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Faith in Autonomous Cars: Exploring Importance of Self-Driving Cars

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Abstract— In this era, the vehicles are focused to be automated to offer human driver relaxed driving. In the field of automobile, various aspects are considered which makes a vehicle automated. The purpose of this study is to investigate the key factors influencing the adoption of autonomous cars. In this paper, the key technologies in self-driving car are discussed. This paper also highlights the working mechanism, advantages and disadvantages of these technologies in the light of safety improvement, especially on highway or freeway facilities. Finally, the debates of self-driving car are discussed and therefore the development trend of self-driving car is predicted.

Keywords—autonomous cars, technology, safety.

1. Introduction

The automotive industry is on the brink of a technological revolution and has come an extended way since Ford debuted his assembly line. Given the rapid pace of technological advancement, what the long run has future for us is restricted only by our imagination. One such innovation is that of the fully autonomous vehicle, or, in other words, driverless cars. Such a technological innovation promises to be, both disruptive and revolutionary, in terms of its impact on human autonomy and shaping the societies of tomorrow.

An autonomous car is a vehicle which is able to sense its environment and can operate without human interference. Driver isn't required to control the vehicle at any time, neither required to be present within the vehicle in the least. An autonomous car can go anywhere as a standard car goes and do everything that an experienced human driver does.

A. Levels of Driving Automation

The Society of Automotive Engineers (SAE) currently defines 6 levels of driving automation starting from Level 0 (fully manual) to Level 5 (fully autonomous).

a. Level 0 (No Automation)

The human is present in the car all the time who controls steering, braking, acceleration, and negotiates traffic.

b. Level 1 (Driver Assistance)

This is the lowest level of automation. The vehicle features one automated system for driver assistance, like steering or accelerating (cruise control). Adaptive control, where the vehicle are often kept at a secure distance behind subsequent car, qualifies as Level 1 because the human driver monitors the opposite aspects of driving such as steering and braking.

c. Level 2 (Partial Driving Automation)

This means advanced driver assistance systems or ADAS. The vehicle can control both steering and accelerating/decelerating. Here the automation falls in need of self-driving because a person's sits within the driver's seat and may take hold of the car at any time.

d. Level 3 (Conditional Driving Automation)

The vehicle can, within the right conditions, manage most aspects of driving, including monitoring the environment. The system will request the driving force to intervene when it encounters a scenario it can't navigate, meaning the driving force must still concentrate and be able to take over at any time.

e. Level 4 (High Driving Automation)

A wheel and pedals remain, but no human input or oversight is required except under select conditions defined by factors like road type or geographical area (like poor weather or other unusual environments). The driving force might manage all driving duties on surface streets then become a passenger because the car enters a highway.

f. Level 5 (Full Driving Automation)

This is truth "driverless" car which will operate any road and in any conditions a person's driver could negotiate. There's no wheel and no pedals. All you've got to just enter a destination within the navigation system, either through touch or voice command.

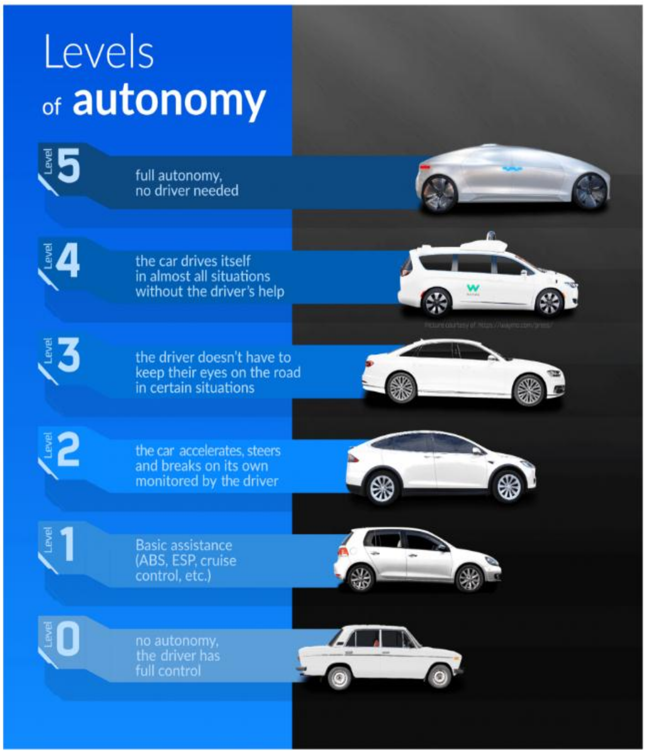

Figure 1: Levels of autonomy

2. TECHNOLOGY

The automatic control, architecture, AI (machine learning), computer vision etc. are put together into the autonomous car, which can be an outcome of the highly developed computer science, pattern recognition and intelligent control technology.

Compared with standard driving, the main feature of a self-driving car that the car is using is automation equipment to replace the human driver. After considering this feature and functional requirement about this type of driving, the core technology of autonomous car is divided mainly into four key parts, which are referred to as car navigation system, path planning, environment perception and car control. The detailed description is provided within the following sections.

B. Car Navigation system

During self-driving, there are two main problems, which are the present location of the car and the path to travel from the current location to the final point, which must be decoded. Certainly, the above two problems are often solved by a human's own intelligence in human driving. However, in self-driving, the car must be ready to automatically and intelligently locate its position and perform the trail getting to destination. For this purpose, the on-board car navigation system is integrated on the autonomous car.

However in order to navigate a particular path autonomously, the driving force has got to drive the vehicle on the specified path just for once while a GPS tracking system memorizes the trail by saving GPS way points received from the GPS sensor of an onboard Android phone and distances calculated from the speed sensor.

C. Location System

The main purpose of the situation system is to work out the vehicle location, which generally are often classified into relative location, absolute location and hybrid location. For relative location, the present position of self-driving car is obtained by adding the moving distance and direction to the prior position. The absolute location method is employed to locate the vehicle's position consistent with the knowledge obtained from positioning system like GPS. The hybrid location, which mixes the characteristics of the above two locating methods, is that the commonest method utilized in obtaining the position of a self-driving car.

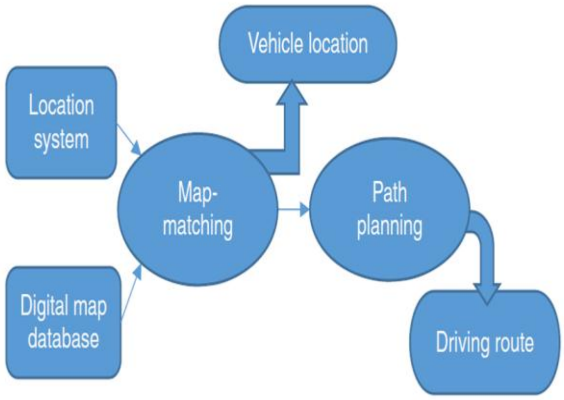

Figure 2: On board car navigation system

D. Electronic Maps

Self-driving cars navigate using both onboard sensors that spot obstacles and detailed, 3-D maps of streets, signs, and infrastructure. But building these maps, and keeping them up to date, is a huge undertaking.

A "Local Dynamic Map" (LDM) stores the specified data within the vehicle. Static information (e.g. map data) can be stored within the LDM beforehand and compared with the actual environment in test runs on the intended route. However, data fed during this way requires constant updating. The LDM may obtain data from sensors on the vehicle itself or from sensors or digital services outside the vehicle.

In particular, the map is divided into three layers: the active layer, the dynamic layer and the analytical layer:

Active Layer: This layer provides us with the road level data, the data of lane attribute, the elevated objects etc.

Dynamic Layer: This layer provides us with the real-time traffic data from other vehicle sensors and road sensors.

Analysis Layer: This helps us to train self-driving car by analyzing the real-time big data of human driving records.

E. Map Matching

Map matching, which is that the foundation of the trail planning, calculates out the car's location by using the geographical information from GPS/INS and therefore the map information from EM.

During the calculation, the advanced fusing technique is used to fuse the longitude and altitude or other coordinates information into the EM. From the sensible viewpoint, the output of car location should be precise and should be updated from time to time. Regarding this, it's a crucial issue to seek out an honest method to fuse the knowledge from GPS and INS. In fact, sometimes the satellite signal in GPS or the INS might be lost, therefore, an honest data fusion method that can integrate the knowledge from the prevailing location and route scenario will greatly enhance the accuracy, robustness and reliability.

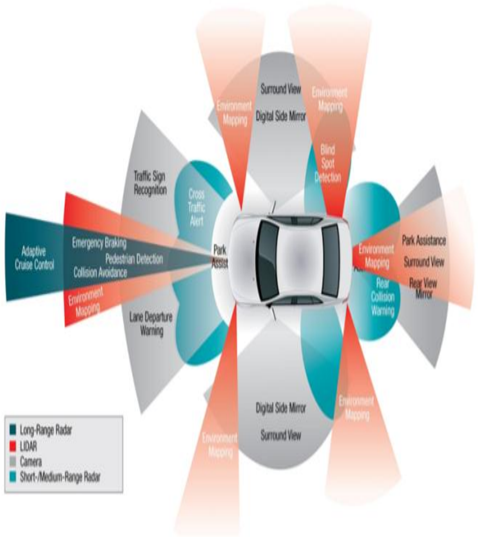

Figure 3: Sensors

3. CHALLENGES WITH AUTONOMOUS CARS

- Formation of maps and keeping them updated for self-driving cars is a difficult work.
- Driving requires many complex social interactions.
- Bad weather
- Many design regulations.
- Cyber security

4. SAFETY

Ninety-four percent of all serious motor vehicle crashes "are due to human error or choices. Fully automated vehicles that can see more and act faster than human drivers could greatly reduce errors, the resulting crashes, and their toll." Vehicles associated with mechanized or self-driving modes can assimilate and process substantially more data in less time than a human driver and they don't get drained and are rarely flushed. They won't miss an advanced traffic light and they can even check out corners to dependably identify complex traffic circumstances at crossing points through side of the road sensors. A greater part of the wellsprings of blunders that are the reason for auto collisions today can be prohibited.

Human mistake and an absence of data lead to a huge piece of traffic interruption. In the event that accessible, programmed and agreeable frameworks can consolidate a practically boundless measure of data for streamlined driving and course direction. Expanding the traffic stream and traffic productivity. Regardless of whether engine vehicles with computerized driving mode increment or repress the progression of traffic to a great extent relies upon the wealth of geo-data and traffic data made accessible to them, just as the advancement of ready and side of the road sensors and advanced general condition frameworks.

5. PROS AND CONS

Benefits	Costs/Issues
1. Relaxed environment : Driver can work, play etc.	1. Increased vehicle cost
2. Mobility of non-driver and older people	2. Increased user risks
3. Saving money from booking cabs	3. Prone to hacking risks
4. Increased safety for riders	4. High Infrastructure costs : highway etc.
5. Decreased Traffic on roads	5. Risks to other road users and prone to criminal activities
6. Reduced Pollution	6. Reduced employment

Table 1: Pros and Cons

6. CONCLUSIONS

If the people's thought hasn't changed about the self-driving cars being safe, these cars are already safe and are getting safer. As long as they believe and provides an attempt to technology, they get to enjoy the posh of computerized driving. Driverless cars appear to be a crucial next step in transportation technology.

Developments in autonomous cars is constant and therefore the software within the car is constant hence to be updated. Though it all started from a driverless thought to frequency , cameras, sensors, more semi-autonomous features will come up, thus reducing the congestion, increasing the safety with faster reactions and fewer errors.

As you see, there are both pros and cons of self-driving cars. No one can say firmly which category surpasses other, but we are sure that technological progress is can't be stopped and will only increase in the future. Progress is the very purpose of human existence after all. But as mindful citizens, one should consider both sides in order to maximize the pros and minimize the cons.

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