Vehicle Detection and Counting System

**Project Overview:**

This project uses a combination of **YOLOv8** object detection and the **SORT** tracking algorithm to detect, track, and count vehicles in a video stream. It processes frames from a video, identifies vehicles such as **cars, buses, trucks, and bicycles**, tracks them using unique IDs, and counts them when they cross a predefined virtual line.

**Key Features**

* Accurate vehicle detection using **YOLOv8**
* Real-time vehicle tracking with **SORT**
* Vehicle counting via virtual line crossing
* Overlay of object ID, confidence score, and bounding boxes.
* Runs on **CPU**, **GPU**, or Apple’s **MPS**

**Requirements**

* ultralytics
* opencv-python
* cvzone
* numpy
* torch

**Implementation**

**1. Model Setup**

* Loads the YOLOv8 model from ultralytics.
* Loads SORT tracker for multi-object tracking.

**2. Detection and Tracking**

* Each video frame is passed through YOLOv8 to detect vehicles.
* SORT tracks each detected vehicle and assigns a unique ID.

**3. Vehicle Counting**

* A horizontal line is defined on the frame.
* When a vehicle’s center crosses this line, it's counted once.

**4. Visualization**

* Bounding boxes, IDs, and vehicle types are drawn on the video.
* Total vehicle count is shown in real time.

**Classes Detected**

Only the following classes from COCO dataset are considered for counting:

* car
* bus
* truck
* bicycle

**Logic for Counting**

python

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if (line\_position - offset) < cy < (line\_position + offset):

if Id not in total\_count:

total\_count.add(Id)

* cy: Vertical center of the vehicle's bounding box.
* offset: Margin to handle frame variations.
* total\_count: Set to avoid double-counting same object.

**Sample Output**

* Real-time video stream with:
  + Bounding boxes on detected vehicles
  + IDs and confidence scores
  + Line for vehicle counting
  + Total vehicle count displayed

**Future Improvements (Optional)**

* Support bidirectional counting
* CSV export of counts with timestamps
* Use zone-based counting instead of line
* Live stream support using webcam or IP cam