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TriNetDerm:An Ensemble Deep Learning Framework for Robust Skin Cancer Classification

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***Abstract*—Skin cancer is one of the most prevalent and severe diseases worldwide, making early and accurate detection critical. Here, we present a deep learning-based approach for classifying skin cancer images with improved accuracy. We experimented with several well-known architectures, including ResNet50, EfficientNetB0, and InceptionV3, both individually and in various ensemble configurations. Our final model combines ResNet50, EfficientNetB0, and a custom Convolutional Neural Network (CNN) into a hybrid ensemble, leveraging pre-trained networks alongside task-specific features. Key metrics such as accuracy, precision, recall, and F1-score were used to evaluate the system. Findings indicate that the hybrid ensemble outperformed individual models and other ensemble combinations, achieving 92% accuracy while maintaining balanced performance across all metrics. These results demonstrate that ensemble deep learning can enhance diagnostic reliability and support automated systems that aid dermatologists in early skin cancer detection and treatment decisions.**

***Index Terms*—Skin cancer; Deep learning; Convolutional Neural Network (CNN); Ensemble model; Skin lesion analysis**

I. Introduction

Skin cancer is a commonly occurring malignancy across the world, affecting millions annually, and its incidence is steadily increasing. Factors such as prolonged sun exposure, aging populations, and shifting environmental conditions continue to drive this upward trend. The International Agency for Research on Cancer (IARC) reported over 1.5 million new cases in 2022, including roughly 330,000 cases of melanoma, which is known to be the aggressive form of the disease and accounts for nearly 60,000 deaths.

Skin cancers are broadly classified into two types: Benign and Malignant. Benign skin cancers are non-cancerous growth or tumor which stays confined to their original location and do not spread or affect the surrounding tissues. They are generally curable with minimal treatment. In contrast, malignant skin cancers are serious type of skin growths that have the ability to spread into nearby body tissues or travel to distant parts of the body, posing serious health risks if not detected early.

Encouragingly, when detected early, most forms of skin cancer are highly treatable. The main challenge, however, lies in ensuring timely and accurate diagnosis, particularly in regions where access to dermatologists and specialized medical facilities is limited.

Growing adoption of Artificial Intelligence (AI) and Machine Learning (ML) is contributing towards novel possibilities across medical imaging and disease diagnosis. Deep learning approaches, particularly CNNs, can autonomously identify important features within complex medical images, including skin lesions. Established network architectures like ResNet50, EfficientNetB0, and InceptionV3 have proven effective in