**Paper:** [Real-Time Detection and Analysis of Vehicles and Pedestrians using Deep Learning](#) **(2024)**

**Key Contributions:** Given the growing importance of self-driving vehicles and smart traffic management, the demand for precise and fast object recognition is critical and this study significantly advances real-time vehicle and pedestrian detection through deep learning. A key strength of this work is the comparative analysis of several versions of YOLOv8 and RT-DETR, two of the most promising object detection architectures. The YOLOv8 Large model proved to be the most effective, particularly in detecting pedestrians—a challenging task for many current systems. <u>This research demonstrates cutting-edge performance in terms of mean average precision (mAP) and recall, establishing a new benchmark standard for traffic monitoring and contributing to the development of safer and more intelligent urban mobility.</u>

**Methodology:** To tackle the challenge of real-time detection, the authors adopted a structured approach that involved data collection, preprocessing, model selection, and rigorous performance evaluation.
The proposed framework is categorized into 3 sections below along with the bullet points

| Section | Point 1 | Point 2 | Point 3 |
|---|---|---|---|
| **Data Collection & Preprocessing** | Videos were gathered from various public traffic cameras in both day and night conditions and under different weather scenarios. | A dataset of 1142 images was created by extracting frames from the videos. These images were then manually annotated, with bounding boxes drawn around six object classes. Those are bicycles, buses, cars, motorcycles, pedestrians, and trucks. | Data augmentation techniques like adjusting color, exposure, and adding noise were executed to enhance the dataset's robustness and ensure it accurately reflected real-world scenarios |
| **Model Selection & Training** | Two classic object detection models YOLOv8 & RT-DETR were evaluated. | Different size variations of each model were tested to find the optimal balance between speed and accuracy. | The models were trained using a batch size of 8, with images resized to 640x640 pixels, and was trained for 100 epochs. |
| **Performance Analysis** | The models' performance was judged using three key metrics: mean Average Precision (mAP), Precision, and Recall. | YOLOv8 Large (YOLOv8l) performed best, achieving a 0.909 mAP on the augmented dataset and a 0.822 mAP for pedestrian detection, significantly surpassing other models. | YOLOv8 was also faster, achieving 40 frames per second (FPS) compared to RT-DETR's 25 FPS, making it more suitable for real-time applications. |

**Potential Applications:** This research offers significant real-world benefits to improve urban safety and efficiency. Some are,

| Section | Point 1 | Point 2 |
|---|---|---|
| Traffic Monitoring and Law enforcement | Real-time vehicle and pedestrian detection enables city authorities to improve traffic flow management, alleviate traffic congestion, and detect violations such as jaywalking and running red lights. | This technology allows automated systems to generate immediate alerts for traffic accidents or congested areas. |
| Autonomous Vehicles & Driver Assistance | Autonomous vehicles depend critically on object detection to navigate and operate safely. The increased accuracy in pedestrian detection achieved by this research has the potential to greatly improve the safety of self-driving cars. | This technology can be incorporated into advanced driver-assistance systems (ADAS) to help prevent accidents by reliably detecting pedestrians and vehicles, even in difficult circumstances. |
| Smart city & infrastructure planning | Information collected by real-time detection systems can inform urban planning, enabling cities to create streets that are better suited for pedestrians and to adjust traffic signals based on actual traffic flow. | The information provided by this system can be used to optimize public transportation schedules and routes. |

**Conclusion:** <u>The research concluded that the YOLOv8 Large model performed best in terms of both accuracy and speed.</u>