Road Sign Detection

(Object Detection)

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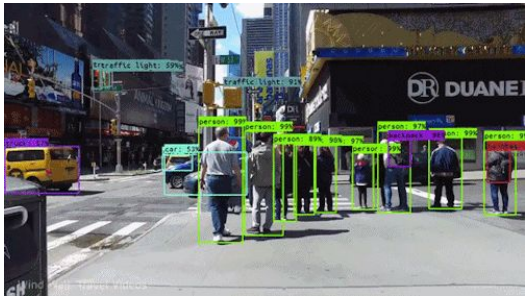
Introduction

Object Detection : Road Signs Detection

Underlying :

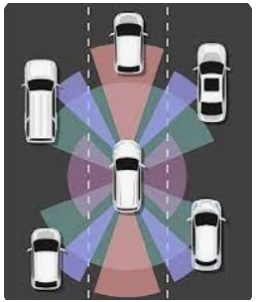
- **Single Shot Multiple Detector (SSMD)**
- **TensorFlow Object Detection API**

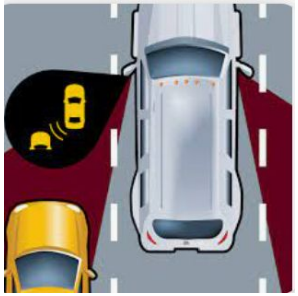
Background & Motivation



Motivation :

- **Advanced Peripherals : high resolution cameras, sensors**
- **Autonomous Driving**
- **Enhance Safety**



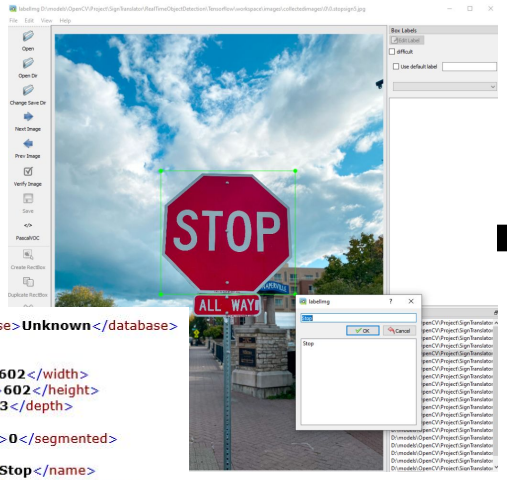


Data Collection and Annotation

Collect Images

collectedimages

Labeling



```
- <source>
      <database>Unknown</database>
  </source>
- <size>
      <width>602</width>
      <height>602</height>
      <depth>3</depth>
  </size>
  <segmented>0</segmented>
- <object>
      <name>Stop</name>
      <pose>Unspecified</pose>
      <truncated>0</truncated>
      <difficult>0</difficult>
    - <bndbox>
          <xmin>94</xmin>
          <ymin>101</ymin>
          <xmax>490</xmax>
          <ymax>501</ymax>
      </bndbox>
  </object>
</annotation>
```

```
{1: {'id': 1, 'name': 'Stop'},
 2: {'id': 2, 'name': 'Yeild'},
 3: {'id': 3, 'name': 'Danger'},
 4: {'id': 4, 'name': 'Deadend'},
 5: {'id': 5, 'name': 'Parking'}}
```

Train/Test Split

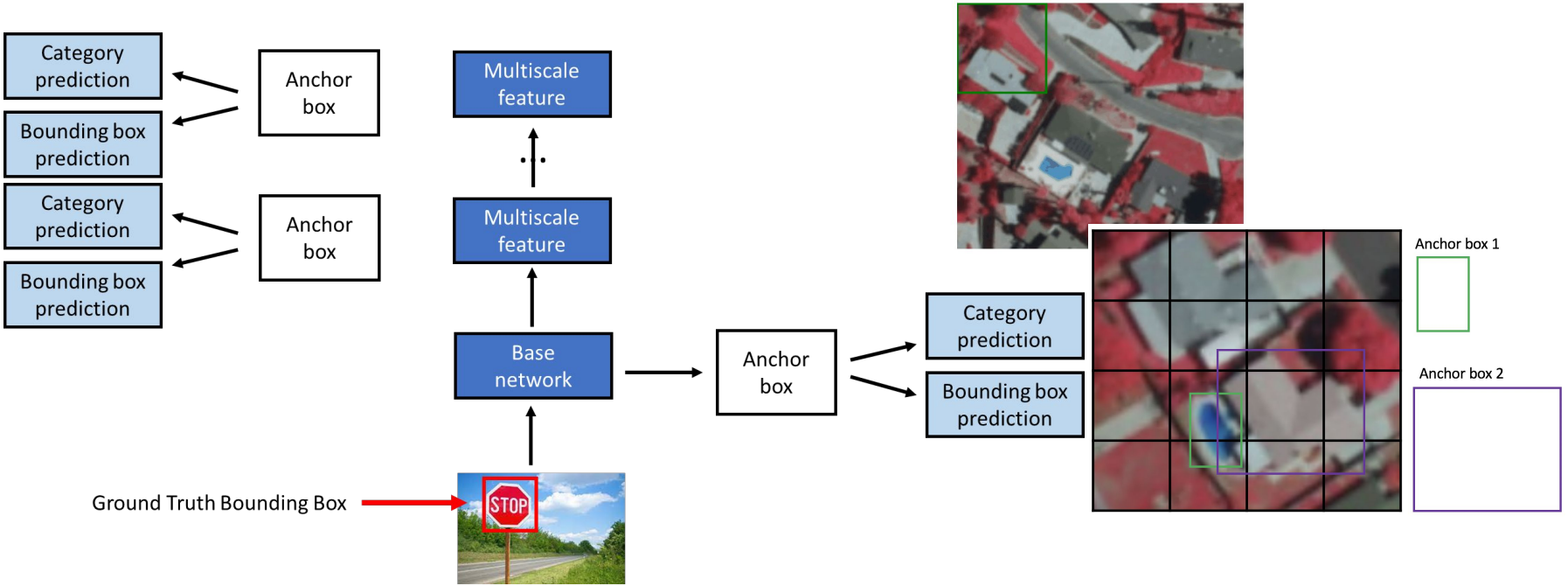
18 for training, 2 for testing

test

train

Model - Single Shot Multibox Detector (SSD) model

- SSD use multiscale features and default boxes



Model Training

- Momentum optimizer to minimize the loss function.
  - Learning_rate_base: 0.079999
  - Total step: 10000
  - Warmup_learning_rate: 0.026666
  - Warmup_step: 1000
  - Momentum_optimizer_value: 0.89999

```
INFO:tensorflow:Step 10000 per-step time 0.119s
I0408 14:27:03.899535 17736 model_lib_v2.py:700] Step 10000 per-step time 0.119s
INFO:tensorflow:{'Loss/classification_loss': 0.036346905,
 'Loss/localization_loss': 0.0067884824,
 'Loss/regularization_loss': 0.10248132,
 'Loss/total_loss': 0.14561671,
 'learning_rate': 0.07352352}
```

Model Evaluation

- IoU = Area of Overlap / Area of Union  v.s.
- Threshold: 0.5 IoU
- Average Precision: 0.89
- Average Recall: 0.90

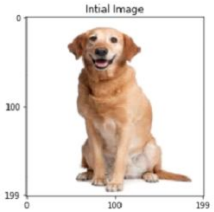
```
Average Precision  (AP) @[ IoU=0.50:0.95 | area=   all | maxDets=100 ] = 0.890
Average Precision  (AP) @[ IoU=0.50      | area=   all | maxDets=100 ] = 1.000
Average Precision  (AP) @[ IoU=0.75      | area=   all | maxDets=100 ] = 1.000
Average Precision  (AP) @[ IoU=0.50:0.95 | area= small | maxDets=100 ] = -1.000
Average Precision  (AP) @[ IoU=0.50:0.95 | area=medium | maxDets=100 ] = -1.000
Average Precision  (AP) @[ IoU=0.50:0.95 | area= large | maxDets=100 ] = 0.890
Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets=  1 ] = 0.900
Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets= 10 ] = 0.900
Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets=100 ] = 0.900
Average Recall     (AR) @[ IoU=0.50:0.95 | area= small | maxDets=100 ] = -1.000
Average Recall     (AR) @[ IoU=0.50:0.95 | area=medium | maxDets=100 ] = -1.000
Average Recall     (AR) @[ IoU=0.50:0.95 | area= large | maxDets=100 ] = 0.900
INFO:tensorflow:Eval metrics at step 10000
```

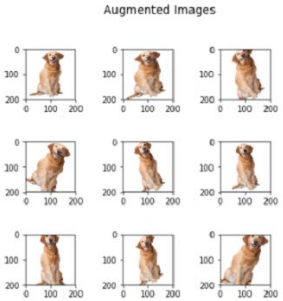
Testing on Unseen Data (still images)

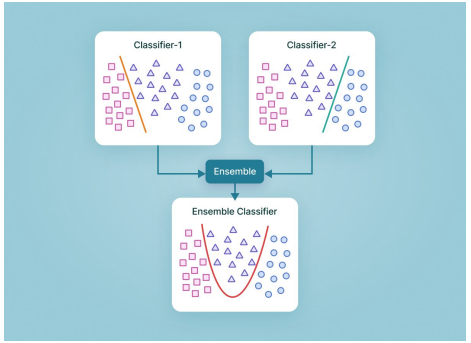
Testing in Real Time (Live)

Future Plan

- Increase Train and Testing Image size (currently we have 18 for training, 2 for testing)
- Try Image Augmentation (since we have limited data and can avoid overfitting)
- Try Ensembling (combine 2 or more learning algorithms to obtain better predictions)







Thanks