

Research status and future development directions of intelligent driving in China

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Abstract. As intelligent driving technology matures and gains market acceptance, its application has become widespread across China. This paper delves into the developmental journey of intelligent driving within the country, while also examining its inherent advantages and disadvantages. Currently, the predominant approach in China is the use of multi-sensor fusion solutions, which enhance sensing capabilities by combining information from various sources. However, this method is not without its challenges, including high implementation costs, limitations in processing complex environments, and vulnerabilities within the chip supply chain. The Chinese government's endorsement of smart driving car brands and technologies is escalating, reflecting a strong commitment to the sector. Public sentiment towards smart driving remains favorable, indicating a receptive market. Looking ahead, for China to maintain its momentum in the intelligent driving arena, it is crucial to pursue breakthroughs and innovations. Furthermore, fostering the integration of key industries with the driving sector will be essential to unlock new potentials and sustain competitive advantage in the global market.

Keywords: intelligent driving, chip supply chain, breakthrough innovation, intelligent vehicles

1. Introduction

With the increase in the number of motor vehicles, problems such as traffic congestion and frequent accidents have emerged frequently. Furthermore, the public's perception of the driving cockpit has evolved; it is no longer merely a traditional means of travel fulfilling basic functions such as driving and transportation. Instead, it has gradually transformed into an intelligent leisure and entertainment space, capable of expanding to meet the diverse material and spiritual needs of passengers [1]. With the rapid development of technologies such as artificial intelligence and sensors, the research demand for intelligent driving is constantly increasing.

The application fields of intelligent driving are very extensive. In the transportation field, functions of intelligent driving such as automatic parking and adaptive cruise can enhance the driving experience and safety when applied to passenger cars; when applied to commercial vehicles, they can optimize the logistics transportation efficiency and reduce labor costs; when applied to public transportation, they can improve the time accuracy of buses and subways arriving at stations and improve service quality. In special operation fields, intelligent driving can improve the accuracy of farming and harvesting in agriculture, be used for the transportation of minerals and other materials in industry, and carry out military reconnaissance and patrol. Nowadays, China has also made great progress in the highly potential intelligent driving field. The advancements in power battery technology within the "three-electric" domain have significantly enhanced the peak performance of motors. Additionally, the sales volume of automotive lidar produced by Hesai Technology, based in Shanghai, has experienced a sharp increase. Moreover, domestic automotive-grade chips, such as the Horizon Journey series, are rapidly gaining ground. Furthermore, intelligent driving systems like Huawei ADS 2.0 and XPeng XNGP have successfully achieved urban intelligent assisted driving capabilities, independent of high-definition maps [2]. In the future, the intelligent driving field in China will actively achieve breakthrough innovation, accelerate the breakthrough of a number of key core technologies, explore new models for going global, and accelerate the process of new energy transformation [2, 3].

This paper will analyze the evolution process of intelligent driving in recent years and speculate on the advantages and disadvantages of its development, so as to provide theoretical guidance.

2. Research and application status

2.1. Intelligent driving technology

As of today's intelligent driving technology, multi-sensor fusion solutions are mostly adopted for intelligent driving in China. Sensors such as lidar, cameras, and millimeter-wave radars are used to collect real-time environmental information around. The original data is processed via high-speed processing and fusion algorithms within the in-vehicle computer, enabling an accurate interpretation of the surrounding environment, identification of key targets, and detection of potential dangers. Ultimately, instructions are transmitted through the electronic control system to manage systems such as power, braking, and steering. However, the defects lie in the high cost of sensors such as lidar, the imperfect environmental processing of the in-vehicle computer in complex scenarios, and the supply chain risks of core hardware such as in-vehicle chips. Taking chip supply as an example, in terms of core chips for in-vehicle equipment and computing platforms, intelligent driving requires extremely high precision such as high computing efficiency, high real-time performance, and high reliability, but China lacks competitiveness in this field; in terms of artificial intelligence algorithm chips, foreign countries can reach a manufacturing process of 2 nanometers and lead in advanced manufacturing processes, while China still has deficiencies in this regard; in terms of communication and security chips, China still lacks chips that support automotive applications [4].

2.2. Market acceptance

In the domestic intelligent driving vehicle market, the sales data of some brands in 2024 demonstrate the development trend of the industry. In 2024, Li Auto delivered a total of 500,508 vehicles, XPeng delivered 190,068 vehicles, NIO delivered 221,970 vehicles, Leapmotor delivered 293,724 vehicles, and Deepal delivered 243,894 vehicles. It is worth noting that the cumulative delivery volume of XPeng in Europe has exceeded 10,000 vehicles, and Deepal has sold 1,800 vehicles in Southeast Asia. Although the remaining brands have not yet announced specific overseas market data, they are all actively promoting the globalization strategy and making all-out efforts to expand overseas markets.

It is not difficult to see from these data that the acceptance of intelligent driving vehicles in the domestic market is constantly increasing, and there is huge potential for future development. At the same time, the global market also shows a certain degree of recognition of Chinese-made intelligent driving vehicles. In fact, relevant surveys show that more than 90% [5] of the surveyed public have heard of intelligent driving, which fully reflects the positive role of technological progress and media publicity in the dissemination of the concept of intelligent driving. Currently, the public generally holds a positive attitude towards intelligent driving and is optimistic about its development prospects. To further promote the deep-rootedness of intelligent driving technology, China needs to continuously adhere to the support policies for intelligent driving and create a favorable market atmosphere. This not only contributes to the sustainable development of the domestic intelligent driving vehicle industry but also lays a solid foundation for its competition in the international market.

2.3. Government support

In recent years, China's support for intelligent driving vehicle brands and technologies has shown a continuous upward trend. At the national strategic level, a series of important strategic plans, such as the "14th Five-Year Plan for Digital Economy Development" and the "Innovation Action Plan for the Development of Intelligent Vehicles (2019 - 2022)", have all listed industries related to intelligent driving vehicles as key development areas. These plans not only clarify the development goals of the intelligent driving vehicle industry in the coming period, but also formulate detailed and operable roadmaps, providing clear guidance and directions for the development of the industry. From a macro perspective, they ensure that the intelligent driving vehicle industry can steadily advance on the right track.

In terms of fiscal policies, the Ministry of Finance has issued a series of targeted notices and implemented substantial tax reduction and exemption policies for enterprises in the intelligent vehicle industry chain. This measure directly reduces the operating costs of enterprises, effectively alleviates the financial pressure on enterprises, enables enterprises to invest more funds in R & D innovation and production operations, and significantly improves the profitability and R & D investment capabilities of enterprises. It provides a solid financial guarantee for the technological breakthroughs and product upgrades of the intelligent driving vehicle industry.

The education sector has also actively responded to the country's support for the development of the intelligent driving vehicle industry. Many universities have successively opened majors closely related to intelligent driving, such as intelligent science and technology, vehicle engineering and other majors. The curricula of these majors cover multi-disciplinary knowledge involved in intelligent driving, such as artificial intelligence, sensor technology, vehicle dynamics, etc. Through systematic teaching and practical training, a large number of professionals have been transported to the field of intelligent driving, injecting a continuous stream of new forces into the sustainable development of the industry. From the perspective of talent reserve, it provides strong support for the long-term development of the intelligent driving vehicle industry.

From the perspective of future development directions, in order to achieve rapid development on a global scale, China's intelligent driving must emphasize breakthrough innovation [3]. On the one hand, it is necessary to emphasize the integration of key fields such as artificial intelligence with the driving industry, advocate the coordinated development of intelligent transportation, promote the deep integration of transportation tools and intelligent transportation systems, and achieve more accurate traffic flow regulation and collaborative driving. Conversely, it is imperative to acknowledge the significance of traditional factors, such as funding [6], and to consider the experiences of other nations. Additionally, attention must be given to the variances and influencing factors at each stage, which arise due to the long-term and complex nature of intelligent driving development.

3. Conclusion

This paper centers on the advancements and challenges in the field of intelligent driving within China. The burgeoning demand for intelligent driving solutions has been fueled by persistent traffic issues, the evolving concept of the driving cockpit, and rapid technological advancements. Consequently, significant strides have been made in this domain. However, the prevalent adoption of multi-sensor fusion technologies in domestic intelligent driving systems is accompanied by challenges such as high costs, inadequate performance in complex environments, and vulnerabilities in the chip supply chain.

Sales data from various brands in 2024 illustrate a growing acceptance of intelligent driving vehicles in the domestic market, complemented by a certain level of recognition on the international stage. Public sentiment towards intelligent driving remains positive. At the national level, strategic plans have been formulated to delineate clear development goals and roadmaps for the industry. Fiscal policies, including tax reductions, are in place to provide financial backing, while the education sector has introduced relevant majors to cultivate a skilled workforce, thereby offering comprehensive support for the growth of the intelligent driving vehicle industry.

Looking forward, for China to lead the global charge in the rapid development of intelligent driving, a focus on breakthrough innovations is imperative. The integration of key sectors with the driving industry should be prioritized, and the role of traditional elements should not be overlooked.

It is acknowledged that this paper provides a specific analysis rooted in the domestic context but falls short in fully integrating global market perspectives. The analysis and predictions presented are relatively superficial and require more thorough consideration. Future research will aim to conduct a more comprehensive analysis, with the goal of offering more valuable theoretical guidance to facilitate the steady development of China's intelligent driving industry in both domestic and international markets.

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