

ABSTRAK

Peningkatan jumlah sampah anorganik menjadi salah satu permasalahan lingkungan yang memerlukan penanganan secara efektif, salah satunya melalui penerapan teknologi klasifikasi citra berbasis *Deep Learning*. Penelitian ini bertujuan untuk membandingkan kinerja model *Custom Convolutional Neural Network (Custom CNN)* dan *MobileNetV2* berbasis *Transfer Learning* dalam mengklasifikasikan enam kategori sampah anorganik, yaitu aluminium, botol kaca, botol plastik, *foam box*, gelas plastik, dan kardus. Dataset yang digunakan berasal dari platform Kaggle dan dilengkapi dengan citra hasil dokumentasi peneliti. Tahapan penelitian meliputi pengumpulan data, *preprocessing* citra berupa *image resizing* menjadi 224×224 piksel, normalisasi nilai piksel, data augmentation, pembagian dataset menjadi data pelatihan (70%), data validasi (15%), dan data pengujian (15%), perancangan arsitektur model, proses pelatihan, serta evaluasi performa model. Evaluasi dilakukan menggunakan metrik *Accuracy*, *Precision*, *Recall*, *F1-Score*, *Confusion Matrix*, dan *Classification Report*. Model *Custom CNN* dibangun dari awal (*from scratch*), sedangkan model *MobileNetV2* memanfaatkan bobot awal dari *ImageNet* melalui metode *Transfer Learning* yang dilanjutkan dengan proses *Fine Tuning*.

Hasil penelitian menunjukkan bahwa model *MobileNetV2* memberikan performa yang lebih unggul dibandingkan model *Custom CNN*. *MobileNetV2* memperoleh nilai *Accuracy* sebesar 89,45%, *Precision* 91,18%, *Recall* 89,94%, dan *F1-Score* 89,65%, sedangkan *Custom CNN* memperoleh *Accuracy* sebesar 57,27%, *Precision* 53,86%, *Recall* 55,78%, dan *F1-Score* 51,28%. Berdasarkan hasil tersebut, dapat disimpulkan bahwa penerapan metode *Transfer Learning* pada arsitektur *MobileNetV2* mampu meningkatkan kinerja klasifikasi citra sampah anorganik dibandingkan model *Custom CNN*. Dengan demikian, *MobileNetV2* dapat dijadikan sebagai alternatif model yang lebih efektif dalam pengembangan sistem klasifikasi sampah anorganik berbasis *Deep Learning*.

Kata kunci: *Deep Learning*, *Custom CNN*, *MobileNetV2*, *Transfer Learning*, Klasifikasi Citra, Sampah Anorganik.

ABSTRACT

The increasing amount of inorganic waste has become one of the environmental issues that requires effective management, one of which is through the implementation of Deep Learning-based image classification technology. This study aims to compare the performance of the Custom Convolutional Neural Network (Custom CNN) and MobileNetV2 based on Transfer Learning in classifying six categories of inorganic waste, namely aluminum, glass bottles, plastic bottles, foam boxes, plastic cups, and cardboard. The dataset used in this study was obtained from the Kaggle platform and supplemented with images collected by the researcher.

The research methodology consisted of data collection, image preprocessing including image resizing to 224×224 pixels, pixel value normalization, data augmentation, dataset splitting into training (70%), validation (15%), and testing (15%) sets, model architecture design, model training, and performance evaluation. The evaluation was conducted using Accuracy, Precision, Recall, F1-Score, Confusion Matrix, and Classification Report metrics. The Custom CNN model was developed from scratch, whereas the MobileNetV2 model utilized pre-trained weights from ImageNet through the Transfer Learning approach, followed by a Fine-Tuning process.

The experimental results indicate that the MobileNetV2 model outperformed the Custom CNN model. MobileNetV2 achieved an Accuracy of 89.45%, Precision of 91.18%, Recall of 89.94%, and F1-Score of 89.65%. In contrast, the Custom CNN model achieved an Accuracy of 57.27%, Precision of 53.86%, Recall of 55.78%, and F1-Score of 51.28%. Based on these findings, it can be concluded that the implementation of the Transfer Learning method using the MobileNetV2 architecture significantly improves the performance of inorganic waste image classification compared with the Custom CNN model. Therefore, MobileNetV2 can be considered a more effective alternative for developing Deep Learning-based inorganic waste classification systems.

Keywords: Deep Learning, Custom CNN, MobileNetV2, Transfer Learning, image classification, inorganic waste.