Technical Description of Self-driving Cars

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Abstract: *Autonomous driving technology symbolizes the development of social technology, so it is necessary for people to understand autonomous driving technology. The current technology has no way to achieve fully automatic driving, it can only be said to help people with assisted driving on simple roads. This article will start with the introduction of autonomous driving technology to give people a preliminary understanding of autonomous driving technology. Explain the feasibility of autonomous driving technology from four aspects: government support, safety, sustainability and economic development, and also talk about potential dangers.*

Keywords: *Automation Development, Autonomous Driving Technology, Sustainable Development*

1. Introduction

Self-driving cars are vehicles that incorporate vehicle automation. This kind of car can sense its surroundings and control the steering wheel, gas, and brake to move safely without human control. Self-driving cars have been applied to some vehicles, but the current truly complete self-driving function cannot be fully realized on city streets and requires the driver's attention. With the current speed of technological development, the popularity of self-driving cars is inevitable. Getting people to accept and trust self-driving cars starts with understanding the technology behind self-driving cars. At the same time, government support also has a non-negligible impact on the development of self-driving cars. Although self-driving cars are high-tech and convenient, there are also some potential risks.

2. Technology Introduction

For self-driving cars, there are six levels of vehicle autonomy explained (Fig. 1). Self-driving cars are more of assisted driving at this stage than fully autonomous driving. According to AutoPilot Review, major manufacturers in 2021 will mostly focus on Level 2 autonomy, which allows the car to handle steering, acceleration, and braking while the driver must monitor the vehicle and be ready to reclaim control at any time [1]. Therefore, the current technology requires a certain amount of attention of the driver, and this function is very useful in some places with simple streets and few people. The self-driving cars mentioned now also refer to secondary autonomous driving, not the very advanced self-driving cars that can be fully intelligently driven in science fiction movies.
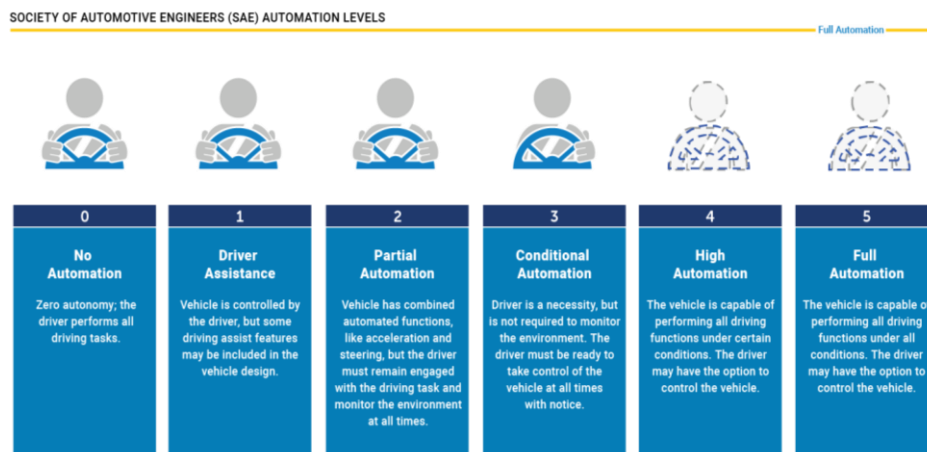

Figure 1: Six levels of self-driving (NHTSA)

Compared with ordinary cars, self-driving cars add cameras, lidar, and radar to achieve the effect of human brain thinking and analysis (Fig. 2). LIDAR can pinpoint potential hazards outside the perimeter by reflecting laser light on surfaces around the car. Radar senses the speed of surrounding vehicles and sends a signal to the onboard processor to control the brakes, allowing the car to avoid a collision. The role of High-Powered Cameras in self-driving cars is a bit like "redundant technology", even if they go wrong, they won't affect the operation of self-driving vehicles [2]. However, High-Powered Cameras are not entirely useless. They can be said to be double insurance. This double insurance can also increase the safety of self-driving cars to some extent.
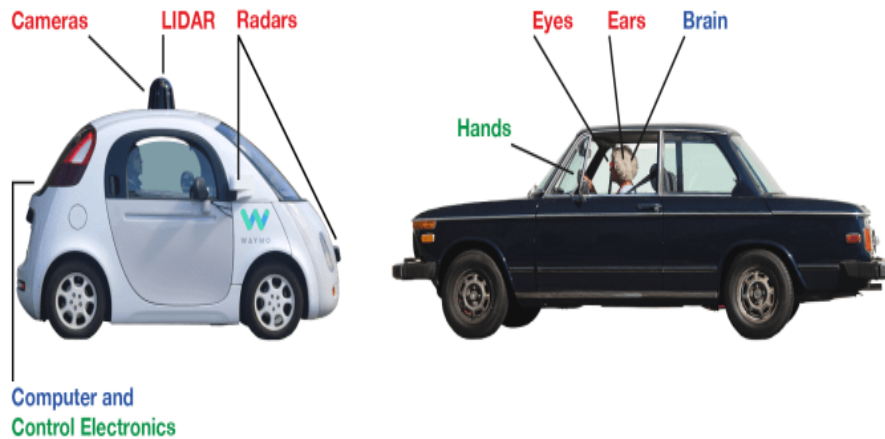

Figure 2: A comparison with a conventional self-driving car illustrates where the components of a self-driving car are located (Menke, 2017).

For self-driving cars, it is handing over the information that the human brain needs to process to the computer. The functions corresponding to self-driving cars and human-driven cars can be clearly seen in the image below (Fig. 3). Camera, LIDAR, and radar are like human eyes and ears mainly used to observe and analyze the situation on the road. Humans transmit observations to the brain for analysis, while Cameras, LIDAR, and radar are transmitted to computers. After analyzing the obtained information, the computer in the self-driving car tells the control electronics instructions, and the human brain controls the hand to turn the steering wheel and the foot to step on the accelerator and brake in the human-driven car. The realization of autonomous driving technology is also dependent on the process of human driving. The ears and eyes correspond to the camera, LIDAR, and radar, which are responsible for the perception part, the brain corresponds to the computer, which is responsible for the computing work, and the hands and feet correspond to the control electronics, which are responsible for the control work.
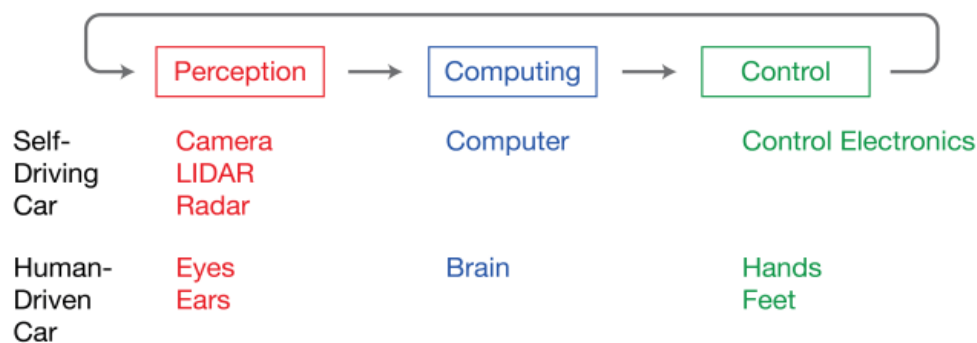

Figure 3: Self-driving cars and human execution loops while driving (Menke, 2017).

3. Government Support

The emergence of new technology is inseparable from the support of the government. The research

and development of self-driving cars are inseparable from the support of the government. For the government, what self-driving cars can bring to society is safer streets, higher sustainability, and economic development.

3.1 Public Safety

A survey shows that 95% of traffic fatalities are caused by human error [3]. The self-driving car will never experience fatigue driving, no matter how long they drive. It can also know through radar when they are about to hit an obstacle and react quickly. Whether it is physical strength or reflexes, the computer will be better than the human brain. Unless there is a computational error or malfunction, automated cars do not experience these issues, implying that the vast majority of traffic events can be resolved by automation [3].

3.2 Sustainability

The transportation industry is the second greatest source of greenhouse gas emissions in the United States, accounting for 27% of all greenhouse gas emissions. Each year, two billion barrels of oil are used by automobiles [3]. More automation and electrification are being implemented in the automobile sector, which both promise to enhance safety and environmental policies. With greater usage of automated ride-sharing and shuttle services, vehicle automation may reduce the demand for specific parking places and lots, thereby transforming land-use considerably. Furthermore, vehicle electrification allows for increased efficiency with less personal driving, resulting in significant reductions in air pollution from the transportation sector [4]. The pollutants emitted by cars cannot be ignored, but self-driving cars use more points, which will be more energy-efficient in comparison. From a sustainability standpoint, self-driving cars are a better option.

3.3 Economic Development

The road safety issues brought about by self-driving cars can lead to the issue of accident costs associated with motor vehicle accidents. So far, fatal collisions have cost $317 billion, non-fatal crashes have cost $226 billion, and time saves have cost $99 billion. Self-driving automobiles have the potential to create $642 billion in annual welfare [5]. Technically speaking, self-driving cars can reduce accidents because of their sophisticated computational prediction capabilities. The technology of self-driving is some program instructions. Compared with the human brain, the reflexes of the computer are undoubtedly more agile, and the speed of detecting danger is faster. Self-driving cars can detect their surroundings via radar. When there is an abnormal sudden collision of a vehicle or a pedestrian suddenly jumps out, self-driving cars can immediately detect and stop the vehicle to avoid the accident. This also solves the cost loss of motor vehicle accidents from the root.

4. Potential Risk

4.1 Self-driving Laws and Regulations

Self-driving cars aren't completely perfect either, and it does have some potential problems. Because autonomous driving technology is a product of technological development, there will be many imperfect legal regulations. The Trump administration has approved final guidelines allowing self-driving vehicle makers to bypass key federal crash safety criteria in cars that aren't meant to transport people. The rule is expected to be the first of several aimed at hastening the use of self-driving cars [6]. New technological products require new laws to regulate. The emergence of this law also means that society is embracing self-drving cars and preparing for a future autonomous society. Therefore, when the government is ready to accept self-driving cars, it must prepare a complete legal system, so there will be no legal crisis related to self-driving cars.

4.2 Over-reliance on the Internet

The automation of vehicles will inevitably become more reliant on networks and signals, and it is this reliance on networks and signals that leaves holes. In places where there is no signal, the GPS signal is weak, the vehicle position cannot be obtained, and it is difficult to navigate. If the signal is not restored, there is a risk of getting lost. Hacking technology is also very dreadful, and the threat of their operation is real. In 2015, hackers took control of a Jeep remotely, forcing it to stop on a St. Louis Freeway while traveling at 70 mph [7]. Hackers can access the car's braking and steer through the in-vehicle entertainment system, so it's a potential danger for self-driving cars.

5. Conclusion

Self-driving cars are a trend to develop. With the development of technology and the efforts of scientific and technological personnel, self-driving will be closer to the human brain's thinking, and the identification of complex road conditions will be more accurate. In the future, I believe that signals and wireless networks will be everywhere in the world, and the GPS systems that self-driving cars rely on will be more stable. When self-driving cars are popularized, related policies will be introduced, and there will be stricter requirements for the network required by self-driving cars. When society has a special legal system for self-driving cars, there will be no potential legal loopholes, and the system of self-driving cars will become more complete. Not only to make life convenient and reduce car accidents with technology but also to reduce the emission of some polluting gases for sustainable development, self-driving cars have very good prospects in the future. So let's look forward to the future era of self-driving.

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