VEHICLE LICENSE PLATE RECOGNITION AND TRAFFIC FLOW MONITORING MODEL

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What ?

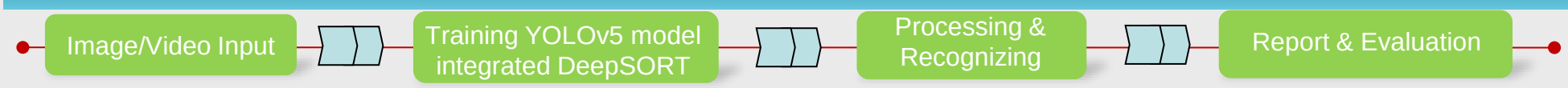
We proposed a model for recognizing and monitoring vehicles, in which we have:

- Building a pipeline to detect and assign vehicle IDs using YOLOv5 + DeepSORT.
- Developing a license plate recognition module: detect, crop, preprocess and OCR.
- Summarizing and reporting vehicle traffic (cars, motorbikes) by time frame.

Why ?

- Helping manage traffic, reducing congestion, improving efficiency of parking lots and toll stations.
- Combining Automatic License Plate Recognition (ALPR) and traffic counting helps integrate comprehensive vehicle management.
- Applying modern computer vision technology (YOLOv5, DeepSORT, OCR) for practical applications.

Overview



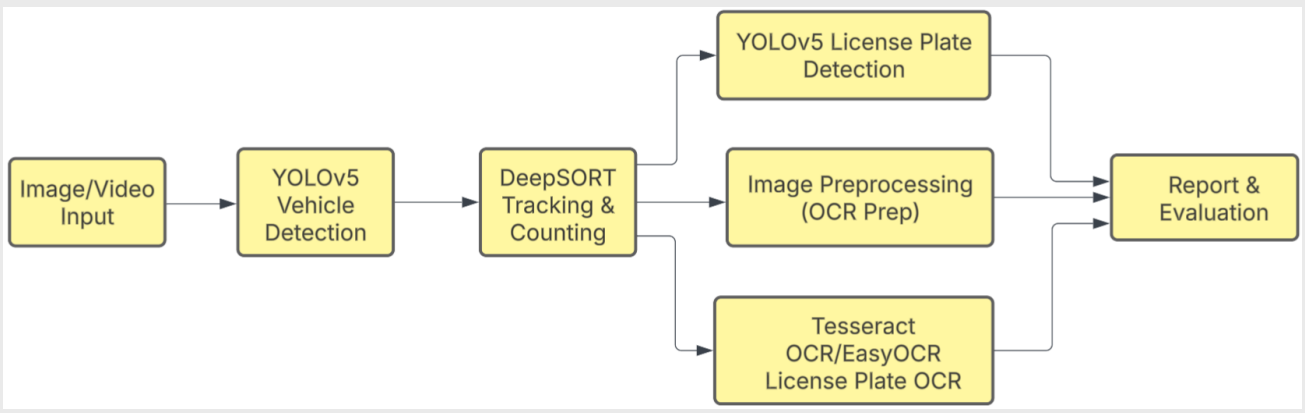


Figure 1. The pipeline system diagram

Description

1. Data collection

- Download traffic photos/videos (resolution ≥720p, 25–30 FPS) in different environment conditions from public sources such as UA-DETRAC or self-record videos at intersections.
- Label vehicle bounding boxes and license plate content using LabelImg or Roboflow, create training/validation/test dataset.
- Normalize data to 640x640 size using OpenCV to fit YOLOv5 input.

2. Model training

- Using YOLOv5 with CSPDarknet53 backbone, train on license plate dataset with PyTorch.
- Applying combined loss function (classification loss, localization loss) to optimize license plate recognition.
- Integrating DeepSORT with deep features from YOLOv5, use Kalman filter to track and assign ID to each vehicle across frames.
- Fine-tunning the model on validation set to improve accuracy under different lighting and weather conditions.

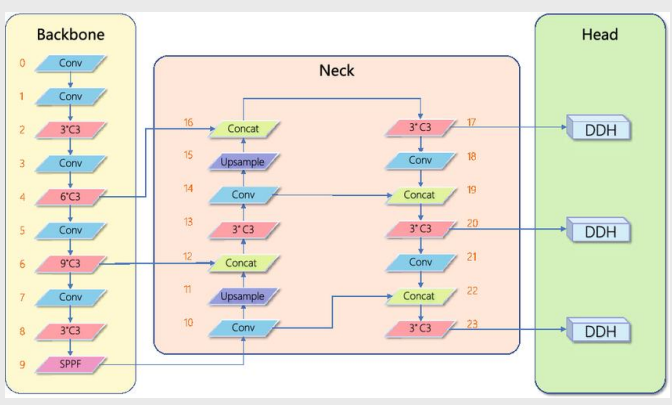


Figure 2. YOLOv5 Model with CSPDarknet53 Backbone Architecture

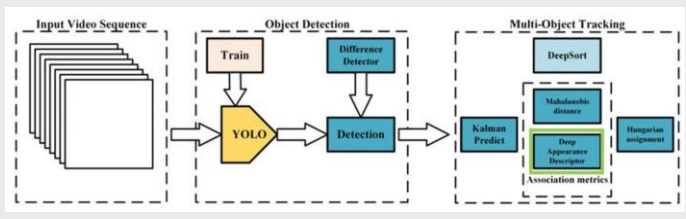


Figure 3. DeepSORT Algorithm

3. Processing and Recognizing

- Preprocessing license plate images: grayscale conversion, white balance, thresholding, and noise removal.
- Defining region of interest (ROI), when the center of the bounding box of the vehicle crosses the ROI, it will count the corresponding traffic.
- From the input video, YOLOv5 detects the area containing the license plate, then uses Tesseract OCR or EasyOCR to recognize characters, then applies regex to standardize the license plate format.
- DeepSORT tracks vehicles across frames, counts the number of vehicles by placing a virtual line in the frame.
- The results are saved to a MySQL database (license plate, time, vehicle ID).

4. Report and Evaluation

- Calculate traffic reports by time frame, represented by matplotlib charts.
- Evaluate license plate recognition using Precision, Recall, and F1-score, compared with ground-truth.
- Evaluate vehicle counting using Mean Absolute Error (MAE).
- Tested in real-world conditions: day, night, light rain.

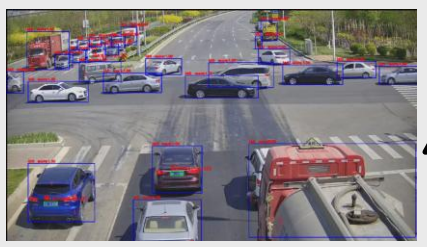


Figure 4. Example of tracking and monitoring vehicles

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