



CSE 4088

Introduction to Machine Learning

Term Project

Object Detection System for Vehicles

Mid-Term Report

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1. Abstract

In this project, we'll create an object detection system that can recognize many kinds of vehicles, including motorcycles, cars, tractors, trucks, bicycles, and more, from images. This technique may be applied to identify the type of vehicle entering through gated entries, such as parking garages, toll roads, etc. When a car approaches the entry barrier and stops, the system will take a photo to identify the kind of vehicle. The classification of the vehicle is important because it changes the pricing per hour (Bigger vehicles are charged more per hour/ distance).

Python will be our main programming language to implement that project. Besides that, the TensorFlow library will be used to train the program. While doing this project, we will use a dataset which contains various types of vehicle images [7].

2. Initial Literature Search

2.1 Real-time vehicle detection using python

An image and the coordinates of the location are used by this system to identify vehicles. That system is used in roads to detect the traffic based on the number of vehicles. Additionally, as that system knows the places of the vehicles in the road, it helps to avoid collisions for self-driving cars. Unlike our project, this system was developed using Python's OpenCV library [9].

2.2 Image Classification using TensorFlow

The article is about how to build a lightweight image classifier using Python framework Tensorflow/Keras. It is an image classifier model just like what we are planning to do. But unlike classifying images based on different types, it classifies based on orientation of the images using a dataset of 11000 images of different orientation [10].

3. Used Frameworks/ Extensions

3.1 TensorFlow

TensorFlow is a free open-source software library for machine learning and artificial intelligence. TensorFlow was created and published by the Google Brain team in 2015 [5]. TensorFlow can be used in Python, which is the programming language that we use to develop this project [3,4].

3.2 Numpy

NumPy which is referred to as Numerical Python is a Python library used for working with arrays [7]. Besides that, NumPy also has functions for working in various operations like linear algebra, matrices etc.

3.3 Matplotlib

Matplotlib is a plotting library of Python which is used for creating static, animated, and interactive visualisations [8]. Matplotlib is generally used with NumPy (Defined in 3.2).

4. Completed Progresses

4.1 Making Initial Literature Search

We have read some articles about image classification using Python and learned how it is done.

4.2 Finding a Dataset

We've found a good dataset which consists of many images of various vehicles for both training and testing the model. (Link is provided in section 6.1)

4.3 Determining the Machine Learning Library and Learning It

After some research about the different machine learning libraries in python, we decided to use Tensorflow as our main machine learning library because it has great tools and broad documentation. After choosing TensorFlow we had some experiences with it and learned the basics to be able to use it in our project.

4.4 Training essential vehicles (Cars, Motorcycle, Bicycle) to the Program

We created the model and for now it can classify only the most essential vehicles like cars, motorcycles and bicycles. When doing this subtask, we learned a lot about how to use the Tensorflow/Keras framework, why they are useful and how easy it is to build an image classifier using Tensorflow/Keras framework. And also we were able to have some hands-on experience besides theoretical concepts we see in the lectures.

5. Remaining Progresses

- Training non-essential vehicles (Ambulance, Van, Limousine etc.)
- Testing the Trained Models using images.
- Representing the outputs visually using libraries such as Matplotlib
- Writing a Final Project Report

6. Project Plan (Revised)

6.1 Dataset Link

<https://www.kaggle.com/datasets/iamsandeepprasad/vehicle-data-set?resource=download> [6]

6.2 Project Schedule Table

In this report, the table differs from the project plan. Several steps were added and several steps were removed. The current table represents as:

Subtask Name	Due Date	Status
Making Initial Literature Search	04.11.2022	Done
Finding a dataset	11.11.2022	Done
Determining the Machine Learning Library and Learning It	14.11.2022	Done
Training essential vehicles (Cars, Motorcycle, Bicycle) to the Program	24.11.2022	Done
Writing a mid-term report	02.12.2022	Done
Training non-essential vehicles (Ambulance, Van, Limousine etc.)	17.12.2022	Working On
Testing the Trained Models using images.	27.12.2023	To Do
Representing the outputs visually using libraries	03.01.2023	To Do
Completing the project	07.01.2023	To Do
Writing a final project report	11.01.2023	To Do
Presenting the project in class	15.01.2023	To Do

Table 1. Project Schedule Table

7. List of References

1. <https://paperswithcode.com/task/object-detection>
2. Python Machine Learning: Machine Learning and Deep Learning with Python, scikit-learn, and TensorFlow, Sebastian Raschka and Vahid Mirjalili, November 20, 2015.
3. <https://www.tensorflow.org/>

4. <https://en.wikipedia.org/wiki/TensorFlow>
5. Dean, Jeff; Monga, Rajat; et al. (November 9, 2015). "TensorFlow: Large-scale machine learning on heterogeneous systems". *TensorFlow.org*. Google Research. Retrieved November 10, 2015.
6. <https://www.kaggle.com/datasets/iamsandeepprasad/vehicle-data-set?resource=download>
7. <https://numpy.org/>
8. <https://matplotlib.org/>
9. <https://kalebujordan.dev/real-time-vehicle-detection-using-python/>
10. <https://neptune.ai/blog/how-to-build-a-light-weight-image-classifier-in-tensorflow-with-keras>