1. Karthik Sivakoti (2024)**.Vehicle Detection and Classification for Toll Collection Using YOLOv11 and OCR** arxiv.2412.12191**,**https://arxiv.org/abs/2412.12191

Abstract

Traditional automated toll collection systems depend on complex hardware configurations, that require huge investments in installation and maintenance. This research paper presents an innovative approach to revolutionize automated toll collection by using a single camera per plaza with the YOLOv11 computer vision architecture combined with an ensemble OCR technique. Our system has achieved a Mean Average Precision (mAP) of 0.895 over a wide range of conditions, demonstrating 98.5% accuracy in license plate recognition, and 99.7% OCR confidence scoring. The architecture incorporates intelligent vehicle tracking and real-time monitoring through an extended dashboard interface. Extensive training using 2,500 images under various environmental conditions, our solution shows improved performance while drastically reducing hardware resources compared to conventional systems. This research contributes toward intelligent transportation systems by introducing a scalable, precision-centric solution that improves operational efficiency and user experience in modern toll collections

2. Karthikeyan R, Karthikeyan P, Muthamizh Selvan M, Babisha A, Suma Christal Mary S,Swagatha J. P(2025). **Finding Stolen Vehicles Using Traffic Cameras**. IJRASET – Journal for Research in Applied Science and EngineeringTechnology,https://www.ijraset.com/research-paper/finding-stolen-vehicles-using-traffic-cameras

Abstract

This paper presents a modern traffic camera–based vehicle tracking system aimed at improving stolen vehicle recovery, particularly in situations where license plates are obscured or intentionally removed. Conventional stolen vehicle detection systems rely heavily on Automatic License Plate Recognition (ALPR), which becomes unreliable under such conditions. To address this limitation, the proposed system integrates ALPR with advanced machine learning and computer vision techniques to identify vehicles using model-specific attributes such as shape and color. The system generates real-time alerts containing critical information including vehicle location, travel direction, and timestamp, enabling faster response by law enforcement agencies. By utilizing CNN and YOLO models, the system is capable of accurately detecting and classifying vehicles under varying lighting conditions and partial occlusions, making it a scalable and effective solution for enhancing public safety and traffic surveillance.

3. Twana Mustafa,Murat Karabatak (2024).**Real Time Car Model and Plate Detection System by Using Deep Learning Architectures**. IEEE Access,12, 107616 - 107630,https://ieeexplore.ieee.org/document/10601685

Abstract

This research presents an integrated deep learning–based system for real-time vehicle identification by combining Vehicle Make and Model Recognition (VMMR) with Automatic Number Plate Recognition (ANPR). Unlike traditional approaches that address these tasks separately, the proposed system offers a unified and efficient solution, achieving an accuracy of 97.5% even under challenging weather conditions. The system is developed using Python and OpenCV, and employs deep learning models such as MobileNet-V2 and YOLOx for vehicle make and model detection, along with YOLOv4-tiny, PaddleOCR, and SVTR-tiny for number plate recognition.

The system was evaluated using over a thousand images captured at Firat University under diverse conditions including fog, rain, and low light, demonstrating strong robustness and practical applicability. Performance analysis was further enhanced using Gradient-weighted Class Activation Mapping (Grad-CAM) to interpret model decisions and improve misclassification handling. The results highlight the system's effectiveness for real-time applications in traffic management, stolen vehicle detection, security surveillance, and autonomous driving, establishing a strong foundation for future research in intelligent vehicle identification systems.

4. Tejasva Maurya,Saurabh Kumar,Mritunjay Rai,Abhishek Kumar Saxena (2025). **Real Time Vehicle Classification Using Deep Learning—Smart Traffic Management**. Researchgate 10.1002/eng2.70082, https://www.researchgate.net/publication/389767336_Real_Time_Vehicle_Classification_Using_Deep_Learning-Smart_Traffic_Management

Abstract

As urbanization increases, traffic congestion and road safety have become major global concerns, with road accidents causing approximately 1.19 million deaths annually worldwide. To address this issue, this study proposes a real-time deep learning–based vehicle classification system to enhance traffic management and safety. The model classifies vehicles into seven categories: Bus, Car, Truck, Van/Mini-Truck, Two-Wheeler, Three-Wheeler, and Special Vehicles.

A custom dataset captured under diverse traffic conditions was used to ensure real-world applicability. The system utilizes the **YOLOv8 framework** with transfer learning to achieve fast and accurate vehicle detection, even in low-resource environments. Performance evaluation shows strong results, achieving high precision, recall, and mean average precision (mAP). The study highlights the model's suitability for deployment in low- and middle-income regions and its potential integration into intelligent traffic management systems. Future improvements include enhancing performance under adverse weather conditions, integrating additional sensors, and extending the system for autonomous vehicle applications.

5. P Ramani,B Manoj Sai,S K Sohail, P Manikanta (2024).**Real-Time Fake Number Plate Detection And Analysis With Raspberry Pi And Deep Learning** IEEE *Xplore* 2024 4th Asian Conference on Innovation in Technology (ASIANCON).
https://ieeexplore.ieee.org/abstract/document/10837818

Abstract

This project presents an innovative system designed for real-time detection and analysis of counterfeit number plates, combining Raspberry Pi and advanced deep learning technology, notably the You Only Look Once (YOLO) object detection algorithm. The primary objective is to bolster security and law enforcement efforts by automating the detection of fraudulent number plates, thereby enhancing traffic monitoring and maintaining the credibility of license plate recognition systems. The project begins with a comprehensive exploration of existing literature, focusing on the state-of-the-art in deep learning algorithms, particularly YOLO, and its applications in object detection tasks. Following this, extensive experimentation and prototyping are conducted to integrate YOLO with the Raspberry Pi platform, ensuring efficient on-board processing for real-time applications. The system's implementation involves the development of a robust pipeline for capturing, preprocessing, and analysing live video streams from surveillance cameras. The YOLO algorithm is then employed to detect and classify number plates within the captured frames, enabling swift identification of counterfeit plates. Our system achieved a detection accuracy of over 90% across diverse lighting conditions and plate variations.