

**Review Article**

# A Review of the Technical Content of Autonomous Vehicle

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**Abstract:** In order to analyze the system composition of the development status of autonomous technology and the problems and prospects of autonomous vehicles, this paper analyzes the development of unmanned driving technology at home and abroad in recent years through field research and literature review, and finds Internet technology. Rapid development has brought new changes to the automotive industry, and the increasingly serious traffic safety problem has accelerated the development of autonomous technology. Through investigation, it is found that autonomous cars are developing rapidly. The development of autonomous cars has greatly improved the efficiency and safety of transportation systems. For the entire automobile development industry, autonomous cars will undoubtedly become the first direction of automobile development. In this paper, the composition of unmanned vehicles is described by explaining the development status of unmanned vehicles at home and abroad. This paper also briefly analyzes the key technologies of autonomous vehicles: environment-aware technology, navigation and positioning technology, path planning technology, decision-making control technology, and further compares the current problems and development prospects of autonomous technology, and through the investigation of materials The study further prospects the development direction of unmanned vehicles. In the end, it was found that despite the series of problems, unmanned driving is in line with the trend of intelligent and Internet-oriented vehicles, which is a major opportunity for the automotive industry to change under the Internet wave.

**Keywords:** Unmanned, Key Technology, Development Question, Development Prospect

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## 1. Introduction

Autonomous vehicle is also called smart cars, unmanned autopilot, autonomous navigation or wheeled mobile robots, is important applications for outdoor mobile robots in the field of transportation [1]. The Autonomous vehicle system is an integrated system that integrates environmental perception, automatic control, architecture, artificial intelligence, visual computing, planning and decision making. It is a vehicle system that takes full account of traffic lane and coordinated planning. It is also an important part of intelligent transportation system. Unmanned car technology to change the traditional driving experience of the traditional driving experience, it is uncontrollable driver from the driving position removed, not only greatly enhance the efficiency of the transport system and safety performance also makes people bid farewell to the long-distance boring driving, And thus improve the social benefits and protect the personal safety. Unmanned car technology to change the traditional driving

experience of the traditional driving experience, it is uncontrollable driver from the driving position removed, not only greatly enhance the efficiency of the transport system and safety performance also makes people bid farewell to the long-distance boring driving, And thus improve the social benefits and protect the personal safety [2]. Unmanned car technology to change the traditional driving experience of the traditional driving experience, it is uncontrollable driver from the driving position removed, not only greatly enhance the efficiency of the transport system and safety performance also makes people bid farewell to the long-distance boring driving [3]. And thus the autonomous vehicles improve the social benefits and protect the personal safety [4]. Pilotless technology is generally divided into six grades, with complete manual driving, auxiliary driving, partial module automation, automation under specific conditions, high automation, and fully automated pilotless driving [5].

## 2. The Development of Unmanned Vehicles

### 2.1. Development Status of Foreign Unmanned Vehicles

As early as the mid-20th century, many developed countries began to proceed with a series of unmanned vehicles. A small number of research and development models are close to mass production, in the United States and Europe, allowing the development of the autopilot driving on the road is becoming a common phenomenon [6]. In 2000, Toyota Motor Corporation for the first time developed an unmanned bus. The bus's autopilot system consists of fleet driving, road grooming, operations management and safety protection. The magnetic sensor in front of the vehicle chassis is mainly based on the permanent magnet buried in the middle of the road to ease, and then to control the direction and speed of vehicle driving [7]. In 2007, an unmanned car Boss, consisting of a converted, finished the unmanned car on a complex barrier track in the city [8]. In early April of this year, an Audi unmanned car completed a 3400-mile trip on American Highway [9], which proves to us that the computer is much more obedient than the human brain. Unmanned system supplier Delphi, to the Audi QS installed radar, camera and laser sensors, etc., successfully control it from San Francisco to New York, although most of the trip is carried out on the highway, but 99% of the time It was driven by its own [10].

### 2.2. The Development of Domestic Unmanned Vehicles

China independently developed autonomous vehicles—By the National Defense Science and Technology University independently developed the HQ3, July 14, 2011 for the first time completed from Changsha to Wuhan 286 km high-speed full-driving test. In the experiment, the red flag HQ3 unmanned vehicle to achieve 67 times overtaking, it is worth mentioning that the experimental road

conditions were fog, rainy complex weather. Baidu has started autonomous vehicle R & D program. and it is in the domestic leading position presently. According to plan, baidu unmanned vehicles can automatically identify traffic signs and traffic information by radar, camera, global satellite navigation and other electronic facilities, and install the synchronization sensor. Owners as long as enter the destination, the car can automatically travel to the destination [11]. During the process of driving, the car will upload traffic information via the sensing device, In a large number of data based on real-time location analysis, to determine the direction and speed of travel.

## 3. The Composition of Autonomous Vehicle

The autonomous system consists of vehicle borne radar, brain processing system, optical rangefinder, type sensor, frequency camera, brain database and so on [12]. It seems that every car manufacturer can say one thing according to his own ideas and can justify it. However, the contents of the above two maps are an important part of the autonomous car so far. If you do not want to know more about it, you only need to understand the two pictures, we can see in the picture above. For environment-aware video cameras, laser rangefinders, and vehicle-mounted radars, it is also possible to see miniature sensors for vehicle GPS navigation functions, as well as a computer database that assists drivers with planning paths. The Figure 1 shows only the most basic three systems, and the most important one is a planning and the decision system for sending and receiving vehicle data and control commands. Through this system, we can control the throttle, brake, and steering in the vehicle's motion system, as well as the functions of emergency braking, speed limit recognition, and automatic parking in the vehicle's assisted driving system.

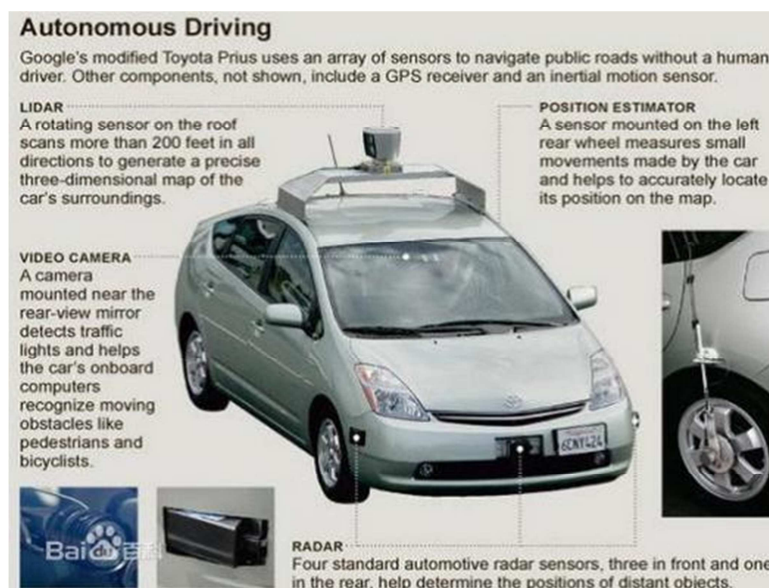


Figure 1. The basic systems of autonomous vehicle.

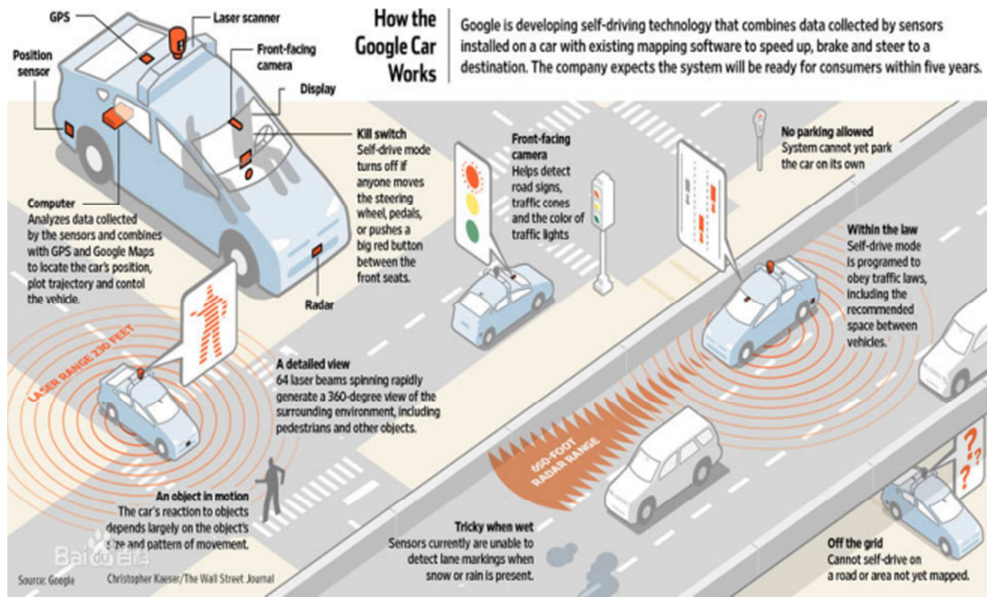


Figure 2. The work style of autonomous vehicle.

In the Figure 2, it is very clear to us that the recognition of the traffic environment on the road when the autonomous car is driving can be done on the pedestrian and on the road through the joint action of the vehicle radar, laser rangefinder, video camera, etc. Traffic conditions and traffic lights are resolved and appropriate responses are made. We can further formalize this summary: it uses on-board sensors to sense the surrounding environment of the vehicle, and controls the steering and speed of the vehicle based on the road, vehicle position, and obstacle information it perceives to make the vehicle safe. Reliable on the road. Combining automatic control, architecture, artificial intelligence, visual computing and many other technologies, it is a product of advanced development in computer science, pattern recognition and intelligent control technology. Through Baidu Encyclopedia,

we learned that autonomous technology is a comprehensive body of sensors, computers, artificial intelligence, communications, navigation and positioning, pattern recognition, machine vision, intelligent control and many other frontier disciplines. For enterprises, it is entirely possible to focus on a certain aspect of technology. Regarding the profitability aspect, purely to promote the development of autonomous technology, companies may be able to openly disclose their most proud technologies to other companies. About the composition of autonomous technology, we can use the following table. 1 to more vividly. Autonomous technology is an interdisciplinary and cross industry integrated technology based on information perception, information control and information execution [13].

Table 1. The composition of autonomous technology.

Environmental Perception Technology	The environmental awareness module is equivalent to the eyes and ears of an unmanned car. The autonomous car identifies the surrounding environmental information through its environmental awareness module and provides information support for its decision-making. The perception of the environment includes two parts: the position of the autonomous vehicle and the perception of the surrounding environment. According to the different objects measured by the environment perception system, we use two methods to detect: 1, radar and other active distance sensors 2, the visual sensor
Navigation and Positioning Technology	The navigation module of the autonomous car is used to determine the geographic position of the autonomous car. It is the support of the route planning and mission planning of the autonomous car. The navigation can be divided into two types: autonomous navigation and network navigation. Existing autonomous navigation can be divided into three categories: Relative positioning, absolute positioning, combined positioning Network navigation has a great advantage in navigation and positioning technology because map data is always up-to-date.
Path Planning Technology	The mission of path planning is to search for a collision-free path from the initial state including position and attitude to the target state in an environment with obstacles according to certain evaluation criteria. Path planning technology can be divided into two types: global path planning and local path planning: Global path planning is known for the surrounding environment Local path planning applies to situations where the environment is unknown
Decision-making control technology	The decision-making control module is equivalent to the brain of a autonomous car. Its main function is to make decisions based on the information obtained by the sensory system, and then to make decisions on the next step. Then control the vehicle. Decision-making techniques mainly include fuzzy reasoning, reinforcement learning, neural networks and Bayesian networks. Decision-making control system behavior is divided into reactive, reflective and integrated

## 4. Unmanned Vehicle Technical Support

It uses vehicle sensors to sense the surroundings about the road, vehicle locations and the constructions to steer or speed, allowing the vehicle to travel safely and reliably on the road. It is a product of computer science, pattern recognition and intelligent control. Not only a product about computer science, pattern recognition and intelligent control technology highly developed, but also an important symbol to measure the level about national scientific research and industrial. In the field of national defense and national economy has a broad application prospects. Autonomous technology is a combination of sensors, computers, artificial intelligence, communication, navigation and positioning, pattern recognition, machine vision, intelligent control and other cutting-edge disciplines.

### 4.1. Environmental Awareness Technology

The environment-aware module is equivalent to the eyes and ears of an autonomous vehicle, autonomous vehicles use environmental awareness modules to identify their surrounding environmental information and provide information to support for their behavior decisions. Environmental perception includes two parts of the autonomous vehicle's own position and the surrounding environment.

### 4.2. Navigation and Positioning Technology

The autonomous vehicle's navigation module is used to determine the geographical location of the vehicle, It is the support about path planning and mission planning, the navigation can be divided into two kinds of autonomous navigation and network navigation.

### 4.3. Path Planning Technology

The task of path planning is to find a non-trailing path from the initial state, including the position and attitude to the target state, in the context of an obstacle in accordance with a certain evaluation criteria. Path planning techniques can be divided into global path planning and local path planning:

Global path planning is targeted for the surrounding environment is known.

Local path planning is applicable to situations where the environment is unknown.

High precision map is an important auxiliary technology of autonomous vehicle, which enables the vehicle to know the direction and road ahead of the vehicle ahead of time [14].

### 4.4. Decision Control Technology

The decision control module is equivalent to the brains of a car, Its main function is based on the information obtained by the perception system to make decision-making judgments, then make decisions about the next step, finally to control the vehicle. Decision-making techniques include

fuzzy reasoning, reinforcement learning, neural networks and Bayesian networks. The behavior of the decision control system is divided into reactive, reflective and integrated. Reactive control is a feedback control, its form of realization is:

IF X1 is True and X2 is True.....and Xn is True THEN Y

Reflective control is a low-level behavior, used to make judgments about emergencies in the course of travel and respond quickly. Integrated control Add a machine learning module to the reaction layer.

## 5. The Development Prospects of Unmanned Vehicles

### 5.1. The Development Question of Autonomous Vehicles

Autonomous vehicles will strictly comply with the rules, coupled with the body covered with cameras, sensors, radar and ultra-fast response speed, There is no doubt that the accident rate will be greatly reduced (now 90% of the accidents are caused by the driver operating errors), but it is not a perfect driving. When there are three situations as shown in the following Figure 3.

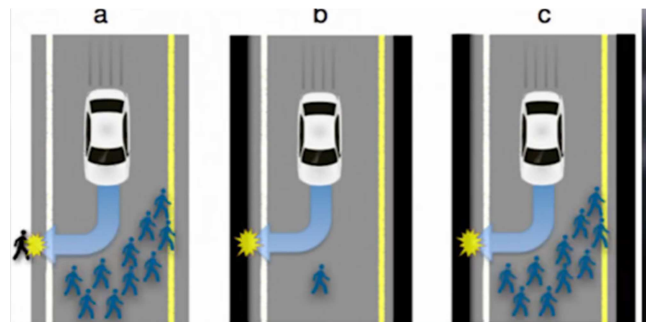


Figure 3. Three situations about the autonomous vehicle.

How to make decisions has been controversial. The human rights issue is not something that we can determine with simple mathematics. The number of people who choose to hurt is relatively less and harm other people. Although it is a controversial issue, there has been no single firm that has explicitly raised it, and it is feared that it will become a target of public opinion. Until this year, Mercedes-Benz decided to clarify it. Proposed, I believe this issue will give a reasonable solution in the near future.

They will also have accident, and even cause casualties, What happens if an accident occurs? owner? Automobile manufacturers? Failure parts manufacturing Or software company? Now we have a lot of real and legal issues need to be resolved, especially after the accident who is responsible for the issue. Many semi-automatic driving technology in the current car has been a large-scale popularity, such as emergency braking, cruise control, automatic parking and lane maintenance. But these are far from the real automatic driving. In some special conditions, such as rain, fog or snow,

the laser and the camera will become slow. Even Google has to admit that their autonomous vehicle in the potholes can't drive, and never tested in the snow. We can also imagine, if someone driving the car occupy the road, autonomous vehicle how to flee the crossroads in the peak period? Carrier system vulnerabilities allow hackers to take advantage of, they can even remotely control the brakes and steering. Hackers are attacking through digital audio broadcast radio signals.

### 5.2. The Opportunity of the Autonomous Vehicles

At present, the research direction of unmanned vehicle at home and abroad has three aspects as follows: (1) unmanned driving system under the ring of the expressway; (2) the unmanned driving system under the ring of the city; (3) the unmanned system under the special ring [15]. The industries about unmanned will account for a large share: Such as ADAS (Advanced Driver Assistant System) Vehicle interconnection terminals, sensors, navigation technology and human-computer interaction technology. Unmanned car is an intelligent mobile vehicle, it can replace the human driver to achieve a series of driving behavior. It involves the field of environmental perception, navigation and positioning, as well as intelligent decision control and other disciplines of research.

## 6. Conclusion

Autonomous vehicle is also called smart cars, unmanned autopilot, autonomous navigation or wheeled mobile robots, is important applications for outdoor mobile robots in the field of transportation. The Autonomous vehicle system is an integrated system that integrates environmental perception, automatic control, architecture, artificial intelligence, visual computing, planning and decision making. It is a vehicle system that takes full account of traffic lane and coordinated planning. It is also an important part of intelligent transportation system.

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