ABSTRAK

SEGMENTASI MULTI THRESHOLD BERBASIS ANT COLONY OPTIMIZATION PADA CITRA DERMOSKOPI UNTUK KLASIFIKASI LESI KULIT MENGGUNAKAN CONVOLUTIONAL NEURAL NETWORK

Oleh :

Arief Kelik Nugroho
(22/501229/SPA/00861)

Lesi kulit adalah pertumbuhan atau tampilan kulit yang tidak normal pada kulit di sekitarnya. Lesi kulit primer dan sekunder adalah dua jenis lesi kulit. Lesi kulit primer adalah kondisi kulit abnormal yang dapat berkembang dari waktu ke waktu. Lesi kulit sekunder dapat berkembang dari lesi kulit primer yang telah mengalami kerusakan atau perubahan.

Segmentasi citra merupakan langkah fundamental dalam sistem analisis gambar medis, khususnya dalam klasifikasi lesi kulit. Salah satu pendekatan segmentasi adalah teknik multithresholding, di mana citra dibagi menjadi beberapa area homogen berdasarkan threshold pada intensitas tertentu. Teknik ini memungkinkan pemisahan area lesi dari jaringan sehat secara lebih presisi. Efektivitas segmentasi sangat bergantung pada pemilihan threshold optimal yang dalam praktiknya sering menjadi tantangan. Penelitian ini mengkaji pengaruh metode segmentasi multithreshold terhadap performa klasifikasi lesi kulit menggunakan *Convolutional Neural Network* (CNN). Segmentasi *multithreshold* dilakukan sebelum proses klasifikasi dengan memanfaatkan algoritma metaheuristik *Ant Colony Optimization*. Citra yang telah disegmentasi kemudian digunakan sebagai input ke dalam arsitektur CNN untuk klasifikasi tujuh kelas lesi kulit, yaitu MEL, NV, BCC, AKIEC, BKL, DF, dan VASC.

Hasil evaluasi performa model klasifikasi berdasarkan metrik Precision, Recall, dan F1-Score menunjukkan bahwa model bekerja dengan baik pada hampir semua kelas lesi kulit. Kelas Akiec memiliki precision dan recall yang seimbang, masing-masing sebesar 98,1%, dengan F1-Score yang konsisten pada 98,1%. Kelas Bcc juga memperlihatkan performa yang tinggi dengan precision 97,16% dan recall 98,09%, menghasilkan F1-Score 97,62%. Kelas Bkl menampilkan recall tertinggi di antara semua kelas, yaitu 98,72%, meskipun precision sedikit lebih rendah sebesar 95,96%, dengan F1- Score akhir sebesar 97,32%. Demikian pula, kelas Df menunjukkan keseimbangan sempurna antara precision, recall, dan F1-Score yang sama-sama mencapai 98,01%. Kelas Melanoma (Mel), model mencapai precision 95,6% dan recall 97,12%, menghasilkan F1-Score sebesar 96,35%. Kinerja pada kelas Nevus (Nv) dengan nilai presisi mencapai 97,83%, meskipun recall sedikit lebih rendah 95,61%, sehingga F1- Score berada pada 96,7%. Untuk kelas Vasc memperoleh precision 96,27% dan recall 95,91%, dengan F1-Score dengan nilai 96,09%.

Kata Kunci: Segmentasi *Multithreshold*, Klasifikasi Lesi Kulit, Convolutional Neural Network (CNN), Ant Colony Optimization (ACO), Confusion Matrix.

ABSTRACT

MULTI THRESHOLD SEGMENTATION BASED ON ANT COLONY OPTIMIZATION IN DERMOSCOPY IMAGE FOR SKIN LESION CLASSIFICATION USING CONVOLUTIONAL NEURAL NETWORK

by:

Arief Kelik Nugroho
(22/501229/SPA/00861)

Skin lesions are defined as abnormal growths or alterations in the skin that differ in appearance from the surrounding tissue. They are generally categorized into primary and secondary lesions. Primary skin lesions refer to initial pathological changes that arise directly on previously healthy skin and may evolve over time. In contrast, secondary skin lesions develop as a consequence of modification, trauma, or progression of pre-existing primary lesions.

Image segmentation constitutes a fundamental stage in medical image analysis systems, particularly in the context of skin lesion classification. One commonly employed segmentation approach is multilevel thresholding, in which an image is partitioned into several homogeneous regions according to predefined intensity threshold values. This technique facilitates a more accurate delineation of lesion areas from adjacent healthy tissue. However, segmentation performance is highly dependent on the determination of optimal threshold values, a task that remains challenging in practical applications. This study investigates the impact of multilevel threshold-based segmentation on the performance of skin lesion classification using a Convolutional Neural Network (CNN). The multilevel thresholding process was conducted prior to classification by incorporating a metaheuristic optimization technique, namely Ant Colony Optimization (ACO). The segmented images were subsequently utilized as input to a CNN architecture to classify seven categories of skin lesions: melanoma (MEL), nevus (NV), basal cell carcinoma (BCC), actinic keratosis/intraepithelial carcinoma (AKIEC), benign keratosis (BKL), dermatofibroma (DF), and vascular lesions (VASC).

The evaluation of the classification model, assessed using Precision, Recall, and F1-Score metrics, demonstrates robust performance across nearly all lesion categories. The AKIEC class achieved balanced precision and recall values of 98.1%, yielding a consistent F1-Score of 98.1%. Similarly, the BCC class exhibited strong performance, with a precision of 97.16% and recall of 98.09%, resulting in an F1-Score of 97.62%. The BKL category attained the highest recall among all classes at 98.72%, although its precision was slightly lower at 95.96%, producing an overall F1-Score of 97.32%. The DF class demonstrated an optimal balance among all three evaluation metrics, each reaching 98.01%. For melanoma (MEL), the model achieved a precision of 95.6% and recall of 97.12%, corresponding to an F1-Score of 96.35%. In the NV class, precision reached 97.83%, while recall was marginally lower at 95.61%, leading to an F1-Score of 96.7%. Lastly, the VASC category recorded a precision of 96.27% and recall of 95.91%, with a resulting F1- Score of 96.09%.

Keywords: Multilevel Threshold Segmentation, Skin Lesion Classification, Convolutional Neural Network (CNN), Ant Colony Optimization (ACO), Confusion Matrix.