**Project 1**

**Detecting 3D objects in point clouds**

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**Problem Statement**

1. What does the topic cover?

The topic is about the recognition of 3D objects and it has a wide range of application prospects.

1. Why it is important?

In the real world, almost everything we see is a 3D object, so 3D object detection helps a lot in our daily life. For example, the iPhone face ID, which uses the technology of 3D face recognition, helps us unlock our phones more quickly and is safer than the traditional unlocking methods. Besides, 3D object detection is also important in the domain of autonomous driving, which is a hot topic in the last decade, and it has been researched and used by many large tech companies, like Tesla, Google, Baidu, Huawei, etc. It helps the driver reduce stress and lower the rate of accidents.

**Applications**

1. What are applications of the topic?

There are plenty of applications using the 3D objects detection technology:

* 3D face recognition

3D face recognition is a hot topic in the last decade. It is a biometric technology that requires sensors and algorithms to implement face recognition.

* Autonomous driving

Autonomous driving has been widely researched and used in the past decade. If properly regulated, self-driving cars will likely reduce the death rate of car accidents and promote healthier urban environments. 3D detection plays an important role in self-driving technology since it enables the self-driving cars to collect data needed for planning its path.

* 3D object detection in robotics

3D object detection technology gives robots a pair of eyes. It can help robots recognize objects and avoid obstacles. In some actual scenarios, like supermarkets and hotels, robots with 3D object detection functionality can replace human and provide better service.

1. What is the societal significance of the research?

3D object detection has great societal significance, which brings both positive and negative societal effects. Take autonomous driving as an example: It helps lower the death rate from the car accidents, lessen traffic jams, reduce drivers’ stress and promote healthier urban environments. However, it also brings some negative societal effects. For example, the accidents are likely to happen if sensors don’t work well. Due to the algorithms’ bugs, there are also some potential safety issues. What’s more, finding out who is to blame for an accident also leads to some social ethical issues.

**Area of focus**

I picked autonomous driving as my area of focus, since it’s a very hot topic and there are plenty of awesome researches and applications done by research community and industry.

**Literature review**

I mainly reviewed the industrial products with a focus on self-driving.

* **Waymo**

Waymo is an autonomous self-driving technology development company and is formerly the Google self-driving car project. It is the top-ranked self-driving company now. Waymo designs fully autonomous driving cars. And Waymo designed and produced its own hardware, like sensors, chips and cameras.

Their cars use Lidar (Light Detection and Ranging) and radar to detect the surroundings on the road, which can cover things up to 3 football fields away. And then the car integrates the data and plan a safe path.

* **Aurora Innovation**

Aurora is an American self-driving car company. Aurora designed, Aurora Driver, a self-driving computer system which can be integrated into the vehicle. Aurora Driver is a combination of sensors, software and hardware, which enables it to detect objects on the road and plan a safe path.

**Open-source research**

* **PyTorch3D**

PyTorch3D is a library for deep learning with 3D data and is provided under the BSD license. PyTorch3D seems to have little to do with autonomous driving, but it can be a powerful tool to develop self-driving programs, since it provides components for 3D computer vision, which can be integrated into other systems to develop self-driving programs.

* **Udacity Self-Driving Car Nanodegree Program**

This is an open-source program developed by Udacity aiming to teach skills and techniques used by self-driving car teams of advanced tech companies. This project provides datasets and models needed by self-driving algorithms development and is starred by 5k+ people.

* **Autoware.AI**

Autoware is a ROS-based open-source software for self-driving vehicles and is provided under the Apache 2 license. Autoware combines many self-driving modules together, like sensing, computing, perception, planning, etc. It uses devices like camera, lidar, GPS to detect 3D objects on the road. And it enables developers to test their cars on different roads and areas.

**References**

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