University at Buffalo
Department of Computer Science and Engineering
CSE 573 - Computer Vision and Image Processing
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Final Project Report

Title of the project:
License plate recognition

Problem:

- Identification of the area of the vehicle thought to be the license plate is known as license plate detection. Identification of the values that make up the license plate is recognition.
- This is known as "license plate detection and recognition" and makes use of computer vision to find and identify a license plate from an input image of a car.
- This technique has numerous applications.
    - It is used to track down vehicles that are violating traffic laws on the road.
    - It is used in security to record the license plates of the cars entering and exiting specific locations. It is used to record the license plates of the vehicles parked in parking lots.
    - Tracking vehicles in residential areas and sensitive areas where security is a priority
    - Use to track vehicles in a drive-thru

Dataset:

The dataset consists of images taken from the Google Open Images Dataset, the Open Images Dataset consists of millions of images that can be used to train and test AI models. For this project images of vehicles are collected.

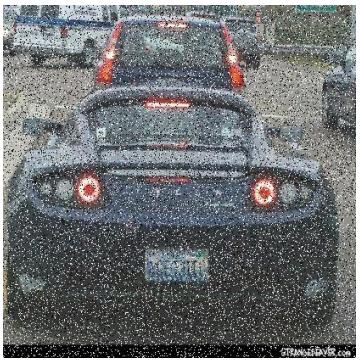
Google drive link:
https://drive.google.com/drive/folders/1-KHew3PpOQpHAuA0g_RA91CgdlN50hZ3?usp=share_link

Pre-processing of the dataset:

- The dataset consists of 716 images which are split into train, test and validation sets
- Annotation of the images:
    - The images are annotated manually to select the area of interest which is the license plate of the vehicle
- Resizing:
    - The image is resized into 416x416 format

- Adding noise:
    - Salt and pepper noise is added to the images to make the dataset have images with noise and blur
    - This is applied for the model to train for the noise and blurry images

Dataset samples:

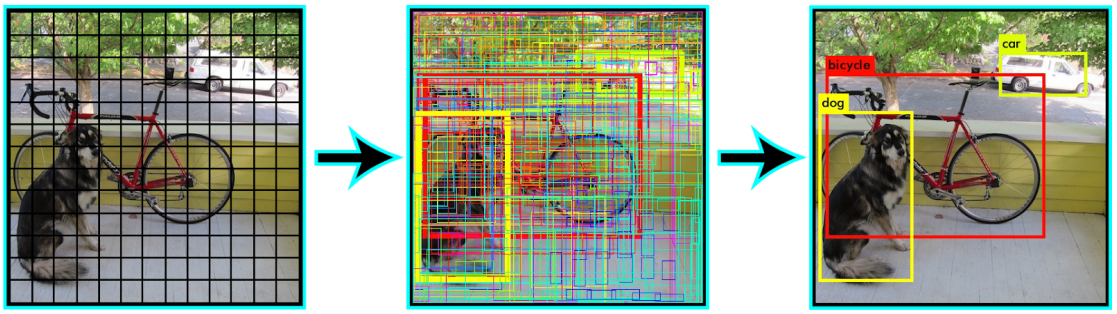


Algorithm:

The model is trained on the yolov7 algorithm using transfer learning and weights from the yolov7 model

Yolov7:

- Since its inception, YOLO has been one of the top object detection networks for three key reasons: accuracy, affordability, and usability.
- Yolov7 is the latest iteration to this model which increases the performance significantly
- YOLO first divides the image into N grids before doing object detection in a single step. These grids are of the same SxS size. It is utilized to find and locate any objects that might be present in any of these areas. Bounding box coordinates, B, for any prospective objects are predicted for each grid along with their object labels and a likelihood rating for their presence.
- Yolo is an opensource project where we can use our own custom dataset to train



What aspects of the algorithm you have coded on your own:

- I have collected and annotated the dataset manually, added salt and pepper noise to the images

- Modified the algorithm to include the custom dataset and weights
- Trained the model on google colab
- Cropping the result images bounding boxes
- Applying OCR on the cropped license plate

What aspects of the algorithm you have used from online resources:

- YoloV7 is an opensource project and the algorithm is available in GitHub

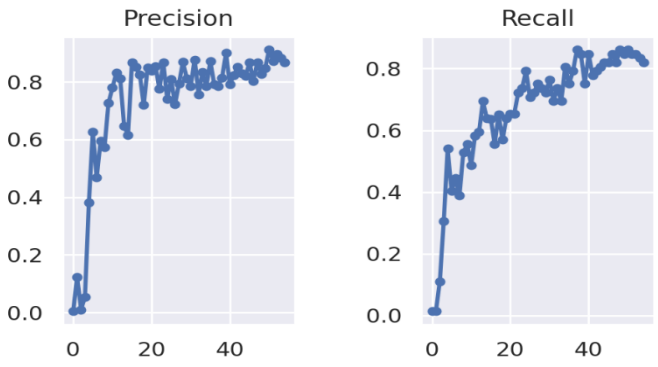
Please share details on what is input and output of the problem:

- Input:

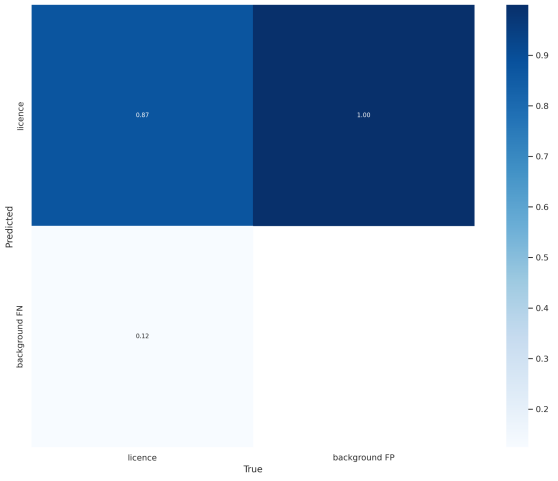
- Output: *Number plate detected from the image*

Results Please report any accuracy that you might be evaluating your project on. Please report some qualitative results.

- The model got an accuracy of 87% on the validation data
- Examples of the batch images below used for validation



Precision and recall graph



Confusion matrix for the label 'license'

Example image:

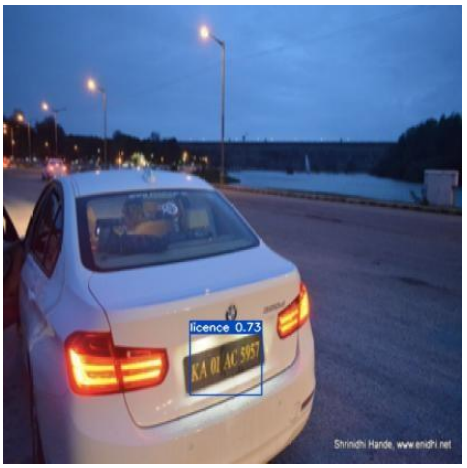
Input

License plate detected

The cropped-out license plate

Blurry image:

Low light image:



Though with low accuracy, the model is able to detect the license plate from a low-quality blurry image

References:

- Yolov7 algorithm - https://arxiv.org/abs/2207.02696
- Blog on Yolov7 - https://blog.paperspace.com/yolov7/