Vehicle Detection, Classification and Counting

GROUP 10:

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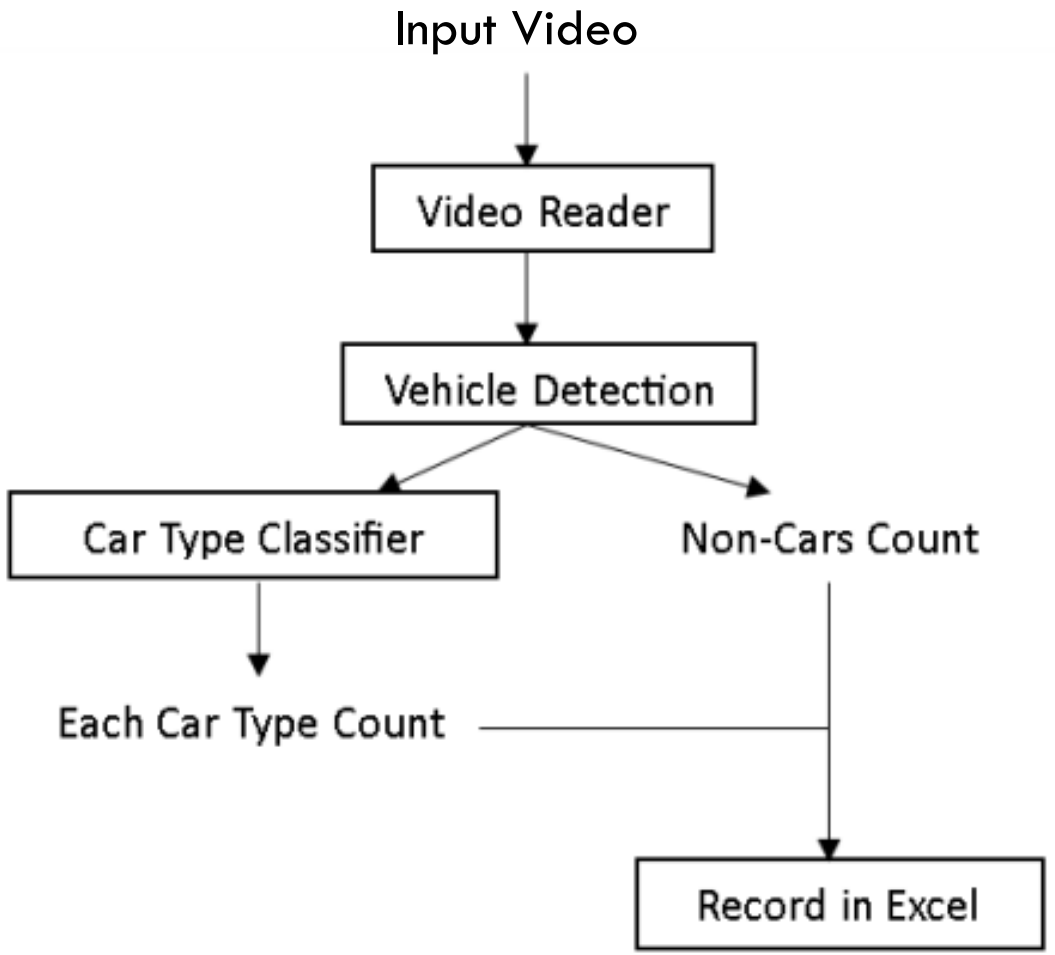
Problem

In transportation-related applications, it is often necessary to know the number and types of vehicles passing through a specific area for statistical analysis. Manual methods can be time-consuming, and prone to errors.

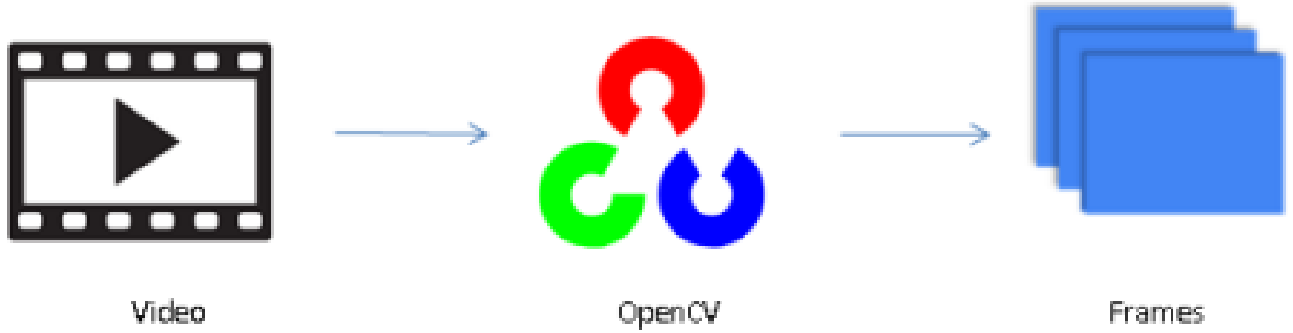
Solution


Input Video
Video Reader
Vehicle Detection
Car Type Classifier
Non-Cars Count
Each Car Type Count
Record in Excel

Dataset

- Vehicle Recognition in Videos (VRiV) dataset from https://www.kaggle.com/datasets/landrykezebou/vriv-vehicle-recognition-in-videos-dataset for vehicle detection.
- Stanford car body type data dataset from https://www.kaggle.com/datasets/mayurmahurkar/stanford-car-body-type-data?resource=download for vehicle classification

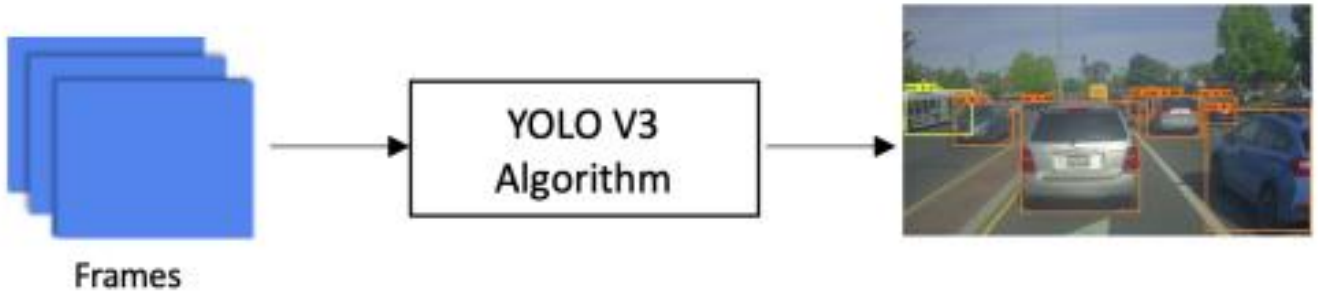
Video Reader using OpenCV



Video Reader Process

- The video stream from the video is given as an input to the system.
- The source video is read frame by frame with the help of OpenCV.
- The queue of frames are passed to the next task.

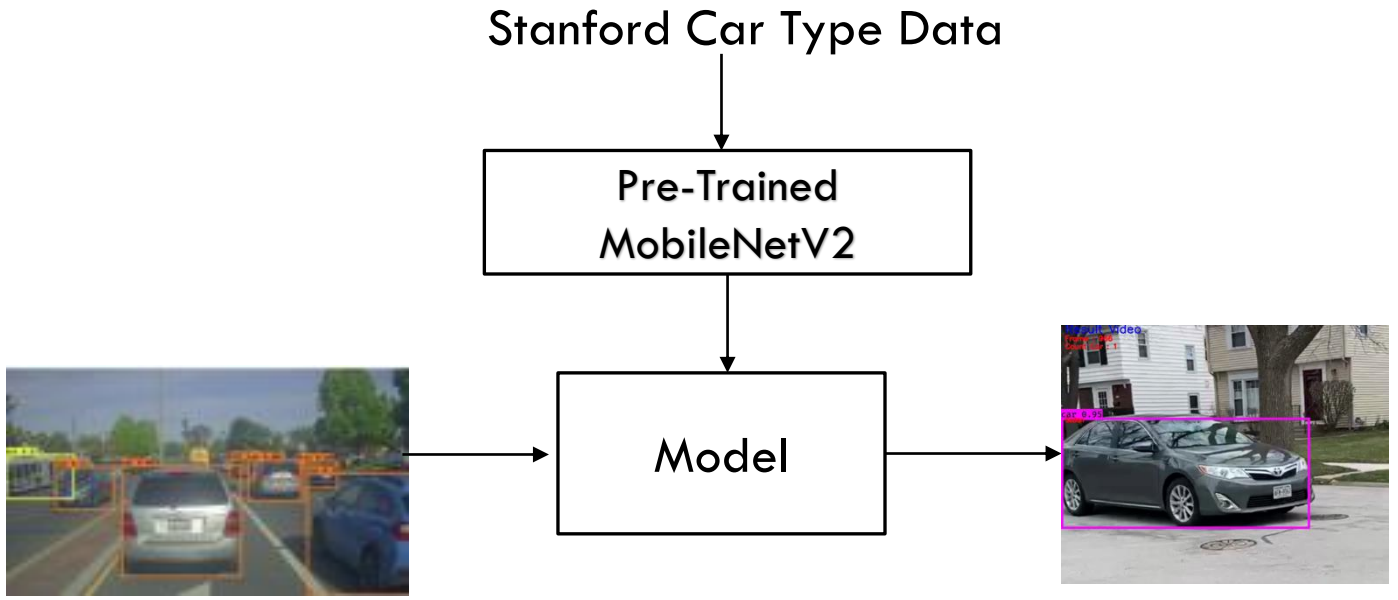
Vehicle Detection using YOLOv3



Vehicle Detection Process

- A queue of image frames as given as the input and each frame from the queue is passed to the (You Only Look Once)YOLO detection algorithm.
- The algorithm detects the vehicles with bounded box in each frame and classifies the detected vehicle as either a car or a truck or a bus or a motorcycle.

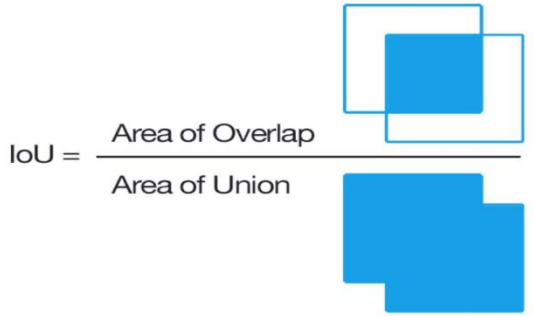
Vehicle Classification using MobileNetV2



- The detected vehicles with the bounding boxes from each frame is given to a pre-trained MobileNetV2 model which predicts the car into distinct types.
- This pre-trained MobileNetV2 model is further trained with different type of cars such as SUV, SEDAN etc., from the Stanford car type dataset.
- Based on the type of car, there is Counter added, which counts the different types of cars.

Evaluation Metrics

Intersection over Union (IOU) metrics is used for vehicle detection.



F1-score, and accuracy are computed for vehicle counting.

$$F1 = \frac{2 \times precision \times recall}{precision + recall}$$

$$accuracy = \frac{TP + TN}{TP + FN + TN + FP}$$

Results

Output Video

IOU

iou 0.6822411419416612

F1-Score & Accuracy

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Accuracy/F1 Score with respect to Ground Truth
Accuracy :  0.779842744817727
F1 Score for Total Cars in each frame:  0.7466603967897094
F1 Score for SUV in each frame:  0.6884605653575783
F1 Score for Sedan in each frame:  0.6935385109724774
F1 Score for Cab in each frame:  0.07819184038618829
F1 Score for Convertible in each frame:  0.2955418668651401
F1 Score for Coupe in each frame:  0.7377396653310273
F1 Score for Wagon in each frame:  0.7987880042739491
F1 Score for Van in each frame:  0.7870061388710848
F1 Score for Minivan in each frame:  0.8339728594017373
F1 Score for Hatchback in each frame:  0.8196369009956541
```

Future Work

- We can increase the model accuracy further more using Inceptionv3 or v4.
- Vehicles on the road can be partially occluded by other objects such as trees, buildings, or other vehicles. The model needs to be able to detect and classify these partially visible vehicles.
- The model needs to be able to process videos in real-time to detect and classify vehicles as they move on the road.


THANK YOU
ANY QUESTION?