INTISARI

FEATURE FUSION DALAM KLASIFIKASI JENIS PLASTIK DAUR ULANG

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Peningkatan volume sampah plastik menimbulkan tantangan besar dalam pengelolaan limbah, terutama pada tahap penyortiran jenis plastik yang efisien di pusat daur ulang. Salah satu kendala utama adalah kemiripan visual antar jenis plastik, yang menyulitkan proses klasifikasi otomatis berbasis gambar. Penelitian ini mengusulkan solusi berupa metode klasifikasi berbasis *feature fusion* yang menggabungkan fitur dari model *deep learning* VGG16 serta fitur tekstur *handcrafted* GLCM dan LBP. Data gambar diproses melalui tahapan *preprocessing*, ekstraksi dan penggabungan fitur, kemudian diklasifikasikan menggunakan tiga model: *Multi-Layer Perceptron* (MLP), *Support Vector Machine* (SVM), dan *Random Forest*. Hasil pengujian menunjukkan bahwa kombinasi fitur VGG16, GLCM, dan LBP yang diklasifikasikan dengan MLP menghasilkan performa terbaik dengan akurasi, precision, recall, dan F1-score sebesar 97%. Dengan demikian, penelitian ini memberikan kontribusi terhadap pengembangan sistem klasifikasi sampah plastik yang akurat dan efisien, serta mendukung otomatisasi penyortiran dalam pengelolaan limbah berkelanjutan.

Kata Kunci: *Feature Fusion, Deep Learning,* Pengolahan Sampah, Sampah Daur Ulang, Klasifikasi.

ABSTRACT

FEATURE FUSION FOR PLASTIC WASTE CLASSIFICATION FOR ENHANCED RECYCLING OPTIMIZATION

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As the volume of plastic waste continues to increase, developing an efficient and accurate classification system is critical to support automated sorting in recycling facilities. The primary challenge lies in the high visual similarity between plastic types, which complicates automatic image-based classification. This study proposes a feature fusion approach by combining deep learning features (VGG16) with handcrafted texture features (GLCM and LBP). The experimental setup includes image preprocessing, feature extraction, feature fusion, and classification using Multi-Layer Perceptron (MLP), Support Vector Machine (SVM), and Random Forest. The best results were achieved by the MLP model using the combined VGG16+GLCM+LBP features, reaching 97% in accuracy, precision, recall, and F1-score. Confusion matrix analysis shows only four misclassifications out of 120 test images, mainly caused by extreme image conditions such as transparency, object angle, and background contrast. This study demonstrates that multimodal feature fusion provides a balanced, accurate, and efficient classification strategy for plastic waste management systems.

Keywords: **Feature Fusion, Deep Learning, Sustainable Waste Management, Recycling Wate, Classification**.