

ABSTRAK

Sistem Monitoring dan Deteksi Pelanggaran Buang Sampah Sembarangan Berbasis CCTV Menggunakan Arsitektur R(2+1)D 3D Convolutional Neural Network

(2026:XVII+ 97 Halaman + 33 Gambar + 13 Tabel + Daftar pustaka + Lampiran)

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Pembuangan sampah sembarangan merupakan permasalahan lingkungan yang masih sering terjadi dan sulit diawasi secara terus-menerus menggunakan metode konvensional. Penelitian ini bertujuan mengembangkan sistem monitoring berbasis CCTV untuk mendeteksi aktivitas membuang sampah secara otomatis melalui integrasi model deteksi objek YOLOv8 dan model pengenalan aktivitas R(2+1)D 3D Convolutional Neural Network (3D CNN). YOLOv8 digunakan untuk mendeteksi keberadaan manusia pada setiap frame video, sedangkan model R(2+1)D mengklasifikasikan aktivitas menjadi dua kelas, yaitu buang sampah dan normal. Sistem dikembangkan menggunakan Python dan diintegrasikan dengan aplikasi monitoring yang mampu memberikan notifikasi ketika pelanggaran terdeteksi. Dataset yang digunakan terdiri atas 1.688 citra manusia untuk pelatihan YOLOv8 serta dataset video aktivitas untuk pelatihan model R(2+1)D. Evaluasi dilakukan menggunakan confusion matrix dengan parameter accuracy, precision, dan recall. Hasil pelatihan YOLOv8 memperoleh precision sebesar 100% dan recall sebesar 67%. Pengujian sistem pada kondisi siang menghasilkan accuracy 80%, precision 81,82%, dan recall 90%, sedangkan pada malam hari memperoleh accuracy 80%, precision 72,73%, dan recall 100%. Hasil penelitian menunjukkan bahwa sistem mampu mendeteksi aktivitas membuang sampah secara efektif pada berbagai kondisi pencahayaan dan berpotensi mendukung pengawasan lingkungan berbasis CCTV secara otomatis.

Kata kunci: YOLOv8, R(2+1)D, 3D Convolutional Neural Network, Deteksi Aktivitas, CCTV, Buang Sampah.

ABSTRAK

CCTV-Based Monitoring and Detection System for Illegal Littering Using the R(2+1)D 3D Convolutional Neural Network Architecture (2026: XVII+ 97 Pages + 33 Figures + 13 Tables + References + Appendices)

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Illegal littering remains a significant environmental problem that is difficult to monitor continuously using conventional surveillance methods. This study proposes a CCTV-based monitoring system that automatically detects littering activities by integrating the YOLOv8 object detection model with the R(2+1)D 3D Convolutional Neural Network (3D CNN) action recognition model. YOLOv8 is employed to detect human objects in each video frame, while the R(2+1)D model classifies activities into two categories: littering and normal. The system was developed using Python and integrated into a monitoring application capable of providing warning notifications when littering activities are detected. The dataset consists of 1,688 human images for YOLOv8 training and a video dataset for training the R(2+1)D model. Performance was evaluated using a confusion matrix with accuracy, precision, and recall metrics. The YOLOv8 model achieved 100% precision and 67% recall for human detection. The integrated system obtained 80% accuracy, 81.82% precision, and 90% recall under daytime conditions, while nighttime testing achieved 80% accuracy, 72.73% precision, and 100% recall. These results demonstrate that the proposed system can effectively detect littering activities under different lighting conditions and has strong potential for automated CCTV-based environmental monitoring.

Keywords: YOLOv8, R(2+1)D, 3D Convolutional Neural Network, Action Recognition, CCTV, Littering Detection.