ABSTRAK

Peningkatan volume sampah membutuhkan dukungan teknologi yang mampu membantu proses identifikasi jenis sampah secara otomatis. Pemilahan sampah berdasarkan jenisnya merupakan salah satu tahapan penting dalam pengelolaan sampah. Perkembangan *deep learning* memberikan peluang untuk mengembangkan sistem klasifikasi sampah berbasis citra secara otomatis. Penelitian ini bertujuan untuk menerapkan dan membandingkan kinerja tiga model *deep learning*, yaitu *convolutional neural network* (CNN konvensional), MobileNetV2, dan ResNet50, serta menentukan model dengan performa klasifikasi terbaik. Penelitian menggunakan dataset TrashNet yang terdiri atas 2.527 citra dalam enam kelas, yaitu *cardboard, glass, metal, paper, plastic,* dan *trash*. Dataset dibagi menjadi data pelatihan, validasi, dan pengujian dengan pendekatan *stratified split*, sehingga proporsi kelas pada setiap subset tetap mendekati distribusi dataset awal. CNN konvensional dilatih dari awal, sedangkan MobileNetV2 dan ResNet50 menggunakan pendekatan *transfer learning* dengan bobot awal dari ImageNet. Kinerja model dievaluasi menggunakan *accuracy, precision, recall, F1-score*, dan *confusion matrix*. Hasil pengujian menunjukkan bahwa ResNet50 memperoleh *accuracy* sebesar 91,84%, *macro precision* 89,97%, *macro recall* 89,19%, dan *macro F1-score* 89,54%. MobileNetV2 menghasilkan *accuracy* sebesar 89,74%, sedangkan CNN konvensional memperoleh 82,11%. ResNet50 menunjukkan performa klasifikasi terbaik di antara ketiga model pada dataset dan konfigurasi eksperimen yang digunakan. Hasil penelitian ini menunjukkan bahwa pemilihan arsitektur dan strategi pelatihan berkaitan dengan kinerja klasifikasi sampah berbasis citra. Penelitian ini diharapkan dapat menjadi bahan pertimbangan dalam memilih model *deep learning* untuk pengembangan sistem klasifikasi jenis sampah berbasis citra.
Kata kunci: klasifikasi sampah, *deep learning*, CNN, MobileNetV2, ResNet50, TrashNet.

ABSTRACT

The increasing volume of waste requires technological support to facilitate the automatic identification of waste types. Waste sorting based on type is an important stage in waste management. The development of *deep learning* offers opportunities to develop automated image-based waste classification systems. This study aims to implement and compare the performance of three *deep learning* models, namely a conventional *convolutional neural network* (CNN), MobileNetV2, and ResNet50, and to determine which model achieves the best classification performance. This study uses the TrashNet dataset, consisting of 2,527 images categorized into six classes: *cardboard, glass, metal, paper, plastic,* and *trash*. The dataset is divided into training, validation, and testing sets using a *stratified split* approach to ensure that the class proportions in each subset remain approximately consistent with the distribution of the original dataset. The conventional CNN is trained from scratch, whereas MobileNetV2 and ResNet50 employ a *transfer learning* approach using pretrained weights from ImageNet. Model performance is evaluated using *accuracy, precision, recall, F1-score,* and a *confusion matrix*. The test results show that ResNet50 achieves an *accuracy* of 91.84%, a *macro precision* of 89.97%, a *macro recall* of 89.19%, and a *macro F1-score* of 89.54%. MobileNetV2 achieves an *accuracy* of 89.74%, while the conventional CNN achieves 82.11%. ResNet50 demonstrates the best classification performance among the three models on the dataset and under the experimental configuration used in this study. These findings indicate that the choice of architecture and training strategy is associated with the performance of image-based waste classification. This study is expected to provide a basis for selecting *deep learning* models for the development of image-based waste classification systems.

Keywords: waste classification, *deep learning*, CNN, MobileNetV2, ResNet50, TrashNet.