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Pattern Recognition using Machine Learning

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ABSTRACT

This project retrains three different versions of You Only Look Once (YOLO) models (the state-of-the-art object detection model using neural network) on self-made DSAT datasets to gain better detection performance. Meanwhile, a web application which is especially built for real-time object detection models is also implemented. The real-time traffic image and prediction results of three YOLO models will be displayed on the website.

After retraining, the tiny YOLOv2 model increases its mean absolute precision (mAP) more than 50% after retraining. As for the most accurate model among the three models, YOLOv2 can achieve 61.45% mAP.

The well-retrained models have significant improvement compared to original models. In addition, the information provided by the web application allows commuters to have better ideas about current traffic congestion level.

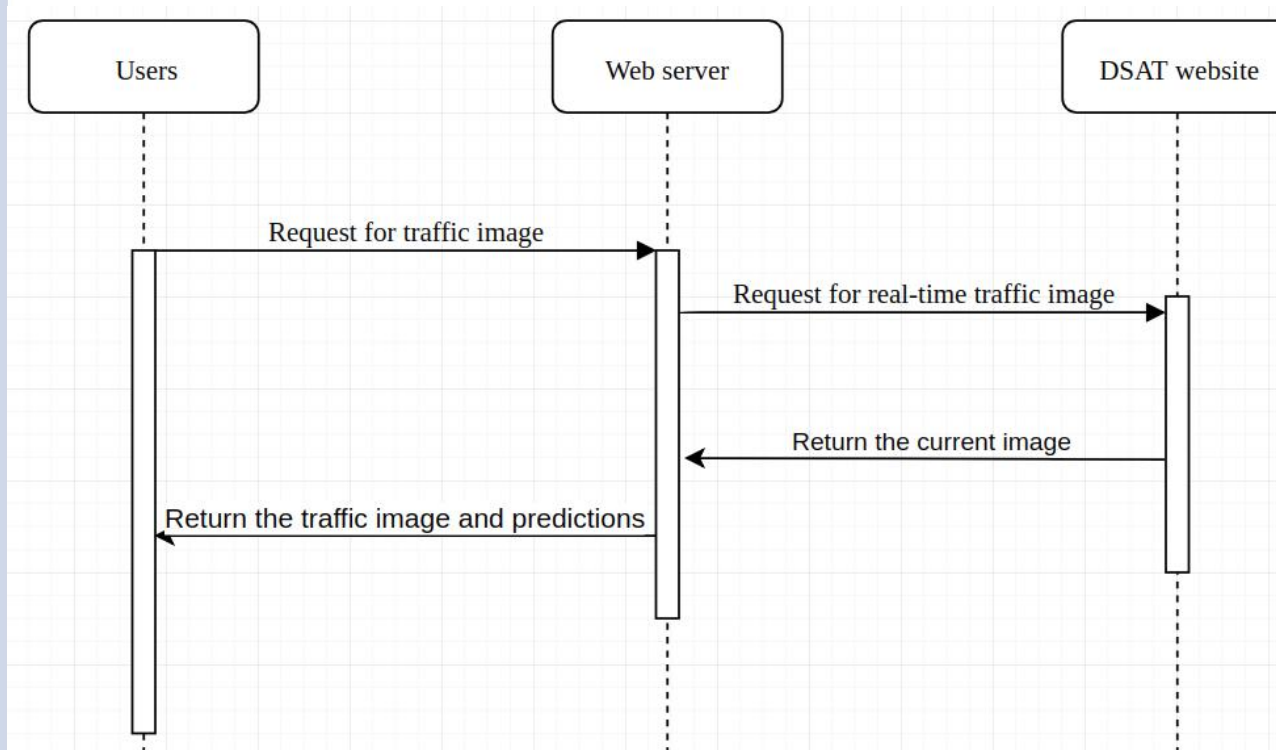
INTRODUCTION

The main objectives of this project are:

- Implement a machine-learning algorithm to recognize the traffic condition.
- Test the algorithm using real-time traffic image crawled from the DSAT website and analyze the traffic results.

WEB ARCHITECTURE

The web application involves three entities: users, web server and DSAT website. The web server returns and updates prediction results and real-time traffic image every 5 seconds. The sequence diagram is shown as below.



DATASETS

3901 traffic images are labeled (4 classes) and saved in XML format.



Labeled images are divided into three datasets.

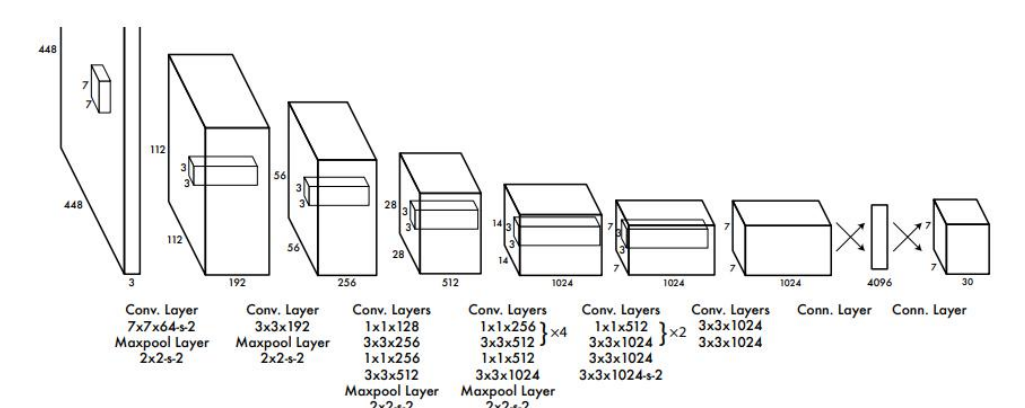
Training dataset	Validation dataset	Test dataset	Total
3511	39	351	3901

YOLO MODELS

The three versions of YOLO models are:

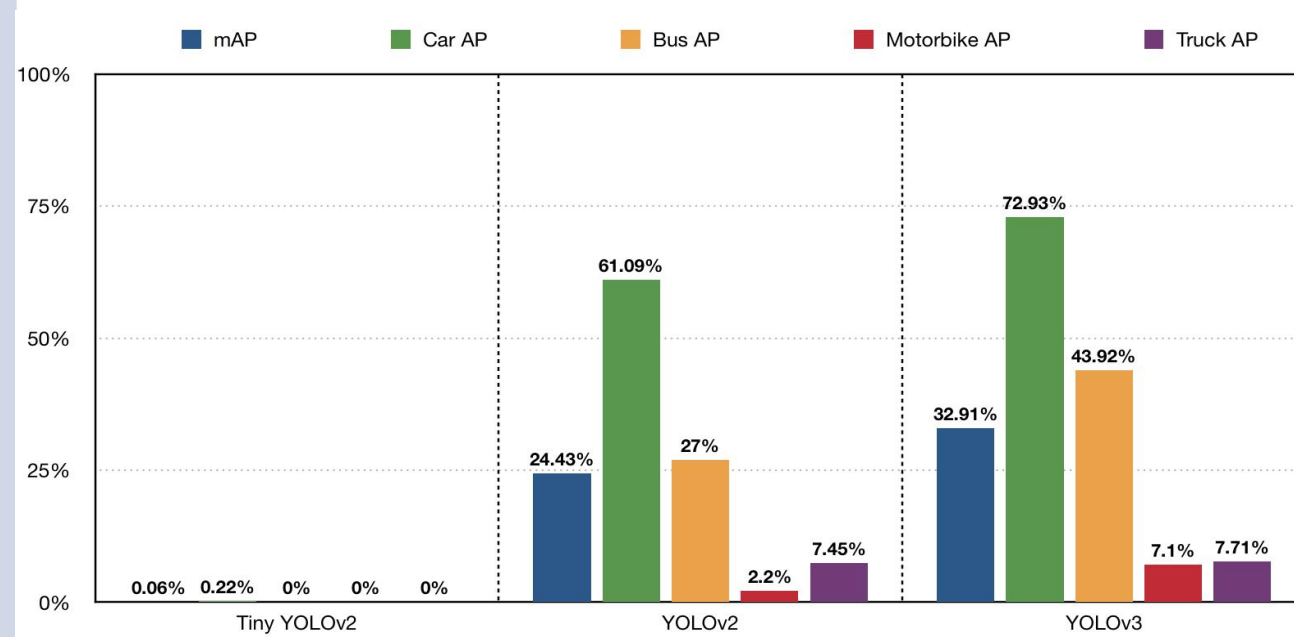
	Tiny YOLOv2	YOLOv2	YOLOv3
No. of detection classes	20	20/80	80
No. of convolutional layers	9	19	53

The architecture of the YOLOv1 is shown below.

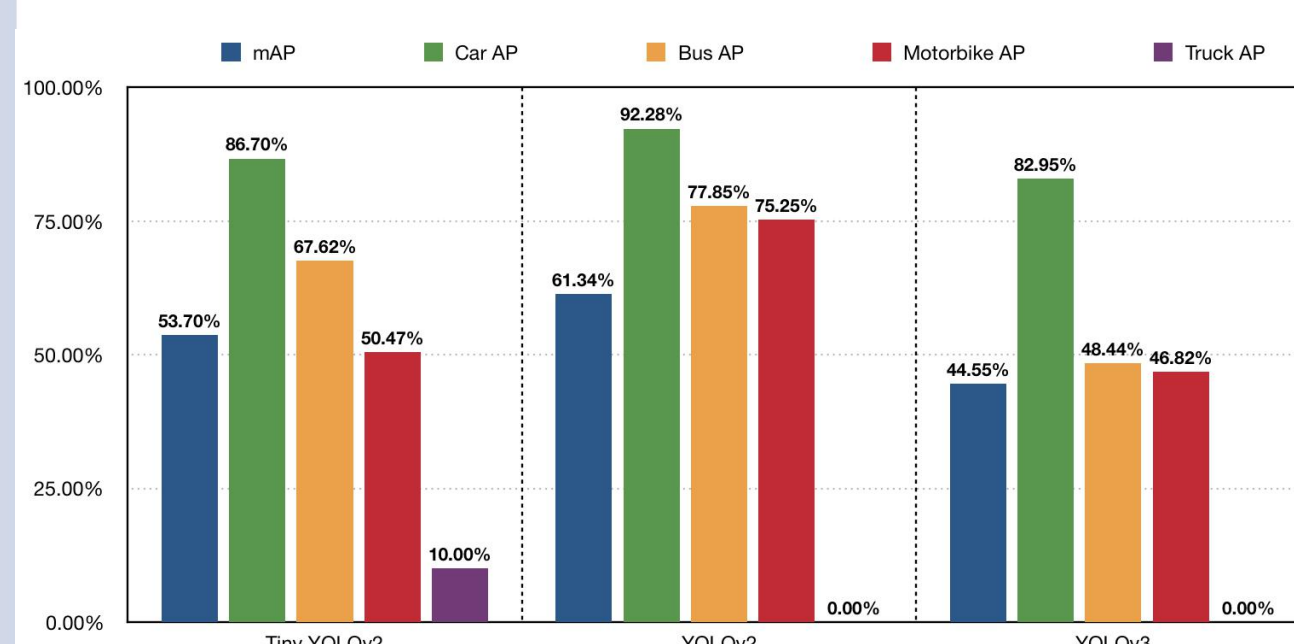


RESULTS

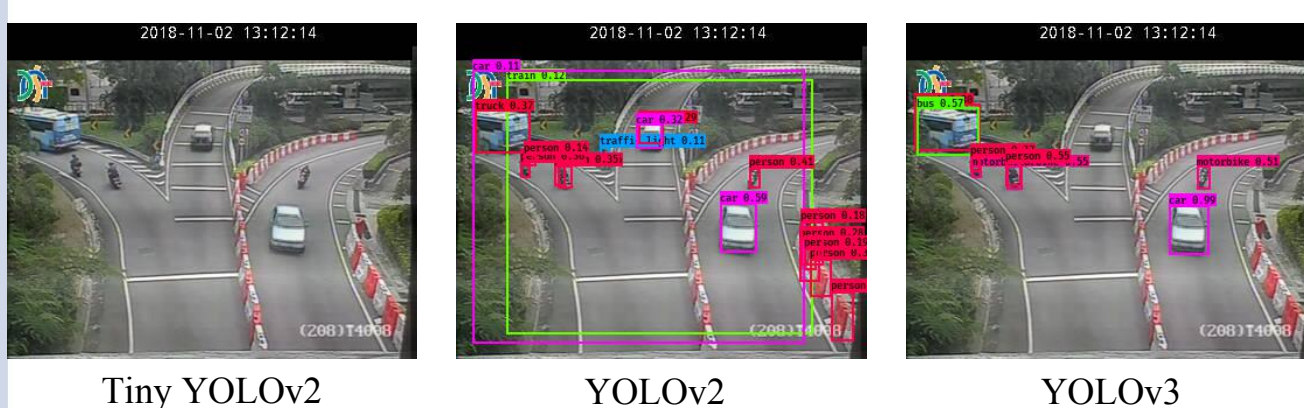
The mAP of three original YOLO models:



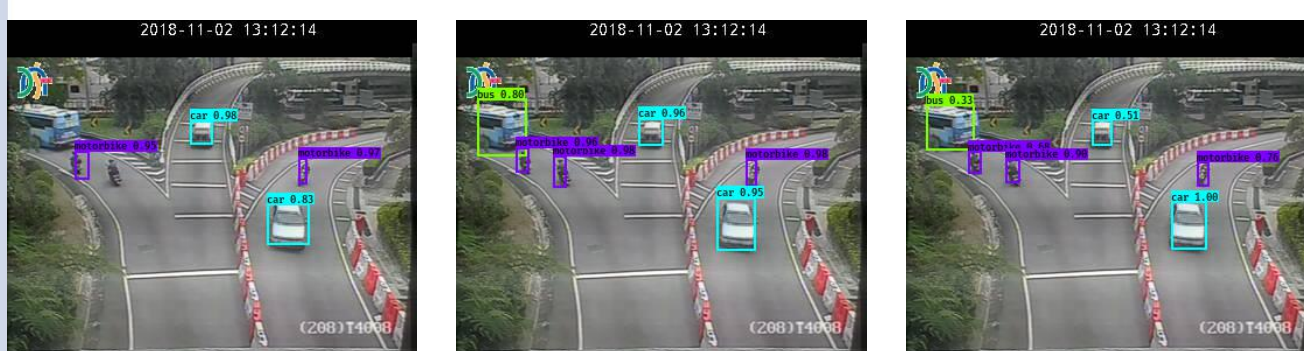
After retraining the full (tiny) YOLOv2 models and last 3 layers of YOLOv3 model:



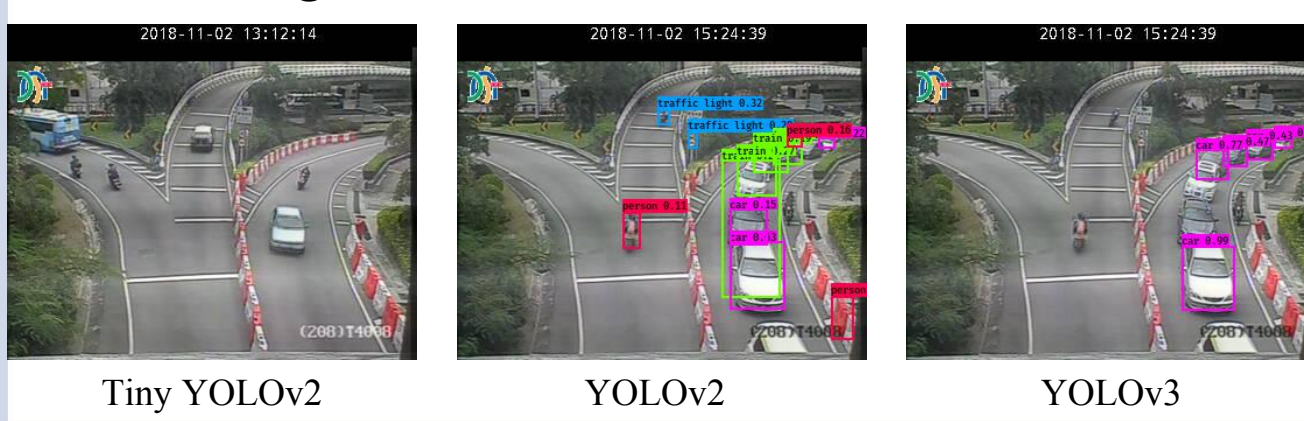
Before retraining, the results of one traffic image:



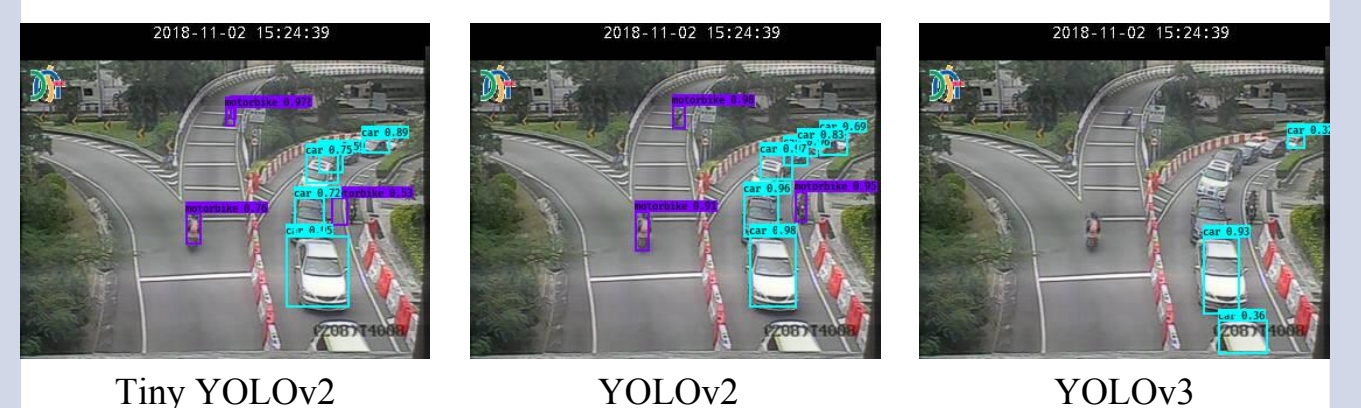
After retraining:



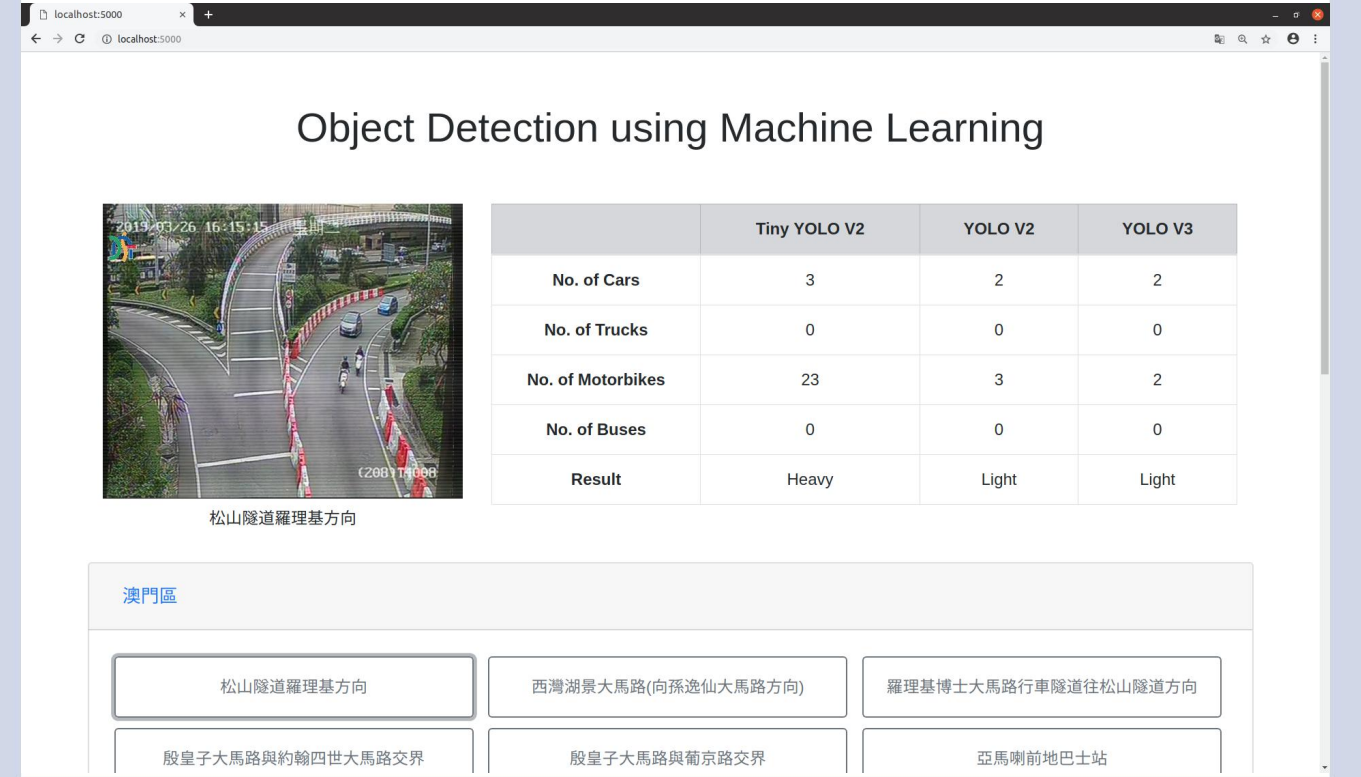
Before retraining, the detection results on another traffic image are shown below.



After retraining:



The web application provides more than 40 different real-time traffic images and prediction results of three retrained models.



Conclusions

In this project, three versions of YOLO object detection models have been retrained and applied on real-time traffic images in Macao. The datasets consist of 3901 DSAT traffic images with annotations are built from scratch. After retraining, the improvements are significant. In addition, the web application is developed for commuters to have clearer ideas about the current traffic congestion level.