Lane and Vehicle Detection

CMPT 733 Project

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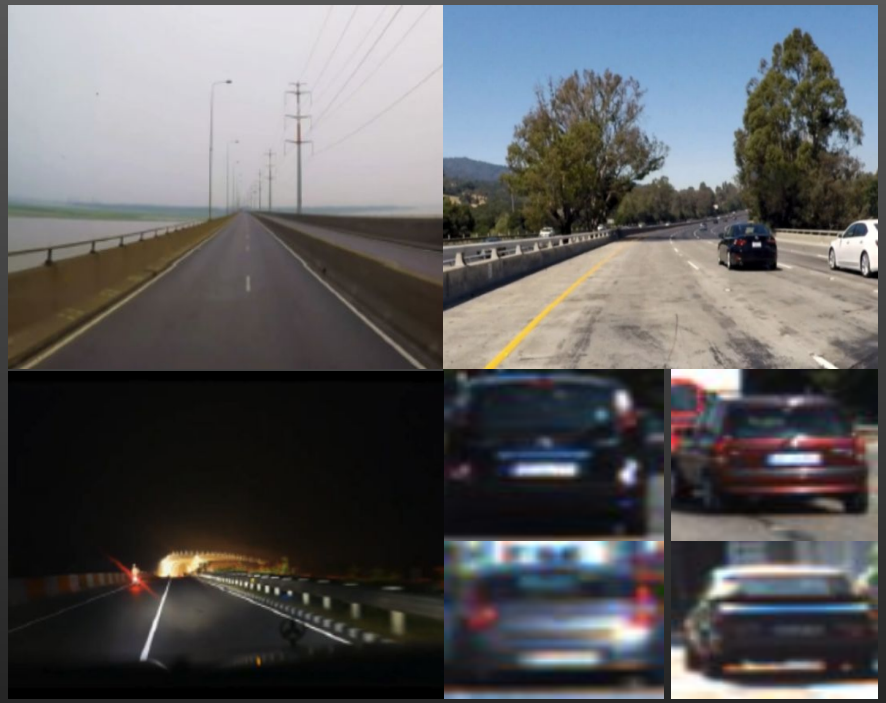
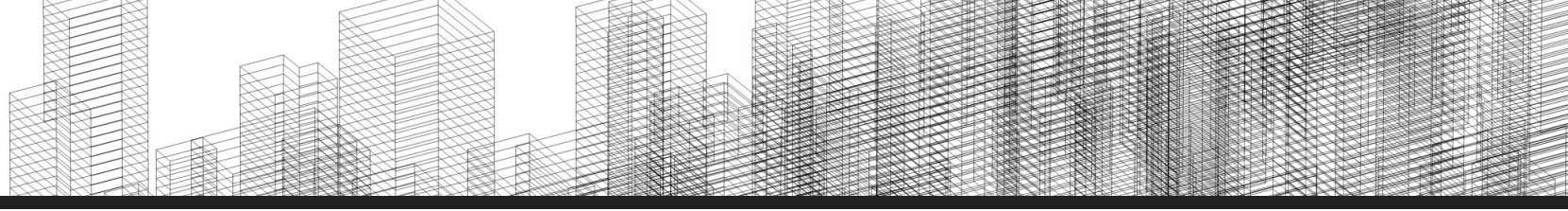
Overview

- Design the deep learning neural network model for the Lane and Vehicle detection
- Train the models on the images of the real vehicles and road Dataset and test on the frames of a driving video
- Compare the result with some different models





Technologies

Programing Language
Python

Framework/Library
PyTorch, NumPy, OpenCV, Scikit-learn, TensorFlow

Google Colab
Connect to and compute on GPU

Models
Our model, PSPNet, LLDNet, YOLO-v6

Dataset

- Training data:
  - Lane Detection
    - Udacity Machine Learning Nanodegree Project Dataset
    - Cracks and Potholes in Road Images Dataset
  - Vehicle Detection
    - GTI vehicle image database (SVM)
    - COCO 2017 Dataset (YOLO)

Dataset

- Testing data:
  - Lane Detection
  - Vehicle Detection
    - Frames extracted video taken on highway

Expected output

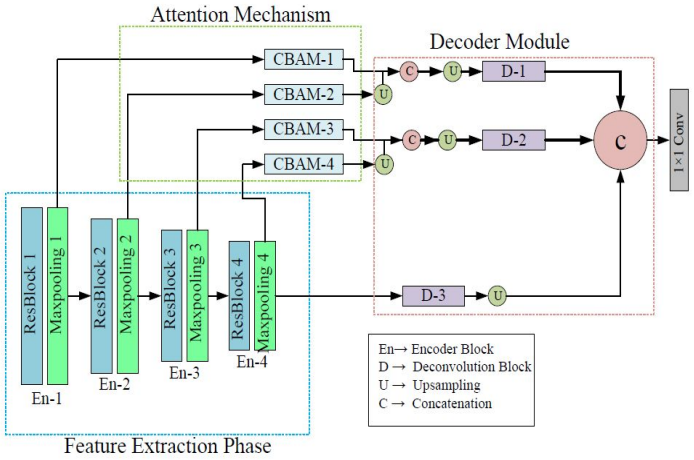
The images that the Lane and vehicles are correctly annotated.

Data Preprocessing - Lane Detection

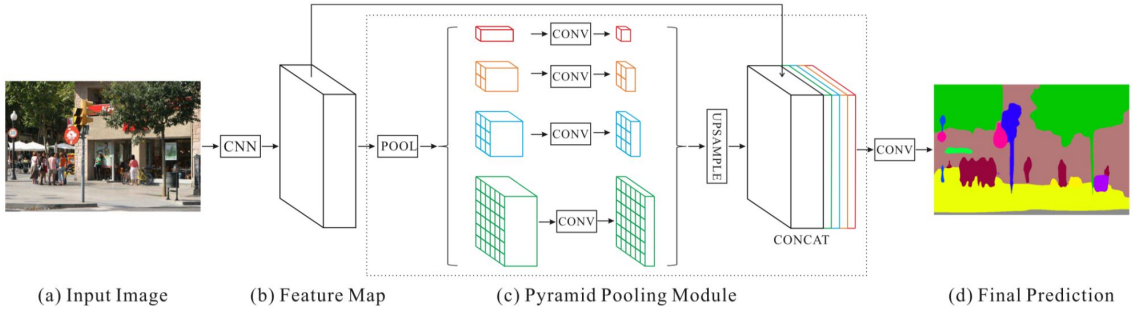
- Traditional CV Technique:
  - Threshold filter of the Saturation/Lightness channel
  - Sobel gradients/Gradient magnitude and direction
  - Perspective Transforming to Bird's-eye view
- PSPNet and LLDNet
  - Convert Images into NumPy files
  - Resize all the images into the same size
  - Merged the files for generating a mixed dataset

Network architectures - Lane

- **Line Detection using Histogram**
- **PSPNet**
- **LLDNet**



LLDNet Architecture



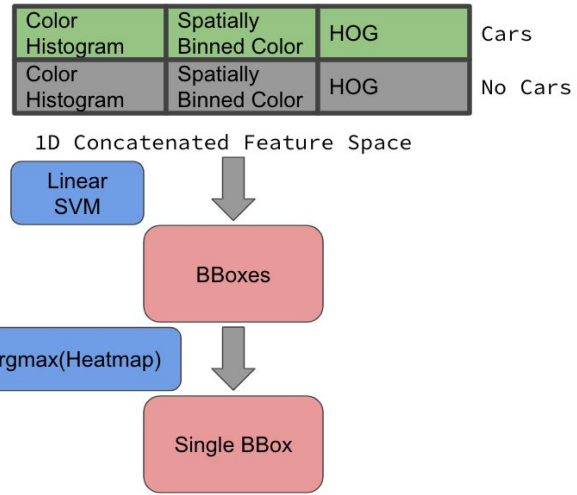
PSPNet Architecture

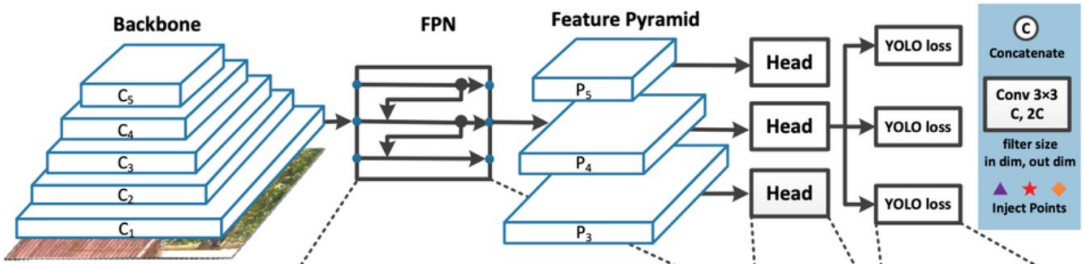
Data Preprocessing - Vehicle Detection

- SVM
  - Image normalization
  - Y-crop: remove sky and hood area
  - Convert to YCrCb
- YOLO
  - Convert to RGB
  - Random HSV
  - Random Perspective + Rotation + Mosaic

Network architectures - Vehicle

Linear SVM





Similar YOLO architecture from PP-YOLO

- **Linear SVM**
  - Small
- **YOLO v7**
  - E-ELAN Layer Aggregation
  - Fast (155 FPS)
  - Accurate
  - High Res (608)

Lane Detection Result

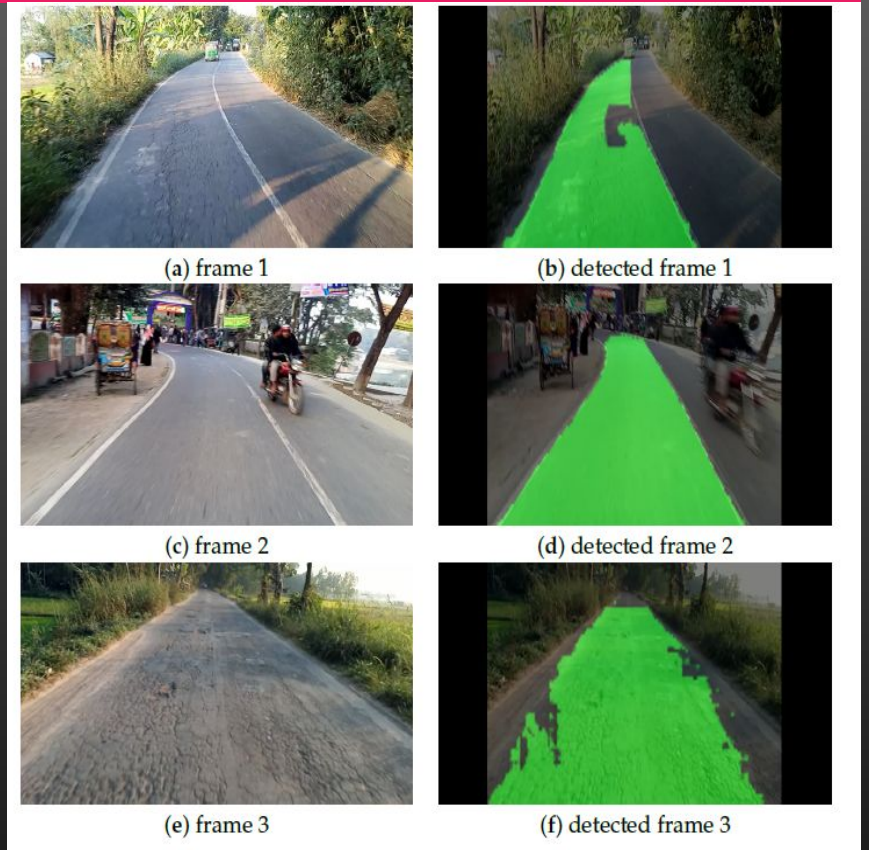
- PSPNet

  Test results

Lane Detection Result

- LLDNet

  Test results



Vehicle Detection Result

- SVM

  Test results

Vehicle Detection Result

- YOLOv7

  Test results

What we will do for the remaining time?

- Lane Detection
  - Try to modify and improve LLD model to make it more suitable for our task
- Vehicle Detection
  - Apply transfer learning on custom dataset for bad weather conditions, cracked roads, etc.
  - Modify network to reduce model size for portability
- Quantitative Comparison
  - Inference time, model size
  - IOUs, mAP

Thank you!