

**SISTEM PENDETEKSIAN DAN PERINGATAN KEDATANGAN KERETA
API PADA PERLINTASAN SEBIDANG DI KOTA PADANG BERBASIS
YOLO DAN LORA**

LAPORAN TUGAS AKHIR TEKNIK KOMPUTER

BERKA ALDIZAR

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SISTEM PENDETEKSIAN DAN PERINGATAN KEDATANGAN KERETA API PADA PERLINTASAN SEBIDANG DI KOTA PADANG BERBASIS YOLO DAN LORA

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ABSTRAK

Penelitian ini merancang, mengimplementasikan, dan mengevaluasi sistem peringatan dini berbiaya rendah untuk perlintasan sebidang kereta api tanpa penjaga di Kota Padang, Indonesia, yang minim peralatan keselamatan akibat keterbatasan sumber daya. Menggunakan metode eksperimental terapan, perangkat sensing (Raspberry Pi 4, kamera, model YOLOv8n) menangkap dan mengklasifikasikan kereta api yang mendekat, lalu mengirim sinyal pemicu via LoRa ke perangkat actuator (ESP32, sirene, lampu strobo) di perlintasan. Perangkat actuator juga melaporkan status ke Firebase Realtime Database yang dapat diakses via aplikasi *mobile*. Uji lapangan pada perlintasan tanpa penjaga mencakup cakupan citra, intensitas alarm, akurasi deteksi, waktu respons, jangkauan LoRa, notifikasi *fail-safe*, dan operasi *end-to-end*. Model YOLOv8n mencapai akurasi deteksi lapangan 95,6% (mAP@0.5 sebesar 99,2% saat pelatihan). Sistem memberi peringatan dalam 1–3 detik setelah deteksi, koneksi LoRa andal hingga 420 m, sirene menghasilkan 85–92,8 dB, lampu strobo hanya mengonsumsi 1,22 W, dan integrasi *end-to-end* berhasil 100%. Sistem berbasis YOLOv8 dan LoRa ini memenuhi seluruh target spesifikasi serta menawarkan alternatif yang andal dan terjangkau dibanding infrastruktur konvensional, khususnya bagi pemerintah daerah dengan keterbatasan anggaran.

Kata Kunci: perlintasan sebidang, deteksi kereta api, YOLOv8, LoRa, sistem peringatan dini

SYSTEM FOR TRAIN DETECTION AND ARRIVAL WARNING AT LEVEL CROSSINGS IN PADANG CITY BASED ON YOLO AND LORA

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ABSTRACT

This study designs, implements, and evaluates a low-cost early-warning system for unguarded railway level crossings in Padang City, Indonesia, where limited resources have left many crossings without adequate safety equipment. An applied experimental method was used. A sensing unit (Raspberry Pi 4, camera, and a YOLOv8n detection model) captures and classifies approaching trains, then transmits a trigger signal via a LoRa module to an actuator unit (ESP32, siren, and strobe light) installed at the crossing; the actuator also reports status to a Firebase Realtime Database accessible through a mobile application. Field tests were conducted at an unguarded crossing, covering image coverage, alarm intensity, detection accuracy, response time, LoRa communication range, fail-safe notification, and end-to-end operation. The YOLOv8n model reached 95.6% field detection accuracy (99.2% mAP@0.5 during training). The system issued warnings within 1-3 seconds of detection, the LoRa link remained reliable up to 420 m, the siren produced 85-92.8 dB, the strobe light drew only 1.22 W, and end-to-end integration succeeded in 100% of trials. The proposed YOLOv8- and LoRa-based system meets all target specifications and offers an affordable, reliable alternative to conventional level-crossing safety infrastructure, particularly for resource-constrained municipalities.

Keywords: level crossing, train detection, YOLOv8, LoRa, early warning system