

**PENGEMBANGAN SISTEM DETEKSI DAN KLASIFIKASI
KENDARAAN MENGGUNAKAN YOLO DAN API *REAL-TIME*
DENGAN METODE *RAPID APPLICATION DEVELOPMENT* (RAD)**

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ABSTRAK

Perkembangan teknologi computer vision memungkinkan penerapan sistem deteksi kendaraan otomatis menggunakan kamera CCTV. Namun, penerapan model deep learning pada kondisi nyata masih menghadapi tantangan, seperti kesalahan klasifikasi antar jenis kendaraan, variasi pencahayaan, serta duplikasi perhitungan akibat satu kendaraan terdeteksi pada banyak frame. Penelitian ini bertujuan mengembangkan sistem deteksi, klasifikasi, dan perhitungan kendaraan berbasis YOLOv8 yang dioptimalkan untuk kondisi lalu lintas nyata melalui pendekatan post-processing rule-based dan algoritma tracking ByteTrack.

Metode penelitian meliputi analisis kebutuhan, perancangan sistem, implementasi YOLOv8, penerapan post-processing berbasis aturan, serta integrasi ByteTrack untuk multi-object tracking. Post-processing dilakukan dengan memanfaatkan informasi geometris bounding box, seperti luas area, rasio aspek, dan posisi objek pada frame, guna meningkatkan akurasi klasifikasi kendaraan. Algoritma ByteTrack digunakan untuk memastikan setiap kendaraan hanya dihitung satu kali melalui mekanisme track ID yang stabil.

Pengujian dilakukan menggunakan tiga video uji dengan kondisi lingkungan berbeda serta pengujian real-time menggunakan CCTV live. Hasil pengujian menunjukkan bahwa penerapan post-processing rule-based mampu meningkatkan nilai precision, recall, dan F1-score secara signifikan dibandingkan tanpa post-processing. Integrasi ByteTrack juga berhasil mengurangi duplikasi perhitungan kendaraan dan menjaga kestabilan sistem pada pengujian real-time. Sistem yang dikembangkan dinilai mampu melakukan deteksi, klasifikasi, dan perhitungan kendaraan secara akurat dan stabil pada kondisi CCTV nyata.

Kata kunci: YOLOv8, Deteksi Kendaraan, Post-Processing Rule-Based, ByteTrack, CCTV, Computer Vision.

**DEVELOPMENT OF A VEHICLE DETECTION AND
CLASSIFICATION SYSTEM USING YOLO AND REAL-TIME API
WITH THE RAPID APPLICATION DEVELOPMENT (RAD)
METHOD**

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ABSTRACT

Advances in computer vision technology have enabled the implementation of automatic vehicle detection systems using CCTV cameras. However, the application of deep learning models in real-world conditions still faces challenges, such as misclassification between vehicle types, variations in lighting, and duplication of calculations due to a single vehicle being detected in multiple frames. This research aims to develop a YOLOv8-based vehicle detection, classification, and counting system optimized for real-world traffic conditions through a rule-based post-processing approach and the ByteTrack tracking algorithm.

The research methods include requirements analysis, system design, YOLOv8 implementation, rule-based post-processing, and ByteTrack integration for multi-object tracking. Post-processing utilizes bounding box geometric information, such as area, aspect ratio, and object position in the frame, to improve vehicle classification accuracy. The ByteTrack algorithm is used to ensure each vehicle is counted only once through a stable track ID mechanism.

Tests were conducted using three test videos with different environmental conditions, as well as real-time testing using live CCTV. The results showed that the application of rule-based post-processing significantly improved precision, recall, and F1-score compared to no post-processing. The ByteTrack integration also successfully reduced duplicate vehicle counts and maintained system stability in real-time testing. The developed system was deemed capable of accurate and stable vehicle detection, classification, and counting under real-world CCTV conditions.

Keywords: YOLOv8, Vehicle Detection, Rule-Based Post-Processing, ByteTrack, CCTV, Computer Vision.