

ABSTRAK

Peningkatan jumlah kendaraan di kawasan perkotaan menyebabkan meningkatnya kepadatan lalu lintas yang berpotensi menimbulkan konflik dan kecelakaan. Oleh karena itu, diperlukan suatu sistem yang mampu mendeteksi kendaraan, melacak pergerakannya, serta mengidentifikasi tingkat risiko tabrakan secara otomatis sebagai bentuk peringatan dini. Penelitian ini bertujuan mengimplementasikan model YOLOv8n dan algoritma DeepSORT untuk mendeteksi dan melacak kendaraan serta mengidentifikasi tingkat risiko tabrakan berdasarkan parameter jarak antar kendaraan, kecepatan relatif, *trajectory overlap*, dan *Time To Collision* (TTC) pada video lalu lintas. Penelitian menggunakan pendekatan *computer vision* dengan data berupa video hasil perekaman langsung pada beberapa ruas jalan dan area persimpangan di Kota Lhokseumawe. Tahapan penelitian meliputi deteksi kendaraan menggunakan YOLOv8n, pelacakan kendaraan menggunakan DeepSORT, perhitungan parameter risiko, serta identifikasi tingkat risiko ke dalam kategori *SAFE*, *WARNING*, dan *DANGER* berdasarkan nilai ambang yang telah ditentukan. Hasil penelitian menunjukkan bahwa model YOLOv8n memperoleh nilai *Precision* sebesar 0,780, *Recall* sebesar 0,704, mAP@50 sebesar 0,747, dan mAP@50-95 sebesar 0,519, sedangkan algoritma DeepSORT mampu mempertahankan identitas (*Track ID*) kendaraan secara konsisten selama proses pelacakan. Berdasarkan hasil pengujian terhadap 2.683 pasangan kendaraan, sistem berhasil mengidentifikasi 1.719 pasangan (64,07%) dalam kategori *SAFE*, 172 pasangan (6,41%) dalam kategori *WARNING*, dan 792 pasangan (29,52%) dalam kategori *DANGER*. Hasil tersebut menunjukkan bahwa integrasi YOLOv8n, DeepSORT, serta analisis parameter jarak antar kendaraan, kecepatan relatif, *trajectory overlap*, dan *Time To Collision* (TTC) mampu menghasilkan sistem identifikasi tingkat risiko tabrakan berbasis video *analytics* yang bekerja secara *real-time* pada kondisi lalu lintas di Kota Lhokseumawe dan berpotensi mendukung pengembangan sistem peringatan dini (*early warning system*) untuk meningkatkan keselamatan lalu lintas.

Kata Kunci: YOLOv8n, DeepSORT, Deteksi Kendaraan, Identifikasi Risiko Tabrakan, *Time To Collision*.

ABSTRACT

The increasing number of vehicles in urban areas has led to higher traffic density, which consequently raises the potential for traffic conflicts and accidents. Therefore, an intelligent system capable of detecting vehicles, Tracking their movements, and automatically identifying collision risk is required as an early warning mechanism. This study aims to implement the YOLOv8n model and the DeepSORT algorithm for vehicle detection and Tracking, as well as to identify collision risk based on inter-vehicle distance, relative speed, trajectory overlap, and Time To Collision (TTC) parameters from traffic video data. The study employed a computer vision approach using traffic videos recorded directly at several road segments and intersections in Lhokseumawe City. The proposed system consists of vehicle detection using YOLOv8n, vehicle Tracking using DeepSORT, collision risk parameter calculation, and collision risk identification into three categories, namely SAFE, WARNING, and DANGER, based on predefined threshold values. The experimental results show that the YOLOv8n model achieved a Precision of 0.780, Recall of 0.704, mAP@50 of 0.747, and mAP@50–95 of 0.519, while the DeepSORT algorithm successfully maintained consistent vehicle identities (Track IDs) throughout the Tracking process. Based on the analysis of 2,683 vehicle pairs, the system identified 1,719 pairs (64.07%) as SAFE, 172 pairs (6.41%) as WARNING, and 792 pairs (29.52%) as DANGER. These findings demonstrate that the integration of YOLOv8n, DeepSORT, and collision risk analysis based on inter-vehicle distance, relative speed, trajectory overlap, and Time To Collision (TTC) can produce a real-time video analytics-based collision risk identification system under real traffic conditions in Lhokseumawe City. The proposed system is expected to serve as an alternative approach for the development of an early warning system to enhance road traffic safety.

Keywords: YOLOv8n, DeepSORT, Vehicle Detection, Collision Risk Identification, Time To Collision.