater accuracy, it requires a skilled medical expert, while biopsies can be unnecessarily invasive. Thus, there is a compelling need to develop automated software tools for accurately classifying skin lesion images. Machine learning based techniques using Multilayer-Perceptrons (MLPs) have been promising. However, MLPs require domain features extracted from images as inputs, such as ABCD metrics or coefficients drawn from waveform analysis. Generally, experts use such metrics as diagnostic aids rather than as conclusive indicators of malignancy. Convolutional Neural Networks (CNNs) are a recent advancement of machine learning technology which have now surpassed human accuracy in classifying images of objects such as animals, vehicles, etc. Unlike MLPs, CNNs analyze image inputs and learn relevant image features during training to accurately classify the inputs. In this study, a CNN model with a residual-network architecture has been developed to identify malignant lesions using only dermascopic image pixels and classification labels as inputs. Its performance exceeds other automated tools with an accuracy, sensitivity, and specificity of 94.5%, 94.6% and 94.4% respectively. Thus, this model can be effective as a pre-screening tool in medical settings. Moreover, these results demonstrate that residual-network architectures can be applied to other medical conditions that are visually diagnosed directly from images.

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