

INTISARI

OPTIMASI TERMOGRAM TELAPAK KAKI UNTUK DETEKSI DINI ULKUS KAKI DIABETIK: PENDEKATAN PENINGKATAN MUTU CITRA

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Diabetes Mellitus (DM) adalah penyakit serius akibat kegagalan produksi insulin yang menyebabkan peningkatan kadar glukosa darah. DM memicu komplikasi seperti penyakit jantung, stroke, dan borok kaki diabetik (*Diabetic Foot Ulcer/DFU*), yang berisiko infeksi serius dan amputasi. Penelitian ini mengembangkan model *Machine Learning* untuk deteksi dini ulkus kaki diabetes menggunakan citra termogram dan Thermo dataset, yang mencakup data suhu rinci telapak kaki. Pembaruan mencakup penerapan *baseline* dan alternatif parameter pada berbagai teknik *image enhancement* (Solarize, Posterize, CLAHE, Gamma Adjustment) untuk meningkatkan kualitas citra dan performa model. Model Multi-Classifer memadukan CNN untuk citra termogram dan MLP untuk data tabular. Evaluasi dilakukan dengan cross-validation menggunakan metrik seperti akurasi, presisi, recall, F1-score, dan ROC-AUC. Solarize *threshold* 128 menghasilkan akurasi tertinggi 97,06%, dengan performa kuat juga pada CLAHE. Kedua metode mencapai nilai ROC-AUC sempurna (1.000), menunjukkan kemampuan deteksi tinggi. Penggunaan data suhu bersama citra termogram meningkatkan akurasi prediksi dan menjaga informasi distribusi suhu. Penelitian ini membuktikan bahwa *image enhancement*, terutama Solarize, efektif meningkatkan akurasi model deteksi dini ulkus kaki diabetes. Pendekatan ini memberikan kontribusi signifikan dalam pengembangan teknologi citra medis untuk diagnosis penyakit.

Kata Kunci: Ulkus Kaki Diabetik, Termogram, Image Enhancement, Multi Classifier

ABSTRACT

OPTIMIZATION OF PLANTAR FOOT THERMOGRAM FOR DIABETIC FOOT ULCERATION EARLY DETECTION: AN IMAGE ENHANCEMENT APPROACH

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Diabetes Mellitus (DM) is a serious disease caused by insulin production failure, leading to elevated blood glucose levels. DM triggers complications such as heart disease, stroke, and Diabetic Foot Ulcers (DFU), which pose risks of serious infection and amputation. This study developed a Machine Learning model for early detection of diabetic foot ulcers using thermogram images and the Thermo dataset, which contains detailed foot temperature data. Updates included applying baseline and alternative parameters across various image enhancement techniques (Solarize, Posterize, CLAHE, Gamma Adjustment) to improve image quality and model performance. The Multi-Classifer model combines CNNs for thermogram images and MLP for tabular data. Evaluation was conducted using cross-validation with metrics such as accuracy, precision, recall, F1-score, and ROC-AUC. Solarize threshold 128 achieved the highest accuracy of 97.06%, with strong performance also observed in CLAHE. Both methods reached a perfect ROC-AUC score of 1.000, demonstrating high detection capability. Integrating temperature data with thermogram images enhanced predictive accuracy while preserving critical temperature distribution information. This study demonstrates that image enhancement techniques, particularly Solarize, are effective in improving the accuracy of early detection models for diabetic foot ulcers. This approach makes a significant contribution to the development of medical imaging technologies for disease diagnosis.

Keywords: Diabetic Foot Ulceration, Thermogram, Image Enhancement, Multi Classifier