PROJECT REPORT

Title: Vehicle Category Tracking using YOLOv8

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Abstract

This project aims to detect and categorize road users such as persons, 2-wheelers, 4-wheelers, and heavy vehicles in a traffic surveillance video using the YOLOv8 object detection model. We use a centroid-based tracking algorithm to assign consistent IDs to detected objects across video frames. The output is an annotated video with bounding boxes and class labels for each detected object. The system does not include directional movement counting but focuses on category-wise identification. This approach demonstrates the effectiveness of YOLOv8 in real-time traffic monitoring.

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1. Introduction

Urban traffic management requires accurate and efficient monitoring of different types of vehicles and road users. Traditional approaches either lack the real-time capabilities or struggle with complex scenes. The recent advancement in deep learning and computer vision models, especially YOLO (You Only Look Once), has made it feasible to perform high-speed object detection with acceptable accuracy. This project explores the use of YOLOv8 for detecting and tracking categories like person, 2-wheeler, 4-wheeler, and heavy vehicle in a traffic video.

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2. Related Work

Early vehicle tracking methods relied on background subtraction and motion detection which were sensitive to lighting and noise. With the rise of deep learning, object detection networks like SSD, Faster R-CNN, and the YOLO series significantly improved speed and accuracy. YOLOv8, developed by Ultralytics, combines anchor-free detection and better architecture for lightweight and efficient inference, making it ideal for real-time surveillance systems.

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3. Methodology

3.1 Dataset

We use the Sherbrooke traffic video, a publicly available urban surveillance dataset that contains a mix of different vehicle types and pedestrians.

3.2 Object Detection

YOLOv8s (a lightweight variant of YOLOv8) is employed to detect objects in each video frame. The model returns bounding boxes and class probabilities for each detected object.

3.3 Class Categorization Logic

Using YOLO's class names, we group the detected labels into four categories:

- Person
- 2-wheeler: bicycle, motorcycle

- 4-wheeler: car
- Heavy vehicle: bus, truck

3.4 Tracking Algorithm

We use a simple centroid-based tracking approach. For each detection, the centroid is calculated and matched with previous detections based on Euclidean distance. A unique ID is assigned and maintained for each object.

3.5 Output

Each frame is annotated with the bounding box, category label, and unique ID, and the processed video is saved as the output.

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4. Implementation

- **Libraries Used:** Ultralytics (YOLOv8), OpenCV, Pandas
- **Programming Language:** Python
- **Execution Environment:** Google Colab
- **Key Steps:**

- Load the YOLOv8 model
- Read video and resize frames
- Perform detection and filter categories
- Track using centroid logic
- Annotate and save the output video

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5. Results and Discussion

The YOLOv8 model successfully detected and labeled persons, 2-wheelers, 4-wheelers, and heavy vehicles across the video frames. Each object was assigned a consistent ID, and the video was processed smoothly with minimal false positives. However, performance under low-light (night) conditions may be reduced, depending on the dataset used. The processing frame rate was sufficient for offline analysis.

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6. Conclusion and Future Work

This project demonstrates the power of YOLOv8 for real-time vehicle and pedestrian categorization. The simplified tracking and annotation system makes it suitable for traffic monitoring applications. Future improvements could include:

- Adding directional tracking (e.g., counting vehicles moving up/down)
- Improving performance in low-light or night-time videos
- Integrating license plate recognition or speed estimation modules

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7. References

- Redmon et al., "You Only Look Once: Unified, Real-Time Object Detection"
- Ultralytics YOLOv8 Documentation: https://docs.ultralytics.com/
- Sherbrooke Dataset (optional dtaset): http://www.livia.etsmtl.ca/urbanscene/