Systematic Review on Early Detection of Diabetic Foot Ulcers Using Image Processing

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Abstract

Diabetic foot ulcers (DFUs) are serious complications of diabetes that reduce mobility and quality of life and increase the risk of lower-limb amputation. The early detection of DFUs is important to avoid serious outcomes, however, the diagnostic techniques presently used rely much on subjective methods, thus delaying early treatment. This review underlines the new developments regarding the detection of DFUs that are being addressed using image processing and AI in disciplines of thermal imaging, wearable sensors, and deep learning models like Convolutional Neural Networks (CNNs). Non-invasive thermography detects skin temperature abnormalities that herald early DFU formation, and wearable sensors track temperature, pressure, and moisture to monitor foot health continuously. Deep learning algorithms, especially CNNs, excel in the identification, classification, and segmentation of DFUs with a high degree of diagnostic accuracy, because they greatly reduce human error. Most AI-based models report a precision of over 90%, hence their potential to transform DFU detection and management. Challenges include the need for standardized diagnostic tools, improved sensor accuracy, and resolving issues related to limited datasets. Multidisciplinary collaboration is essential to develop explainable AI models, larger datasets, and reliable tools for clinical use. Moreover, patient education and engagement with wearable devices and mobile applications are crucial for preventing DFU progression. This research highlights the importance of combining AI and image processing to enhance early detection and management of DFUs, ultimately aiming to reduce the risk of limb loss. Future research should focus on incorporating these technologies into clinical practice and mobile platforms for real-time patient-centred care. Overcoming the existing barriers, AI-driven solutions can significantly reduce the global burden of DFUs and improve patient outcomes.

Keywords: *Diabetics foot ulcers, Image processing, Deep learning, Convolutional neural networks, Artificial intelligence*