RADemics

AI-Assisted Skin Cancer Classification Using Dermoscopic Images

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Abstract

Early and accurate identification of skin cancer remains a critical challenge in dermatology due to the visual similarity between benign and malignant skin lesions. Dermoscopic imaging provides enhanced visualization of subsurface skin structures, enabling improved assessment of pigmentation patterns, vascular structures, and lesion morphology. Rapid advancements in artificial intelligence have created opportunities for developing automated diagnostic systems capable of assisting clinicians in skin cancer detection. Integration of machine learning and deep learning techniques with dermoscopic image analysis enables extraction of discriminative features related to color variation, texture distribution, and structural irregularities within skin lesions. This chapter presents a comprehensive overview of AI-assisted approaches for skin cancer classification using dermoscopic images, emphasizing image preprocessing, lesion segmentation, feature extraction, and classification strategies. Discussion also highlights commonly used dermoscopic datasets, performance evaluation metrics, and key challenges affecting real-world clinical deployment. Emphasis on intelligent diagnostic frameworks demonstrates potential for improving early detection accuracy and supporting efficient dermatological screening in clinical environments.

Keywords: Skin Cancer Detection, Dermoscopic Imaging, Artificial Intelligence, Deep Learning, Medical Image Analysis, Computer-Aided Diagnosis.

Introduction

Skin cancer represents one of the most frequently diagnosed forms of cancer worldwide and continues to pose a significant public health challenge across many regions [1]. Continuous exposure to ultraviolet radiation from sunlight and artificial sources contributes to progressive damage of skin cells, leading to abnormal cellular growth and formation of malignant lesions [2]. Rapid growth in incidence rates has drawn considerable attention from medical researchers and healthcare professionals seeking effective diagnostic and preventive strategies [3]. Early identification of suspicious skin lesions plays a crucial role in improving survival outcomes because treatment during initial stages prevents deeper tissue invasion and metastatic spread. Melanoma, basal cell carcinoma, and squamous cell carcinoma constitute the primary categories of skin cancer observed in clinical practice. Among these, melanoma demonstrates aggressive biological behavior and accounts for a substantial proportion of skin cancer–related deaths due to its capacity for rapid metastasis [4]. Rising awareness regarding skin health and preventive dermatology has increased the number of individuals undergoing clinical skin examinations, which subsequently increases demand for accurate and efficient diagnostic tools capable of assisting dermatologists during lesion assessment [5].

Dermoscopy has emerged as an essential imaging technique within dermatological practice for detailed examination of skin lesions [6]. This non-invasive imaging method provides magnified visualization of subsurface skin structures that remain invisible through standard visual inspection. Specialized dermoscopic devices illuminate and magnify lesion regions, enabling observation of complex morphological features such as pigment networks, streaks, globules, vascular patterns, and irregular pigmentation structures [7]. Clinical evaluation of these dermoscopic features assists dermatologists in distinguishing benign lesions from malignant tumors through systematic pattern analysis [8]. Diagnostic rules such as asymmetry assessment, border irregularity analysis, color distribution examination, lesion diameter evaluation, and temporal evolution of lesion characteristics support clinical decision-making during dermoscopic examination. Interpretation of dermoscopic patterns requires extensive clinical expertise, since subtle structural differences often indicate the presence of malignant transformation [9]. Increased adoption of digital dermoscopy within hospitals and dermatology clinics has generated large collections of dermoscopic images, creating valuable opportunities for computational analysis and automated diagnostic support systems capable of assisting clinicians during complex diagnostic evaluations [10].