Tesla Autonomous Vehicle Detection - YOLOv8 Project

Part 1

[the doc can be read in conjunction with ref:
https://github.com/Rimbik/assessments/blob/main/gen-ai/capstone1/autonomousCar/Code/capstoneReadmeVD.pdf

For Tesla autonomous vehicle detection, building a self-made CNN-based model from scratch is extremely challenging.
The **first challenge** is object identification—determining **whether an object is a vehicle or not** is itself a major hurdle.
Then comes the challenge of identifying the **type** and **number of vehicles**.

Given the objective and the annotation `.csv` provided with the assignment, the approach chosen was:

> **Use a pre-built (semi/full) model and customize it using the dataset**, which aligns with the assignment's purpose.

Among many available models and technologies, we chose the **YOLOv8** model to train on our custom images and dataset.

Implementation Steps

Step 1: What We Have

- All the training images
- Their annotation CSV file

Step 2: Why We Didn't Use the Provided CSV

The existing `.csv` annotation was found to be **faulty**:

- Many entries in the CSV had **filenames without corresponding images**.

- For instance, the image `00000009.jpg` should have an annotation entry labeled `"00000009"`, but this consistency was not found.

> **Decision:** Create a **fresh annotation CSV** and generate **YOLOv8-compatible YAML** for training data.

Step 3: Image Uploads

Due to GitHub's file size limits, images were uploaded in `.rar` format (~19MB each).

- All images were uploaded to GitHub in split `.rar` format
- Downloaded and extracted via code to recreate the complete image dataset locally

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Step 4: Annotation Preparation

- Created a **fresh annotation CSV**
- Converted CSV to **YOLOv8 YAML** format for training
- Used manual tools to rectify annotation coordinates when required

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Step 5: Model Training

- Trained the YOLOv8 model with:
  - **10 epochs**
  - **Early stopping**
  - Saved model as `.pt` file for future inference

Step 6: Inference

Ran inference on the saved `.pt` model to achieve:

- **Vehicle detection with bounding boxes**
- **Vehicle count on roads**

GitHub Repository

The entire codebase is available publicly on GitHub for:

- Easier access
- Further learning and experimentation

Project Directory Structure

[all are autogenerated on code exucution in google colab]

```
dataset/
├── images/
│   ├── train/
│   └── val/
├── labels/
│   ├── train/
│   └── val/

multifiles/
├── annot/
│   └── annotation.csv
├── extractedImg/
│   ├── Images/
│   │   └── *.jpg
│   ├── labels/
│   │   └── *.txt
│   ├── Images.part1.rar
│   ├── Images.part2.rar
│   └── Images.part*.rar
```

public
Source code: https://github.com/Rimbik/assessments/tree/main/gen-ai/capstone1/autonomousCar/Code