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Traffic Volume Count from surveillance cameras in a highly occluded environment using Deep Convolutional Neural Network

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Background

Analysis of traffic volume is essential for road traffic infrastructure and transportation policies. Many developing countries do not have any automated traffic volume counter to get traffic data which makes it difficult for the government to make transportation policies for passenger and goods movement efficiently. In this research, we use YOLOv3 together with Simple Online and Realtime Tracking (SORT) algorithm to demonstrate a traffic volume counter from surveillance videos. We train YOLOv3 from surveillance video frames at intersections having high occlusion between vehicles for detection and then track the vehicles using SORT algorithm. Our model trained with surveillance images achieves an overall recall of 85%, outperforming the model trained with the COCO dataset by 73%. Such traffic volume counter can be useful for traffic flow data in developing countries as well as for real-time driving assistance systems.

Objectives

(i) To develop a dataset for vehicle detection in occluded environment of Yangon Surveillance Images at Intersection (YSII)
(ii) Examine YOLOv3 for vehicle detection using models trained on the YSII dataset and the Common Objects in Context (COCO) dataset, and
(iii) Compare the performance of traffic volume counter for vehicles moving in different directions at an intersection using the two datasets.

Methodology

i) Development of the YSII dataset

We prepare 10,241 annotations of vehicles from the surveillance videos of '*Pyay Road and Hledan Road*' and '*U Wisara and Dhama Zay Ti*'. Vehicles are annotated based on human accuracy.

ii) Detection of vehicles

For vehicle detection, we use YOLOv3 neural network architecture as shown in Figure 1with pre-trained convolutional network weights from the ImageNet.

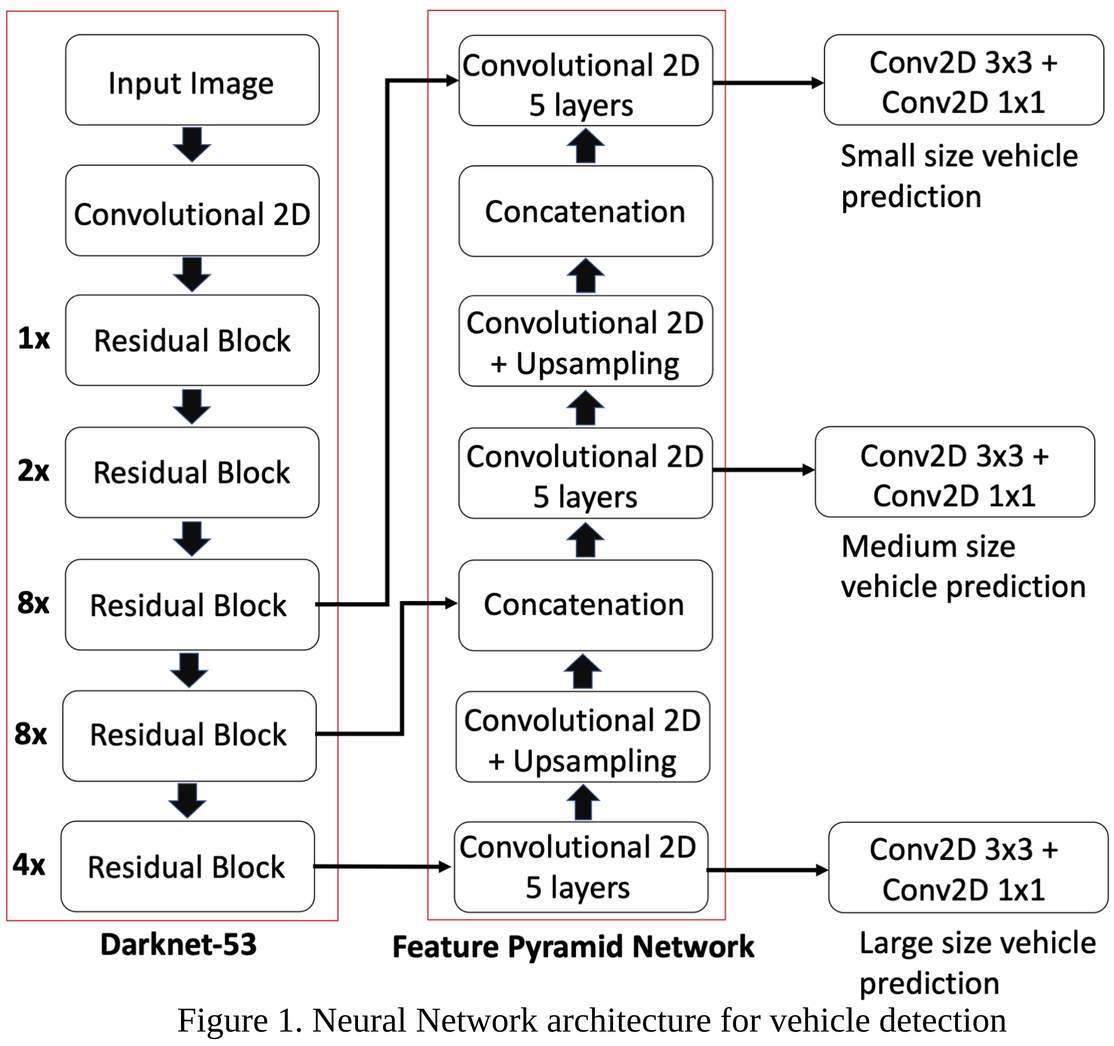


Figure 1. Neural Network architecture for vehicle detection

iii) Tracking and counting the vehicles

For vehicle tracking, we use Simple Online Realtime tracking (**SORT)** algorithm. This tracking algorithm requires the detection of vehicles on every frame. For counting, we use the intersection between the flowline of the tracked vehicles and the screen line as shown in Figure 2.

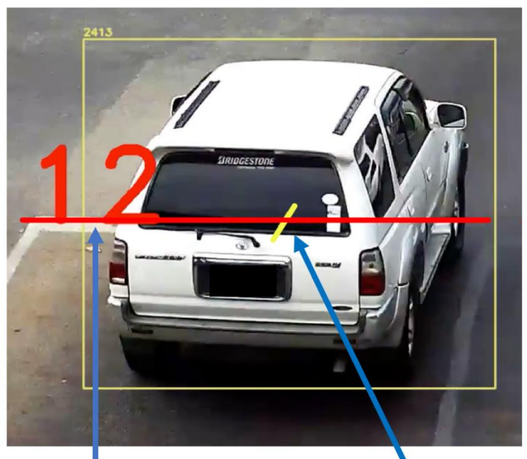
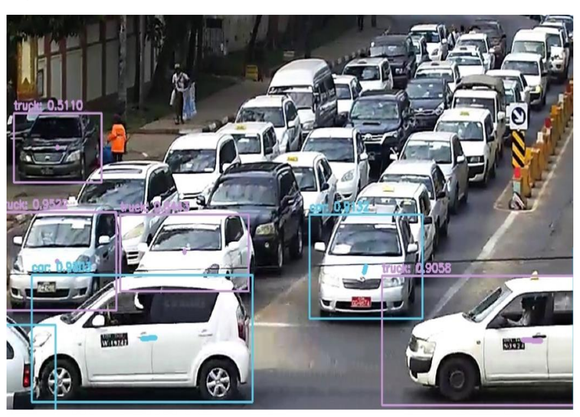


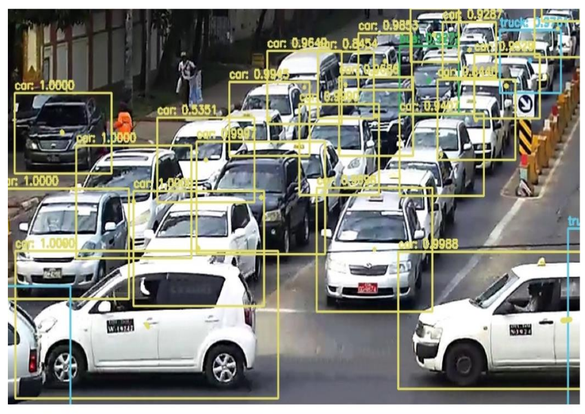
Figure 2. Screen line (in red) registers the vehicle count on intersection with the flow line (in yellow) as shown by the arrows

Results

i) Detection results with the datasets



Detection with the COCO dataset



Detection with the YSII dataset

Dataset	Average Recall
COCO	0.49
YSII	0.85

ii) Counting of vehicles

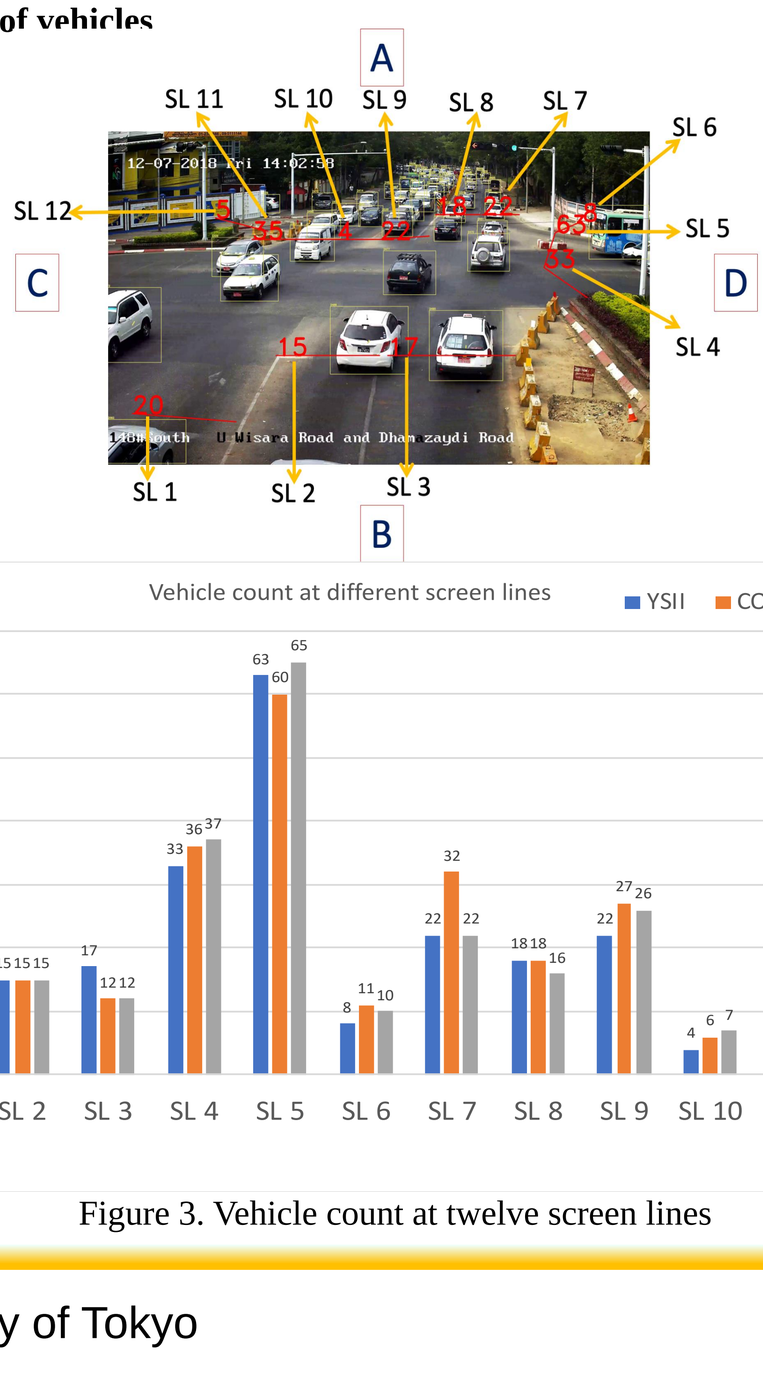


Figure 3. Vehicle count at twelve screen lines