Lightweight Monocular 3D Vehicle Detection

Supervisors:

Marçal Rossinyol marcal@allread.ai
Dimosthenis Karatzas dimos@cvc.uab.es

Company:

AllRead http://www.allread.ai

Institute / Group:

Computer Vision Center http://www.cvc.uab.cat/
Intelligent Reading Systems

Conditions:

Paid project. Possibility to do practicals at AllRead MLT.

ABSTRACT

This project deals with the design and training of an object detection model able to produce 3D bounding-boxes for different types of vehicles in monocular images. Taking inspiration from the CenterNet model, we want to obtain a lightweight 3D object detection model that can run in real time in low-resource environments.

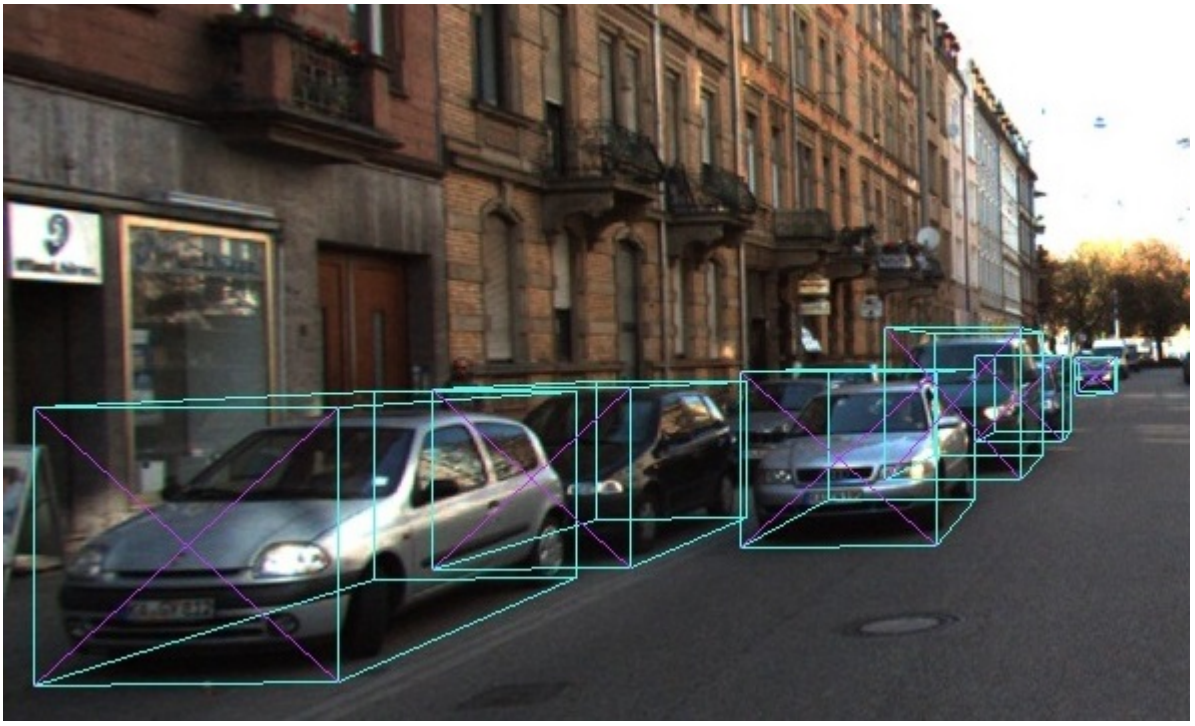

Fig 1: Example of monocular 3D vehicle detection

CONTEXT AND NEED

To detect, monitor, count vehicles is a feature that is applied in a wide range of different applications, from autonomous driving, to access control in video security products or smart-city traffic analysis.

State-of-the-art object detection techniques, from YOLO, SSD, Faster-RCNN to Retinanets have excelled in such particular application, although their most common use is to regress 2D bounding-box coordinates.

In order to specifically tell the position of the vehicle in the image, we need to design methods able to regress 3D bounding-boxes from monocular images. In addition, they should be able to also classify the vehicles in different types (cars, motorbikes, vans, trucks...)

In order for those methods to run in real-time in low resources devices, the backbones of the CNNs and the post-processing steps should be designed with the efficiency in mind.

PROJECT OBJECTIVES

The main objective of this research project is to design and train a functional neural network that is able to regress 3D bounding-boxes of vehicles from monocular images while classifying the type of vehicle. We will take as baseline the CenterNet model:

> Zhou, X., Wang, D., & Krähenbühl, P. (2019). *Objects as points*. arXiv preprint arXiv:1904.07850

that has already proven that it is able to perform well in this task.

During this project, the student will be expected to:

- Study the state of the art and research new 3D object detection models
- Analyse different public training datasets (e.g. KITTI)
- Develop from scratch a custom CenterNet model for 3D object detection in Tensorflow/Keras
- Train, test and keep evolving the model while analysing accuracy
- Optimise the models for efficiency
- Evaluate the proposed methods in a real and relevant environment

AllRead will offer real-life test data and use-case scenarios on which the student will be able to establish pilot studies, to evaluate the efficiency of the produced models.

Fig 2: Sample of AllRead use-case scenarios.

BACKGROUND AND TEAM

AllRead was founded in mid 2019 as a spinoff of the CVC to commercialise a novel text recognition technology. During these years, we have focused on the logistics sector with a product able to monitor and track different assets moving through the ports facilities such as containers, trains, trucks, etc. We are working today with the major Spanish ports and have clients in several other countries such as France, Italy, Portugal, Belgium, Switzerland, Brasil, Mexico and Colombia.

The MSc project will be developed within our existing research line on access point monitoring in logistic environments, and the student will work closely with the Deep Learning research and technical team of AllRead.

PAID PROJECT AND FUTURE PERSPECTIVES

In parallel to the Master project we offer the possibility to do practicals at AllRead, which will offer the student the possibility to dedicate more time on the project, and extend it to specific application domains.

Both the Master project and the practicals at the company will be paid. High performing students will be offered the possibility to continue professionally as computer vision engineers in AllRead.

Please, do not hesitate to contact us for more clarifications while we chat a bit over a coffee! The sooner you contact us, the better!

Marçal: marcal@allread.ai
Dimos: dimos@cvc.uab.es