Optimised EfficientNet for multi-class skin cancer diagnosis: integrating chaotic grey wolf algorithms

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The detection of skin cancer holds paramount importance worldwide due to its impact on global health. While deep convolutional neural networks (DCNNs) have shown potential in this domain, current approaches often struggle with fine-grained variability in skin lesion features, imbalanced datasets and inadequate augmentation. The objectives of our study encompass building a model that not only enhances accuracy but also reduces training time and cost, improves dimensionality reduction during classification and segmentation, and is evaluated on larger datasets for robustness. We enhance the learning process using an improved nature-inspired optimisation algorithm tailored specifically for skin cancer classification tasks. This algorithm optimises model parameters to maximise classification accuracy while minimising computational overhead. Our proposed architecture leverages a gold standard dermatological image dataset meticulously curated and validated by experts. This dataset spans eight distinct classes, including actinic keratosis, basal cell carcinoma, melanoma, nevus, and others, ensuring a diverse representation of skin conditions. The balanced class distribution in the training and test sets enables fair evaluation and robustness assessment of our deep learning models. The developed algorithm showcases novelty in its approach, contributing to advancements in early skin cancer detection technologies. This study introduces an optimised deep learning model designed for the early detection of skin cancer, achieving a notable accuracy of 97.48%. Our study aims to contribute significantly to the medical field by providing a reliable and efficient tool for dermatologists and healthcare practitioners to assist in diagnosing skin conditions accurately and promptly, ultimately improving patient outcomes and healthcare efficiency.

Keywords: Actinic keratosis, basal cell carcinoma, classification, deep convolutional neural networks, segmentation, skin cancer detection.

exposed to ultraviolet (UV) radiation, although it can also occur on parts of the skin not typically exposed to sunlight[1]. Worldwide, skin cancer stands out as the prevailing cancer type. It encompasses basal cell carcinoma, squamous cell carcinoma, and melanoma. Annually, in the United States, more than 3.5 million cases are identified, exceeding the collective diagnoses of lung, breast and colon cancers. Statistically, one individual is diagnosed with skin cancer every 57 sec. The five-year survival rate for all types of skin cancer, including the most lethal forms, such as melanoma, reaches 98% when they are diagnosed at an early stage[2]. In recent years, deep learning (DL) and machine learning (ML) have significantly revolutionised the field of skin cancer detection and classification[3]. The automated identification of skin lesions from images presents significant challenges due to the subtle and diverse variations in how skin lesions appear[4–14]. Early detection of cancer in dermoscopy images significantly improves survival rates. Thus, precise automated detection of skin abnormalities can greatly enhance the efficiency and expertise of pathologists[15]. The timely identification of skin cancer is parameter due to the limited treatment options available. Accurate assessment and reliable identification of skin cancer are essential elements of an effective skin cancer prevention strategy[16]. In recent years, convolutional neural networks (CNNs) have surpassed human experts in classifying lesions in skin cancer[17]. Pre-trained models have revolutionised the field of image classification, including the specific area of skin cancer detection. These models, which are initially trained on large datasets such as ImageNet, can be fine-tuned to specialise in recognising dermatological images with high precision[18]. The present study explored the application of pre-trained CNNs to enhance the accuracy of skin cancer diagnosis through image classification[19,20]. By leveraging models initially trained on extensive general datasets, we adapt and fine-tune them specifically for identifying and classifying skin lesions