

## Article

# Assist-Dermo: A Lightweight Separable Vision Transformer Model for Multiclass Skin Lesion Classification

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**Abstract:** A dermatologist-like automatic classification system is developed in this paper to recognize nine different classes of pigmented skin lesions (PSLs), using a separable vision transformer (SVT) technique to assist clinical experts in early skin cancer detection. In the past, researchers have developed a few systems to recognize nine classes of PSLs. However, they often require enormous computations to achieve high performance, which is burdensome to deploy on resource-constrained devices. In this paper, a new approach to designing SVT architecture is developed based on SqueezeNet and depthwise separable CNN models. The primary goal is to find a deep learning architecture with few parameters that has comparable accuracy to state-of-the-art (SOTA) architectures. This paper modifies the SqueezeNet design for improved runtime performance by utilizing depthwise separable convolutions rather than simple conventional units. To develop this Assist-Dermo system, a data augmentation technique is applied to control the PSL imbalance problem. Next, a pre-processing step is integrated to select the most dominant region and then enhance the lesion patterns in a perceptual-oriented color space. Afterwards, the Assist-Dermo system is designed to improve efficacy and performance with several layers and multiple filter sizes but fewer filters and parameters. For the training and evaluation of Assist-Dermo models, a set of PSL images is collected from different online data sources such as Ph2, ISBI-2017, HAM10000, and ISIC to recognize nine classes of PSLs. On the chosen dataset, it achieves an accuracy (ACC) of 95.6%, a sensitivity (SE) of 96.7%, a specificity (SP) of 95%, and an area under the curve (AUC) of 0.95. The experimental results show that the suggested Assist-Dermo technique outperformed SOTA algorithms when recognizing nine classes of PSLs. The Assist-Dermo system performed better than other competitive systems and can support dermatologists in the diagnosis of a wide variety of PSLs through dermoscopy. The Assist-Dermo model code is freely available on GitHub for the scientific community.

**Keywords:** skin cancer; pigmented skin lesions; dermoscopy; classification; deep learning; vision transformers; SqueezeNet; depthwise separable CNN



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## 1. Introduction

Skin cancer is becoming more widespread in the Western world, with significant ramifications for both general skincare and the availability of dermatological treatments. Day after day, about 99,780 individuals in the United States are identified with melanoma or skin cancer. Among them, two or more are likely to die per hour. Skin cancer affects more individuals in the United States each year than all other cancers combined [1]. Europe accounts for 9% of the global population yet bears 25% of the worldwide cancer cases. If tumors are recognized and treated early, cancer mortality can be considerably decreased. Thus, it is crucial to devote research resources to implementing systems for primary cancer