Summative assessment: System design

The SAE J3016 describes five levels of autonomous driving, from driver support to fully automated driving (SAE, 2021). While significant progress has been made recently in the technologies that support self-driving vehicles, such as GPS, LIDAR, RADAR, Inertial measurement units and cameras (Reddy, 2019) there is still progress required before vehicles can be considered fully autonomous.

The software is designed to perform the following functions:

Speed adjustment to cruise speed. Route plan data provided to my software also contains speed limit data, in the form of a queue. The software will recognise this data as the speed the car will aim to travel at if there is a clear road ahead, with no obstructions. This can be overridden by camera data if a speed limit sign is detected, for example in the case of a temporary restriction due to roadworks, etc. Based on IMU and odometry data, if the car is too fast or too slow, then the car will react accordingly to adjust the speed to maintain the car at the desired speed.

Traffic light recognition. Using visual detection through cameras in the sensor module the car will detect traffic lights and react accordingly. If red, the car will stop, if green, the car will either continue driving, or restart driving if it had stopped. Deep learning can be used to analyse the captured images to recognise the traffic signal (Kulkarni, 2018) however this is obviously outside the scope of this project.

Object detection and avoidance. According to Schwarting (2018), accurate perception is required to make decisions to drive safely. Using LIDAR and visual data from the sensor module, the software can detect objects in the desired path of the car. It can then perform an emergency stop, if required. While the reliability of

LIDAR technology has been questioned, (Zhou, 2019), when coupled with camera technologies it is an essential tool in gathering environmental data.

The car is considered an instance of a class with current speed and speed limit as attributes. It can perform functions such as accelerate, decelerate, stop or emergency stop.

The software will be programmed with a dictionary of recognised objects (meaning potential obstructions in the road rather than instances of a class) which it can identify when an object is detected on the road ahead. This will assist with the decision making process if evasive action is required.

Terms used to perform background research included:

Autonomous vehicle, Self driving, traffic light recognition, speed adjustment, levels of automation in vehicles, decision making in autonomous vehicles, automated vehicle advancements, automated vehicle technologies, self-driving challenges, connected vehicles, capabilities/features of self driving vehicles, road sign detection. During my research I particularly focused on the 3 functions I wanted to include.

References

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Schwarting, W., Alonso-Mora, J. & Rus, D. (2018). Planning and Decision-Making for Autonomous Vehicles. *Annual Review of Control, Robotics, and Autonomous Systems.* 6(59): 187-210

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