SISTEM PEMANTAU DEMONSTRASI BERBASIS YOU ONLY LOOK ONCE VERSI 5 NANO (YOLOV5N) MENGGUNAKAN RASPBERRY PI

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ABSTRAK

Deteksi dini terhadap potensi bencana kerumunan dalam aksi demonstrasi, penting untuk mendukung pengambilan keputusan cepat petugas keamanan. Penelitian ini mengembangkan sistem deteksi objek berbasis You Only Look Once (YOLO) untuk menghitung kerumunan dan mendeteksi api dari sudut pandang atas (top-down view). Tiga varian ringan—YOLOv3-Tiny, YOLOv4-Tiny, dan YOLOv5n—dibandingkan berdasarkan *precision*, *recall*, F1-*score*, dan *mean average precision* (mAP), serta inferensi pada Raspberry Pi 4B. Hasil evaluasi menunjukkan YOLOv5n unggul dengan *precision* 91,5 %, *recall* 91,6 %, F1-*score* 91,5 %, dan mAP@50 95,6 %, sehingga diimplementasikan pada perangkat. Sistem terintegrasi dengan antarmuka *web* yang menampilkan video *stream* hasil deteksi secara *real-time* dan mengirimkan peringatan saat jumlah massa melebihi ambang batas atau api terdeteksi. Pada pengujian menggunakan video demonstrasi luar ruangan, Raspberry Pi 4B menjalankan inferensi YOLOv5n dengan latensi rata-rata 216 ms, jitter 34,8 ms, *throughput* 5,2 FPS, penggunaan CPU 71,3 %, memori 15,9 %, dan *confidence score* 65,3 %.

Kata kunci: *YOLOv5n; Raspberry Pi 4B; Deteksi Kerumunan; Deteksi Api; Real-Time Monitoring*

PROTEST MONITORING SYSTEM BASED ON YOU ONLY LOOK ONCE VERSION 5 NANO (YOLOV5N) USING RASPBERRY PI

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ABSTRACT

Early detection of crowd-related hazards during protests is crucial for enabling rapid decision-making by security personnel. This study develops a real-time object-detection system based on You Only Look Once (YOLO) to count crowds and detect fire from a top-down view. Three lightweight variants—YOLOv3-Tiny, YOLOv4-Tiny, and YOLOv5n—were compared using precision, recall, F1-score, and mean average precision (mAP), as well as inference performance on a Raspberry Pi 4B. Evaluation results show that YOLOv5n outperforms the others with a precision of 91.5 %, recall of 91.6 %, F1-score of 91.5 %, and mAP@50 of 95.6 %, and was therefore selected for deployment. The system integrates a web interface that streams detection output in real time and issues alerts when crowd size exceeds a predefined threshold or when fire is detected. In tests using outdoor protest videos, the Raspberry Pi 4B running YOLOv5n achieved an average latency of 216 ms, jitter of 34.8 ms, throughput of 5.2 FPS, CPU utilization of 71.3 %, memory usage of 15.9 %, and an average confidence score of 65.3 %.

Keywords*: YOLOv5n, Raspberry Pi 4B, crowd monitoring, fire detection, Real-Time Monitoring*