

ABSTRAK

William Jordan Hutabarat,Amd . Analisis Perbandingan Metode Klasifikasi ResNet-50 dan Random Forest pada Sistem Deteksi Keaslian Uang Kertas Rupiah Menggunakan Ekstraksi Fitur HOG. Dibimbing oleh Juara Mangapul Tambunan, S.T., M.Si

Pemalsuan uang kertas masih menjadi permasalahan yang signifikan di Indonesia meskipun teknologi keamanan terus berkembang. Deteksi manual oleh masyarakat umum seringkali tidak efektif karena keterbatasan pengetahuan dan variasi kualitas uang palsu yang semakin canggih. Penelitian ini mengusulkan sistem deteksi keaslian uang kertas rupiah otomatis berbasis pengolahan citra digital dengan membandingkan dua pendekatan klasifikasi: Residual Network (ResNet-50) sebagai representasi deep learning modern dan Random Forest dengan ekstraksi fitur Histogram of Oriented Gradients (HOG) sebagai pendekatan machine learning klasik.

Dataset dibangun secara mandiri mencakup 500 citra uang kertas rupiah emisi 2016 dan 2022 dengan pecahan Rp 50.000 dan Rp 100.000, yang terdiri dari uang asli dan uang palsu dengan tiga tingkat kualitas reproduksi. Pra-pengolahan meliputi normalisasi, augmentasi data, dan ekstraksi Region of Interest (ROI) pada area portrait, watermark, dan security thread. ResNet-50 diimplementasikan dengan strategi transfer learning dua fase, sedangkan Random Forest dioptimasi melalui grid search cross-validation setelah reduksi dimensi PCA pada vektor fitur HOG.

Evaluasi performa menggunakan metrik akurasi, presisi, recall, F1-score, dan AUC-ROC serta analisis efisiensi komputasional berupa waktu training, inference, dan ukuran model. Hasil penelitian diharapkan dapat memberikan rekomendasi metode optimal berdasarkan trade-off akurasi dan efisiensi untuk implementasi sistem deteksi uang palsu dalam konteks aplikasi nyata.

Kata Kunci: deteksi uang palsu, ResNet-50, Random Forest, Histogram of Oriented Gradients, pengolahan citra, transfer learning

ABSTRACT

William Jordan Hutabarat,Amd . *Comparative Analysis of ResNet-50 and Random Forest Classification Methods on Rupiah Banknote Authenticity Detection System Using HOG Feature Extraction.*
Supervised by Juara Mangapul Tambunan, S.T., M.Si

Counterfeit banknote detection remains a significant issue in Indonesia despite continuous advancements in security technology. Manual detection by the general public is often ineffective due to limited knowledge and the increasingly sophisticated quality variations of counterfeit currency. This research proposes an automated Indonesian Rupiah banknote authenticity detection system based on digital image processing by comparing two classification approaches: Residual Network (ResNet-50) as a representation of modern deep learning and Random Forest with Histogram of Oriented Gradients (HOG) feature extraction as a classical machine learning approach.

The dataset was constructed independently comprising 500 banknote images from 2016 and 2022 emissions with Rp 50,000 and Rp 100,000 denominations, consisting of genuine and counterfeit notes with three levels of reproduction quality. Preprocessing included normalization, data augmentation, and Region of Interest (ROI) extraction in portrait, watermark, and security thread areas. ResNet-50 was implemented using a two-phase transfer learning strategy, while Random Forest was optimized through grid search cross-validation following PCA dimensionality reduction on HOG feature vectors.

Performance evaluation employed accuracy, precision, recall, F1-score, and AUC-ROC metrics as well as computational efficiency analysis including training time, inference time, and model size. The research results