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The Development Obstacles and Correction Strategies of Intelligent & Connected Vehicles

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Abstract: *As the development of artificial intelligence has brought about great changes in the field of transportation, intelligent & connected vehicles have been playing an increasingly important role in the transportation and also show multiple values. But at the same time, it also exposes various obstacles, like difficulties in moral coding, lack of basic regulation, inherent technical defects, and unclear accident liability. It is urgent to solve them by setting up the industry self-regulation standard, establishing a comprehensive regulatory mechanism, setting up the industry self-regulation standard, improving the technical competence of self-control, establishing accident liability identification and imputation mechanism, and abandoning moral code. Finally, the healthy development of intelligent & connected vehicles can be realized.*

Keywords: *Artificial Intelligence, Intelligent & Connected Vehicles, Multiple Values, Development Obstacles, Correction Strategies*

I. Introduction

Under the strategic lead of Artificial Intelligence, intelligent & connected vehicles (the moving-wheel-type mobile robot) have subverted the usages of the traditional transportation industry. with the help of vehicle systems, it can have a deep perception of the complex and dynamic road environment, automatically plan traffic routes and control the car successfully reach the target place. A safe, convenient, efficient, and environmentally-friendly sharing travel mode can be composed of autonomous driving, intelligent control, and teleoperation. It is increasingly widely used in every aspect of social life like military, agriculture, fishery, transportation, and public entertainment, helping safe life, make less congested and less polluted road and finally make a better future for everyone.[1]

II. Multiple values of intelligent & connected vehicles

The business operation of intelligent & connected vehicles is still in the conceptual stage and only the primary technology, the representative of which is Autopilot of Tesla, began to infiltrate the mass market. But under the guidance that 'making everything controlled by the machine will bring a nice future', no matter giant enterprises, including upstarts of automobile industry like Google, NIO, and Tesla and traditional automobile enterprises such as Volkswagen, BMW, Mercedes Benz, and so on, or research institutions like Stanford, Tsinghua University, National University of Defense Technology, etc. all actively gathered in Ann Arbor testing area, Jiading testing area and other specific areas with complex road types and diverse traffic patterns. They try to eliminate all human interventions in the limited geographic fence to test and conclude the efficiency of cooperative awareness, cooperative decision making, and the control of development trend

when intelligent & connected vehicles are exposed in rare scenes. It has gradually shown important development benefits of intelligent vehicles that this industry is an important power to strengthen industrial innovation and to optimize the layout of a powerful country.

Under the effect of opening ideas of the comprehensive open-source research and development of artificial intelligence, intelligent & connected vehicles achieved the long-term development, seeming like that the black technology from science fiction films, such as *Knight Rider* and *I, Robot* has come true. For instance, the four-layer core technology platform of Baidu Apollo 1.0 makes it possible for developers to rapidly assemble an autonomous car belong to themselves within three days. BWM unites with Qualcomm to launch a version of AR (Augmented Reality) glasses which can make drivers see 'the navigation data, the driving speed, the speed limit and information of forks' after wearing them when driving. The biometric system of Continental AG can efficiently judge whether the driver is suitable to drive, as a result, the incidence of dangerous behaviors like driver fatigue, drug driving, and drunk driving can be reduced. With the help of the smart operating system, the Honda NenV concept car can have emotional communication with the driver. Intelligent cars showed multiple values during the process of developing, testing, and preliminary application.

2.1 Significant benefits in wide-area applications

The wide uses of intelligent & connected vehicles like unmanned rescue vehicles, unmanned disabled vehicles, unmanned patrol vehicles, unmanned agricultural vehicles, and unmanned distribution cars are beneficial to reduce the casualty of recusing workers, to reduce the labor cost, and labor intensity and to increase the work efficiency. JD has already delivered 10 unmanned distributions to Renmin University of China, Tsinghua University, Zhejiang University, and other universities, constructing a convenient and fast mobile nest. Another example is the successful application of autonomous driving in the mining area. The Australian mineral company Rio Tinto currently uses 73 driverless delivery trunks, continuously working in four mines 24 hours a day without break. The main reason for the $1.27 billion loss of Uber is the payments of drivers. Thus, David Keith, an assistant professor at MIT says that 'Autonomous cars offer a great opportunity for Uber'[2].

2.2 Serving as a typical model for sharing applications

The self-driving intelligent & connected vehicles, without manual intervention, have a great resource to optimize configuration spaces and promote the car industry to transform from based on personal ownership into a mode of sharing vehicle. Car sharing, basing the new digital consumption conception and consumption pattern that 'using but not buying', is beneficial to save a lot of manpower and material cost, to improve energy efficiency, and to save large areas of car parking spaces (the intelligent system can automatically park the car compactly and do not need to prepare door open space for drivers). Deloitte Consulting 'estimates that the cost could drop by two-thirds in a world of shared, self-driving vehicles'[3]. With the development of these sharing applications, the number of private cars will become less and will need fewer parking spaces. According to The Boston Consulting Group and the World Economic Forum, this mode would finally produce almost 50% more space.[4]Moreover, over the course of the lifetime of cars, 'shared cars will drive 500,000 miles—that's two and a half times more than the average privately-owned car'[5]. Thus, this mode will fully realize the value of vehicles.

2.3 Reducing the cost of trial and error correction

After embedding the intelligent system based on the deep learning algorithm, the automotive industry can strengthen the ability of scene recognition and object recognition and improve environmental sensing techniques like vehicle detection and tracking, evaluation of driving lane and pavement conditions, distance and speed detection, etc. Moreover, it makes every smart car can learn experiences from their own small probability errors and timely deliver it to other intelligent & connected vehicles. Thus, similar mistakes can be effectively avoided, and vehicle collisions and other traffic accidents can be greatly reduced. For example, the fully intelligent driverless car can detect whether the driving car is at risk of a blowout or spontaneous combustion through the OBD cloud. The cloud will push the solution to the user's mobile phone so that risks can be avoided in time. Nexar develops the AI-based driving record app to help users analyze road conditions to give early warnings on dangerous situations and to record accidents. Moreover, China Automotive Technology & Research Center Co. Ltd establish the autonomous driving scene database to solve basic common problems in the height of the whole industry. TOYOTA security system 'Guardian' can realize constant learning through driving experience and data sharing[6].

2.4 Breaking through old and complex driving operations

Smart cars can keep people away from old and complex driving operations and greatly reduce human errors. Thus, autonomous cars can increase driving safety and save time and energy. For example, the human brain needs 0.5-1.2 seconds to respond and then make the car brake, but Baidu's self-driving car only needs 0.2 seconds. BMW 7 Series installed the gesture control system, greatly facilitating the driver's interaction with the system during the driving process. BOSCH automated parking technology enables 'the driver to park the car in specified position only with the help of smart phone'.

III. Development obstacles of intelligent & connected vehicles

3.1 The difficulty of moral code for intelligent & connected vehicles

The autonomous car needs to code a large number of processing schemes for specific dilemmas and authorize the machine to make moral decisions that human beings haven't solved. For instance, Mercedes Benz decides its next generation of self-driving cars will be set to first save passengers in any case. Moreover, Tesla decides not to use its auto emergency braking system, but to hit pedestrians directly[7]. It means that algorithmic technology gives the privileged class the priority lane over other lives and will infringe the equal right to live for the general residents when facing a crisis. Thus, it is difficult to get the recognition of legislation and policy-making in civilized countries. However, if the car-makers decide to give priority to the greatest interests of the largest majority, they will lose a large number of users and the market will disappear.

3.2 Lack of basic regulation

On the one hand, in the main countries and regions, the traffic laws and regulations, the automobile industry standards, the technical framework, the derived traffic liability and relief mechanism, and the insurance claims system are based on the traditional driving industry. It is difficult to adapt to the vigorous development of the new technology of intelligent & connected vehicles and their application. *The Geneva Convention on Road Traffic* requires that 'Drivers shall at all times be able to control their vehicles'. In the *Law of The People's Republic of China on Road Traffic Safety* that the vehicles and personnel that can be allowed on the road do not include intelligent & connected vehicles. On July 5th 2017,

Robin Li, chairman of Baidu, took an autonomous car through the Beijing Wuhuan road to the 'Baidu Artificial Intelligence Developer Conference' and he get serious examination and treatment by the traffic management department. The large legal gap in intelligent & connected vehicles seriously hindered the whole industry's orderly development. On the other hand, the unified geodetic datum, elevation datum, depth datum, gravity datum, etc. set up and adopted in the *Surveying and Mapping Law of the People's Republic of China* are different from the geographical location information of the international coordinate system, which leads to the error between the navigation coordinates and actual coordinates. It may cause the judgment error of the road condition and cause the safety risk.

3.3 Inherent technical defects

Many participants of the intelligent & connected vehicle industry have actively carried out the security test under extreme scenarios, but small errors of the design scheme, sporadic omissions in the production process, the improper storage during the sales the unlawful operation in the actual use as well as the complexity and difficulty of the real traffic and road condition make that intelligent & connected vehicle in the test may threaten public safety if they come to the road. For example, the first killing case in the area of autonomous cars was caused by the Tesla car; The 'Toyota sudden acceleration case shows how bad code can kill'[8]; Moreover, GM caused 6 accidents of autonomous driving. The deep learning algorithm, an important core of intelligent vehicle technology, is 'the opinion expressed in the mathematical way or computer code'. Its design, purpose, success standard, data use and so on all have traces of artificial intervention. Human engineers coach machines rather than code them line by line, and the end result can be the question[9]. And in the subjective choice, developers often embed the defect or fuzzy information into the algorithm system because of their own bias. It leads to the error of the recognition and extraction of the massive data and then affects the accuracy of the algorithm.

3.4 Unclear accident liability

Drivers take responsibility for traditional traffic accidents by insurance or by themselves. However, with the development of intelligent & connected vehicles, people choose ride-hailing services over owning a car and no longer carry personal auto insurance[10]. In the absence of manual intervention, the accident responsibility of intelligent & connected vehicles will be taken by insurance or directly by manufacturers who produce or sell the hardware and software, making the risk from dispersed drivers to a small number of manufactures. For instance, the new bill of England regulates that even in the automatic driving mode, the accident loss of driverless cars will be borne by the insurance company and the victim can also be compensated; the final liability of the inartificial error will be shouldered by the manufacturer. This severely cracks down the research & development and the production power of autonomous vehicles.

IV. Correction strategies of intelligent & connected vehicles

Although *China Manufacturing 2015* has put forward the programmatic development planning of driverless cars, advocate to set up cooperative management mechanisms, clear the specific time points of various legislation and perfect supporting measures, it still doesn't form a specific correction strategy system. The orderly development of the intelligent & connected vehicle not only needs good top-level design and scientific planning but also needs a mechanism of coordinated promotion and linkage between traffic, public security, industry and information, geographical surveying, and other departments from aspects of policy guidance, legal norms and standardized operation. Thus, the technology can be developed without endangering public safety.

4.1 Perfecting the system of relevant legal norms

In recent years, many countries and regions that are forward-looking have begun to formulate legal norms on robot cars. For example, *Vienna Convention on Road Traffic* stipulates that 'Countries that have subscribed to the convention will need to agree on a new convention, or find other ways of accommodating the conception that a programmed machine may take over some of all of the functions of the driver'. The US Department of Transportation and National Highway Traffic Safety Administration jointly promulgated the *Federal Automated Vehicles Policy*, the first national automatic driving guideline, incorporating the supervision of automatic driving safety into the federal legal framework. Then, Nevada, California, Florida state governments have also issued relevant regulations one after another. Germany has established the quality standard and testing methods for the highly automated driving system, allowing autonomous driving to replace human driving under certain conditions. This kind of car is required not only to equip equipment that records all testing operation data but also to keep the steering wheel, throttle, brake, etc. Moreover, the driver should sit on the steering wheel so that he can control the car when in an emergency the first time. In addition, Germany's Legal Ethical Guidelines for driverless vehicles lists human life safety as the highest priority. The Ministry of industry and information and the National Standardization Management Committee of China jointly enacted the *Guideline for Developing National Internet of Vehicles Industry Standard System (Intelligent & Connected Vehicle)*, pointing out that the system of low and high-level automatic driving technical standards will be set up separately in 2020 and 2025.

The traffic legislation and responsibility system in each country are initially based on the drivers' fault or drivers' qualification. The traditional legislation is not suitable for the development of driverless cars. It is necessary to use innovative thinking to fill the loopholes in time and establish a whole system of rules to regulate the research and development, the application allowance and the quality management of autonomous cars, and processing method under specific situations. So that the safety and reliability of the intelligent & connected vehicles can be ensured from the source. Moreover, we should also improve relevant laws and regulations on road construction and safety to clearly deal with various situations and corresponding responsibilities after into the road.

4.2 Establishing a comprehensive regulatory mechanism

It is urgent to establish a unified and coordinated regulatory mechanism. And then we can avoid the short-board of the scattered supervision and clear the supervision methods and means of the central and local government, comprehensively supervise the development, testing, inspection, and licensing activities of intelligent & connected vehicles. Moreover, the mechanism should also regulate the road obstacle monitoring system, supervise the various measures for technical failure and ensure the application of the security method of the network system. As an example, basic principles of the *Guideline for Developing National Internet of Vehicles Industry Standard System (Intelligent & Connected Vehicle)*, which tries to ultimately build a safe, efficient, healthy and intelligent operated future automotive society, are 'conduct overall planning based on national conditions; basic and urgent agenda shall be prioritized; enterprises should play the major role to promote coordinated cooperation'. The Ministry of industry and information has drafted the first draft of the *Management Specification for the Verification of Public Road Adaptability of Intelligent & Connected Vehicles (Trial Implementation)* to regulate the application and audit process, the verification process management, accident responsibility and handling during the validation period[11].

4.3 Setting up the industry self-regulation standard.

Car-makers know the technology best, thus they should be allowed to set the standard by themselves. For instance, establishing a communication standard according to the DSRC scheme (Datang Telecom Technology) and LTE-V (HUAWEI) for the whole industry. China Industry Innovation Alliance for the Intelligent and Connected Vehicles cooperated with Chang An automobile, GM, Tsinghua University, and other units to formulate the '*Cooperative intelligent transportation system; vehicular communication; application layer specification and data exchange standard*', the first group standard in the V2X application level in China.[12] NHSTA released 'Automated Driving System: A Vision for Safety' and advocates self-regulation. In order to realize the territory of autonomous driving, Google, Uber, the automakers, and others involved with creating self-driving cars need to come together and create the industry self-regulation together[13] to realize the healthy development of autonomous driving.

4.4 Improving the technical competence of self-control

It is necessary to improve the adaptive driving rules in complex environments, and 'improve the real-time and effectiveness of rule acquisition in the complex environment'. In Wuhan, one of the big cities in China, there are many geomagnetic sensors, which can effectively detect vehicle flow and speed, and automatically optimize and adjust traffic lights at the crossing. As a result, they can help avoid traffic jams, reduce traffic accident rates and save resources[14]. At present, when vehicles in front break down, detect that the road is slippery or have an emergency braking, the V2X technology used in Cadillac CTS can broadcast the information to other Cadillac CTS cars within the maximum 300 meters range. In the future, the range to broadcast warnings will gradually expand. Ford's new cross-country technology system 'can detect obstacles in the environment, and even move over obstacles even under the driverless mode'. What's more, Google Waymo builds backup systems and redundancy mechanisms to deal with unforeseen circumstances.

4.5 Establishing accident liability identification and imputation mechanism

The imputation ideas of the intelligent and connected vehicles should be extended forward and should put emphasis on whether the operator has set the route, time, and hedging according to the operation specifications before the operation of the car. A Double-track liability mechanism ought to be used. Autonomous cars should compulsively equip the recording equipment to record the testing data and then we can use these data to clear the liability of traffic accidents. On 21 June 2017, Germany enacted a bill legalizing automated vehicles ('AV Bill'), which requires that 'automated vehicles must be equipped with a black box to identify whether the driver or the system had control at the time of an accident'[15] to help clear the accident liability. If the accident occurs under the circumstances of human driving, the driver will respond to it. If it happens because of the automatic driving system, the responsibility will be shouldered by smart chip designers, producers, sellers, etc. according to specific reasons. For example, if developers do not deliberately write illegal code and the car has been tested again and again before production, then the sudden traffic accidents of intelligent cars are unforeseen accidents. On 8 November 2017, in Las Vegas, the first unmanned bus collided with a cargo truck. It was determined that the main responsible person was the truck driver, and the driver was fined by the local police. In the first autopilot death case of Tesla, the driver ignored the visual warning from the system 7 times and did not take any measure to avoid the accident. Thus, NTHSA decided that Tesla has no safety defects and does not need to be recalled. When establishing the relevant responsibility identification system, the relation between the two situations should be fully balanced. If the liability laws are too punitive towards driver bots, then companies might avoid the sector entirely. On the other hand, if the laws leave car-owners on the hook for anything the gadgets do, consumers may be scared away from buying them.[16]

4.6 Abandoning moral code

By feeding the different valuation of his and others' lives reflected by the drivers' choice in simulated car accidents to the intelligent & connected cars, the cars will know 'the value that driver gives to his or her living relatives to the lives of others'[17] and will make a similar choice as the driver in the event of an accident. This method can avoid the unfairness caused by the moral set in advance. In addition, engineers should take their cues not from morals, but from the limits of technology, tort law, and consumers[18]. It is necessary to regulate it with laws. For example, Germany has drafted the world's first ethical guidelines for self-driving cars.

Conclusion

As the new entrance of the Internet of things, intelligent & connected cars can gradually realize convenient, comfortable, safe, efficient, and energy-efficient driving by improving the supporting facilities, constructing the cloud platform, and promoting the control technology. It has already become one of the most important parts of the artificial intelligence industry and attracted a large number of enterprises to participate around the world. However, at present, problems such as technical defects, legislation backwardness, ethical dilemmas, and so on restrict its development. It is urgent to realize a new leap at the technical level. Countries also need to improve the relevant laws and regulations to confirm the responsibility and supervise it so that the barbarous growth of technology can be avoided and the ethical dilemma can be solved. Moreover, it is necessary to create a positive and healthy development atmosphere by industry self-discipline, so as to solve all kinds of problems that are gradually exposed in the development process and build an intelligent network of intelligent network vehicles with high efficiency and positive development.

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