

ABSTRAK

Serangan hama dan penyakit pada tanaman cabai kerap menjadi salah satu faktor utama penurunan produktivitas hasil panen, sementara proses identifikasi yang dilakukan secara manual oleh petani rentan mengalami kesalahan akibat tingginya kemiripan karakteristik visual gejala pada permukaan daun. Guna mengatasi permasalahan tersebut, penelitian ini menerapkan arsitektur ConvNeXt V2 Tiny berbasis *Masked Autoencoders* (MAE) dengan pendekatan *transfer learning* untuk mengklasifikasikan lima kondisi daun cabai secara otomatis, yaitu Daun Sehat, *Leaf Curl*, *Yellowish*, *Leaf Spot*, dan *Whitefly*. Pengujian dilaksanakan melalui dua skenario komparatif, yakni Skenario A yang menerapkan teknik augmentasi data *on-the-fly* dan Skenario B tanpa augmentasi data. Penelitian ini menggunakan dataset berjumlah 2.100 citra digital yang bersumber dari platform Kaggle, dengan pembagian data dilakukan melalui metode *Stratified Split* menjadi 80% data latih, 10% data validasi, dan 10% data uji. Evaluasi model dilakukan secara kuantitatif melalui metrik *classification report* serta grafik riwayat pelatihan, dan dianalisis secara kualitatif menggunakan metode visualisasi Grad-CAM. Berdasarkan hasil penelitian, dapat disimpulkan bahwa arsitektur ConvNeXt V2 Tiny yang didukung teknik augmentasi data (Skenario A) terbukti sangat efektif dan andal, dengan menghasilkan performa tertinggi berupa nilai akurasi sebesar 95,71%, presisi sebesar 95,79%, serta nilai *recall* dan *F1-score* yang mencapai 95,71%. Penerapan teknik augmentasi pada Skenario A terbukti berhasil mengatasi permasalahan *overfitting*, berbeda halnya dengan Skenario B yang mengalami penurunan kemampuan generalisasi akibat munculnya celah divergensi pada kurva akurasi dan loss di riwayat pelatihan Fase 2, yang diperkuat pula oleh hasil visualisasi Grad-CAM yang menunjukkan fokus atensi model terdistorsi oleh elemen latar belakang citra.

Kata Kunci: Cabai, Klasifikasi Citra, ConvNeXt V2, *Masked Autoencoders*, Grad-CAM.

ABSTRACT

Pest and disease attacks on chili plants are often one of the major contributing factors to declining harvest productivity, while manual identification by farmers remains prone to error due to the high visual similarity of symptom characteristics on the leaf surface. To address this issue, this study applies the ConvNeXt V2 Tiny architecture based on Masked Autoencoders (MAE) with a transfer learning approach to automatically classify five chili leaf conditions: Healthy, Leaf Curl, Yellowish, Leaf Spot, and Whitefly. Testing was carried out through two comparative scenarios, namely Scenario A, which applies on-the-fly data augmentation techniques, and Scenario B, without data augmentation. The dataset used consists of 2,100 digital images sourced from the Kaggle platform, with data splitting performed using the Stratified Split method into 80% training data, 10% validation data, and 10% test data. Model evaluation was conducted quantitatively through classification report metrics and training history graphs, and qualitatively analyzed using the Grad-CAM visualization method. Based on the research findings, it can be concluded that the ConvNeXt V2 Tiny architecture supported by data augmentation techniques (Scenario A) is highly effective and reliable, achieving the highest performance with an accuracy of 95.71%, precision of 95.79%, and recall and F1-score reaching 95.71%. The application of augmentation techniques in Scenario A proved successful in overcoming overfitting issues, in contrast to Scenario B, which experienced a decline in generalization performance, as indicated by a divergence gap between the accuracy and loss curves during the Phase 2 training history, further reinforced by Grad-CAM attention visualization results showing distortion caused by background elements within the images.

Keywords: Chili Pepper, Image Classification, ConvNeXt V2, Masked Autoencoders, Grad-CAM.