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A Collision Avoidance System Using Reinforcement Learning

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1 Introduction

This report is drawn up after the development of the thesis project at Tongji University (同济大学) for the Double Degree project Politong.

The thesis project aims to develop a machine learning algorithm that allows an autonomous vehicle to avoid obstacles.

The research will focus on Reinforcement Learning methods.

Nowadays it is possible to hear more and more about Autonomous Driving Vehicles. According to research firm, autonomous vehicles will match or exceed human safety by late 2020s and fulfill all mobility needs in 2040s to 2060s. Optimists predict that by 2030, autonomous vehicles will be sufficiently reliable, affordable and common to displace most human driving, providing huge savings and benefits. However, there are good reasons to be skeptical. There is considerable uncertainty concerning autonomous vehicle development, benefits and costs, travel impacts, and consumer demand. Considerable progress is needed before autonomous vehicles can operate reliably in mixed urban traffic, heavy rain and snow, unpaved and unmapped roads, and where wireless access is unreliable[1].

The autonomous cars(also known as a self-driving cars or a driverless cars) are a vehicle that are capable of sensing its environment and navigating without human input The ability of autonomous vehicles to operate without human intervention depends on their level of technological sophistication, in accordance with the current six-degree autonomy scale proposed by the International Society of Automotive Engineers (**SAE**)[2]. There are 6 levels of driving automation, from level 0 (no automation) to level 5 (full unlimited automation); intermediate levels (1 to 3) are considered semi-autonomous[3, 4].

Currently we are between level 2 and 3, so even if the current technology is behind the famous Level 5 of driving automation, there is lot of work to make it happen.

The idea behind these cars is quite simple: outfit the vehicles with sensors that can track all the objects around and make the cars understand the world around them. Autonomous vehicles are driven using technology such as GPS, odometry, radars, laser lights and other devices[4]. These sensors themselves do not make the car ‘smart’, what make it autonomous are the big computers inside and the algorithms they are running. Usually these softwares run neural networks: these take as input the sensor recordings, elaborate them and output some values like steering angle, accelerate, brake or other important values. Even if the idea behind these technological innovative vehicles is simple the implementation is not: not enough hardware computation, not enough training data, problems with handle different weather conditions(fog, rain, snow, etc.), the current

regulation remains in a nascent stage.

Even if this technology is not diffused yet, there are many potential benefits that autonomous vehicles could introduce in our society:

- **Transportation Safety.** The most notable predicted benefit of autonomous vehicle technology is a substantial reduction in the human and economic toll of traffic accidents. Indeed, impairment, distractions, and fatigue alone account for over 50% of all fatal crashes. The use of autonomous vehicles could significantly reduce the incidence of such crashes, as vehicles with no human operators are never drunk, distracted, fatigued, or otherwise susceptible to human failings.
- **Access to Transportation.** Another important potential benefit of autonomous vehicle technology is increased mobility for populations currently unable or not permitted to operate traditional vehicles. These populations include older citizens, the disabled, people too young to drive, and others without a driver's license.
- **Traffic Congestion and Land Use.** Autonomous vehicles could reduce congestion and change the way in which cities are planned. Most cars are moving only for 5% of their lives, for the 95% they are parked[5]! For this reason a lot of space is dedicated to parking lots; the same space that could be used for different purposes (green spaces, etc.).
- **Energy and Emissions.** Autonomous vehicle technology has the potential to reduce both energy consumption and pollution thanks to efficiencies gained through smoother acceleration and deceleration and increased roadway capacity.[6]

2 The

ience and in the back-end server development part.

2.1 Test

The first task was .

2.2 Complex-Analysis

This part concerns the st

2.2.1 Dataset

m movements

3 Conclusion

This internship was a formative experience that allowed me to discover many new topics but also to understand how a company works. Moreover, it allowed me to understand that there is a substantial difference between the university environment and the corporate environment: university, as mentioned by some professors during the courses, has the task of giving a general knowledge of the topics and the real task is to give a way of thinking and analysing a problem to find a solution; indeed, during this period in the company I realized that computer knowledge was not always essential but it was more important to understand what was needed to be done and how to do it.

I believe that this internship was very useful because it allowed me to deepen and learn about new topics and gave me an idea to understand if the tasks assigned could be addressed in a future university career or in a possible job. This is also an experience that allows to grow both personally and professionally, not to mention that it is a way to enrich the Curriculum Vitae.

I am fully satisfied with the internship as AI researcher and developer and I am satisfied with the atmosphere of serenity and professionalism that I lived in the company thanks to the kind and extremely helpful colleagues.

References

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