Ulcer Shield: An AI-Powered Intelligent Foot Care System for Diabetics, Integrating Image Analysis and Sensor Technology for Personalized Prevention, Early Detection, and Continuous Monitoring of Foot Ulcers

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Diabetic foot ulcers (DFUs) are a major cause of lower-limb amputations, with over 160,000 diabetics in the United States undergoing amputations annually. This project presents an AI-powered mobile application and a smart diabetic shoe designed for the classification, prevention, and early detection of DFUs. The mobile application integrates an advanced imaging system that analyzes patient-uploaded foot images using five AI models trained on a dataset of 16,000 images. These models classify ulcers, assess infection status and severity, and extract wound dimensions for precise evaluation. The smart diabetic shoe is designed to relieve pressure and incorporates temperature and moisture sensors for early ulcer detection, along with vibrational motors for massage therapy and pressure sensors for prevention. The app and shoe function synergistically, continuously monitoring foot health and providing real-time alerts based on sensor data. The questions asked during the patient sign-up process initiate personalized early detection and prevention strategies. The accuracy of the app's ulcer classification was evaluated by comparing its results with clinical observations from specialists. Performance assessment of the five AI models employed various classification, segmentation, and depth conversion metrics, demonstrating high accuracy, as reflected in the ROC curves. The findings show that this system aids patient self-assessment and improves clinical treatment planning by pre-classifying ulcers, saving time, and reducing the risk of complications.

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