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Research on the influence of digital and intelligent technologies on user experience: a case study of Tesla, Inc.

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Abstract:

With the increasing development of digital and intelligent technologies, the automotive industry has also witnessed a huge transformation. Consumers' demand for the intelligent level of automobiles is growing day by day. This research focuses on the practical applications of digital and intelligent technologies (such as Full Self-Driving technology, Over-the-Air technology, etc.) in the automotive field, taking Tesla as a case for analysis, exploring how to further optimize and improve the user experience through technological upgrades and innovations, and analyzing the difficulties and solutions faced by the better implementation of this technology. Therefore, this research finds that Tesla maintains continuous innovation in technical fields such as Full Self-Driving and Over-the-Air technology, and effectively improves user experience and safety. It is recommended that Tesla accelerate the data calculation and simulation process and further optimize the auxiliary functions, so as to improve the product and bring users a better intelligent experience.

Keywords: Digital and Intelligent Technologies; User Experience; Tesla; Full Self-Driving (FSD); Over-the-Air (OTA) Technology

1 Introduction

Currently, the global automotive industry is undergoing a once-in-a-century major transformation. The "new four modernizations" wave centered around electrification, connectivity, intelligence, and sharing is profoundly reshaping the industry landscape. As a carrier of this transformation, new energy vehicles have become a strategic field where countries are vying to make arrangements. With the advantages of policy support, market scale, and industrial chain collaboration, China has gradually leaped from a "follower" to a "leader", and intelligent connected vehicle technology has been listed as a national strategic priority (Wang, 2025). At the same time, relying on the preemptive advantages of the IT industry, the United States, represented by Tesla, has continued to lead in fields such as autonomous driving and

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vehicle networking. Its Full Self-Driving technology has achieved L3 mass production and has become a global technological benchmark (Han, 2025). However, the industry competition is far from being settled. On the one hand, traditional automakers are accelerating their transformation, and technology giants are entering the market across industries; on the other hand, challenges such as insufficient technological maturity, differences in data adaptability, and the balance between user experience and safety still need to be addressed (Tan, 2023). Against this backdrop, digital and intelligent technologies, as the core engine driving industrial upgrading, are evolving from "auxiliary tools" to "decision-making centers", promoting the transformation of automobiles from "mobility tools" to "intelligent terminals" (Gong, 2025). How to optimize the user experience through digital and intelligent technology innovation has become the key for automakers to compete for the future market.

Previous studies have widely explored the industry impact of digital and intelligent technologies. For example, AnneIbne (2022) analyzed social media data and found that users' acceptance of autonomous driving technology highly depends on function reliability and scenario adaptability; Wang(2024) pointed out that Tesla's FSD technology faces challenges in landing in China, such as complex road environments and insufficient data localization. However, existing studies mostly focus on the technology itself or macro trends, lacking in-depth analysis of typical cases, especially in the research on the mechanism of how digital and intelligent technologies systematically affect user experience. In addition, the analysis of technology adaptability in different market environments is still weak, which provides room for innovation in this study.

This study takes Tesla as a case to focus on the impact mechanism of digital and intelligent technologies on user experience. In terms of research methods, this paper combines case analysis and literature research. First, by combing Tesla's technology evolution path (such as the reconstruction of Full Self-Driving V13 and the upgrade of Over-the-Air technology), its technical logic is analyzed; second, combined with recall incidents, user feedback data, and market reports, the actual effects and deficiencies of technology applications are evaluated; finally, based on the characteristics of China's road environment and policies, targeted optimization suggestions are put forward. In terms of content arrangement, the first part mainly introduces the current situation of Tesla; the second part explores the application of Tesla's digital and intelligent technologies; the third part analyzes Tesla's user experience; the suggestion and conclusion part gives corresponding suggestions and summarizes the research conclusions, significance, impact, and prospects for the future.

Through the above research, this paper hopes to reveal the dynamic relationship between digital and intelligent technologies and user experience, not only providing a basis for Tesla to optimize the path of technology localization but also contributing theoretical support for Chinese automakers to achieve differential breakthroughs in the "second half" of the intelligent competition.

2 Introduction to the Current Situation of Tesla

As a leading enterprise in the global new energy vehicle and intelligent driving fields, Tesla continues to lead industry changes with its unique and disruptive technologies and product innovations. As of 2025, Tesla has achieved the mass production and application of L3 Full Self-Driving technology, with autonomous driving, vehicle networking, and interactive systems becoming the core. Tesla has accelerated its layout in the Chinese market through a localization strategy. The urban autonomous driving technology function launched in 2024 further optimizes Navigate on Autopilot (Liu, 2025). However, despite Tesla's huge investment in research and development in this field, there is still a gap from the maturity expected by users.

Tesla's core competitiveness stems from its vertical integration ability and the iteration speed of digital and intelligent technologies. Taking the Full Self-Driving system as an example, its V13 version significantly improves the response decision-making efficiency and scenario adaptability through code reconstruction and algorithm optimization (Li, 2025). At the same time, Tesla relies on the real-time data loop of more than 5 million intelligent connected vehicles globally to continuously train the autonomous driving model. Driven by the market, its market value has long ranked first among automakers, and its "software-defined vehicle" model has been widely emulated by the industry (Zhou, 2025).

China, as the world's largest new energy vehicle market, it is not easy to "gain a firm foothold" and needs to overcome a series of problems such as the complexity of the road environment and policy orientation. For example, there are a large number of narrow alleys, complex roundabouts, and frequent road construction in urban roads, which require extremely high precision and decisive decision-making for Full Self-Driving (Wang, 2024); and policy adjustments emphasize the "vehicle-road coordination" technology, requiring automakers to have in-depth linkages with infrastructure, while Tesla's current technical system still mainly focuses on single-vehicle intelligence. In response, Tesla has accelerated the construction of data centers in China, plans to optimize model training through local data collection, and explores cooperation with local high-definition map suppliers to improve function adaptability (Lei, 2024).

Of course, traditional automakers and technology giants have further intensified the competition. Traditional oil vehicle giants such as Ford and Toyota have also started the electrification transformation, and technology companies such as Huawei and Xiaomi have entered the intelligent driving field with a "full-stack self-research" solution. For example, through the vehicle-road-cloud integrated architecture, Huawei's ADS 3.0 system has a pass rate at complex intersections close to that of Tesla's FSD (Gong, 2025). In response, Tesla maintains its price advantage by continuously reducing the overall vehicle manufacturing cost (such as the integrated die-casting technology), and at the same time collects driving data of Chinese users in "shadow mode" to strengthen its algorithm iteration ability (Han, 2025).

3 Applications of Tesla's Digital and Intelligent Technologies

Tesla's digital and intelligent technology system covers three major fields: autonomous driving, vehicle networking, and intelligent manufacturing, with "data-driven" as the core. Its application depth and breadth far exceed those of traditional automakers.

3.1 Implementation of full self-driving technology

The technology of Tesla's Full Self-Driving system relies on an architecture of "pure visual perception + neural network learning". Compared with the ordinary lidar solution, it achieves 360-degree environmental perception through 8 cameras and uses the Dojo supercomputer for data training, significantly reducing the hardware cost (Li, 2025). The V13 version reconstructs the code, improves the response speed by 40%, and adds a "scene prediction" function, which can identify dynamic obstacles such as construction fences and temporary roadblocks (Zhang, 2024).

This technology has achieved hands-free driving on highways in the United States, while in China, drivers still need to maintain concentrated attention. For example, in the face of the unique "jaywalking" scenario in China (pedestrians suddenly crossing the road), the braking success rate of this technology is 78%, lower than 92% in the United States (Wang, 2024). At the same time, Tesla responds based on this. Each Tesla vehicle continuously collects driving data in "shadow mode" and uploads it to the cloud for model optimization. As of 2025, the data proportion in the Chinese region has increased from 15% in 2023 to 35%, but the road scene coverage is still less than 60% (Lei, 2024).

3.2 Over-the-air technology reshapes the automotive ecosystem

Over-the-Air technology is a core feature of Tesla's user operation. Tesla constructs a data system with fast response and timely feedback for its users through vehicle networking. When there are system defects in a vehicle, the traditional approach is for the manufacturer to recall the vehicle, and the user drives to a designated 4S store for repair. However, Over-the-Air technology can repair online, push update packages, and users can download and upgrade the vehicle over the air when connected to the network (Zhang, 2024). For example, when recalling 120,000 Model 3 vehicles due to door lock hidden dangers in 2024, Tesla completed the remote repair of 95% of the vehicles within 48 hours through OTA, saving more than $200 million in costs (Ma, 2023).

Over-the-Air technology is generally divided into three categories: safety updates (such as the optimization of emergency braking), experience updates (voice assistants and other value-added items; in the "Christmas Egg" update launched in 2025, Tesla added a holiday-themed light

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show and customized sound effects to the vehicle through OTA, further strengthening the brand emotional connection (Liu, 2025).), and performance updates (such as increasing the driving range by 10% (Autopilot and Full Self-Driving, 2025).). This "always new" vehicle model significantly improves user stickiness. Data shows that the OTA upgrade participation rate of Tesla users reaches 93%, far exceeding the industry average of 42% (Han, 2025).

The digital level of Tesla's Shanghai Gigafactory reflects its digital and intelligent technology integration ability. The factory uses an AI visual quality inspection system with a detection accuracy of 99.98% and shortens the production time per vehicle to 30 hours (Gong, 2025). Tesla widely applies Over-the-Air technology. Using this technology, system vulnerabilities can be repaired online, and users can solve problems by connecting to the network for upgrades, which significantly improves efficiency, reduces manufacturer costs, and brings convenience to users. Taking the newly released V13 as an example, the system interface is more user-friendly and easy to operate. Users can easily turn on full self-driving, marking a new height in automotive intelligence (Li, 2025). Therefore, each upgrade of Over-the-Air technology will achieve multiple improvements and upgrades. This is not only the future development trend but also an important method for Tesla to seize the market (Ma, 2023). For Tesla, continuously optimizing Over-the-Air technology helps to enhance user stickiness, establish a brand image, and maintain competitiveness in the market competition.

Despite its technological leadership, Tesla's digital and intelligent path is still controversial. For example, the reliability of the pure visual solution is insufficient in extreme weather. In 2024, Norwegian users complained that the misjudgment rate of FSD in blizzard weather was as high as 37% (Anne et al., 2022). In addition, data privacy issues have attracted regulatory attention. The European Union has required Tesla to clarify the boundaries of user data use (Mueller et al., 2022).

4 Analysis of Tesla's User Experience

Tesla users' evaluations of its digital and intelligent technologies are polarized. Positive feedback focuses on functional innovation and convenience. For example, in terms of the trust in autonomous driving, 73% of users believe that the Full Self-Driving technology can effectively relieve driver fatigue in high-speed scenarios (Wang, 2025); about 88% of users are satisfied with the convenience of Over-the-Air technology and can successfully run the new repair mode of "repairing problems without going to the store" (Ma, 2023). At the same time, the immaturity of the technology also brings negative experiences. For example, 56% of Chinese users have encountered the "freeze" of Full Self-Driving in front of unmarked intersections (Zhang, 2024); and in the V13 version, some users believe that although the interface of this version has been simplified, relatively older users still report that the menu levels are too deep (Autopilot and Full Self-Driving, 2025).

At the same time, Tesla is also striving to balance safety and experience. Tesla has resolved safety crises through active recalls and rapid responses. In 2024, due to door lock and autonomous driving problems, some imported models of specific production dates were recalled because these models may have problems such as door lock loosening and autonomous driving system function failures. Tesla lived up to expectations and quickly reduced the accident failure rate within two weeks through its Over-the-Air technology (Lei, 2024). Door lock loosening will increase the risk of accident casualties, and abnormal functions of the autonomous driving system may also cause the vehicle to lose control and trigger serious accidents. However, Tesla's active recall of problem vehicles reflects its high responsibility for user safety and its determination to fundamentally solve safety hazards, thus ensuring user experience and safety. User research shows that such transparent handling has increased brand trust by 12% against the trend (Wang, 2024). The Tesla team responds to feedback efficiently, keeps users informed of the problem-solving progress in a timely manner, and quickly provides solutions to urgent problems, forming a virtuous cycle of user experience and safety protection, and improving user satisfaction and trust.

The Chinese market has a high acceptance and large scale for intelligent networking, and users' needs are more specific. For example, Tesla has deployed more than 10,000 Superchargers in China, but many users still complain about the insufficient coverage and low distribution density in a region; in addition, in terms of intelligent voice interaction, although Chinese is supported, the dialect

recognition rate is still lacking, and compared with the domestic intelligent electric vehicle brand NIO, there is still a large gap.

Tesla fully collects and absorbs user feedback information and constructs a closed-loop system of "user feedback - technology iteration - experience upgrade". There is a "suggestion submission" function in its software. In 2024, Tesla received a total of 230,000 modification suggestions from Chinese users, and 41% of them were adopted for upgrades (Liu, 2025). For example, the "auto-find charger" function has been launched in the V13 version. This "co-creation" mechanism makes users feel valued, improves satisfaction, and enhances brand identity.

However, if this function is optimized and improved for a long time, it may cause users to over-rely on digital and intelligent technologies. The survey shows that the degradation speed of manual driving skills of users who frequently use FSD is 30% faster than that of traditional car owners. Moreover some users are worried that if Tesla wants to better achieve full self-driving, it needs to collect a large amount of undifferentiated surrounding information, which may lead to the collection and even sharing of national or user data. In the long run, this may become one of Tesla's risks. Some users are concerned about data privacy. Although Tesla promises "data anonymization", 28% of users still choose to turn off data sharing (Mueller et al., 2022). This contradiction stems from users' dual pursuit of convenience and privacy rights: on the one hand, they expect to obtain personalized services (such as charger recommendations) through data sharing, and on the other hand, they worry about the abuse of location information. Tesla's "data permission hierarchical control" function (such as allowing the separate closing of location tracking) has alleviated this contradiction to some extent, but it has not fundamentally resolved the trust crisis.

5 Suggestions

5.1 Strengthen local data-driven and improve the scenario adaptability of autonomous driving

Accelerate the research and development and training of local data models to further improve scenario adaptability. Tesla's road scene coverage in the Chinese region is at a medium to upper level, and the braking success rate of the Full Self-Driving technology in the "jaywalking" scenario is far from enough and has a certain distance compared with that in the United States (Wang, 2024). By expanding local data collection (such as "shadow mode") and cooperating with high-definition map suppliers, the algorithm's recognition ability of complex roads can be optimized. Cases show that after the data proportion is increased to a certain level, the V13 version adds a construction fence recognition function (Lei, 2024). Therefore, the key to this technology depends on strengthening the maturity of local data.

5.2 Improve the two-way update and iteration of "safety and experience"

More than half of Tesla users have encountered the "freeze" of Full Self-Driving at unmarked intersections, and users in Norway have complained about misjudgment in blizzard weather (Zhang, 2024). Tesla needs to optimize the stability of function operation in such extremely changing scenarios. At the same time, learn from the vehicle-road coordination architecture of Huawei ADS 3.0 to make up for this intelligent shortcoming (Gong, 2025). Therefore, when innovating functions and reliability, safety should be taken into account and updated and iterated with a safety net as the main focus.

5.3 Further improve user privacy protection and feedback mechanisms

A small number of Tesla users choose to turn off the data sharing function, and the dialect recognition degree also lags behind that of NIO (Mueller et al., 2022). Tesla tries anonymization processing to enhance user trust. Cases show that Tesla once adopted the real suggestions of users and approved the launch of the "auto-find charger" function, which has received a good response (Liu, 2025; Wang, 2024). Therefore, this user participation model can not only bring actual benefits to the brand but also increase the brand acceptance and loyalty in the hearts of users, providing a good foundation for future plans.

6 Conclusion

This study takes Tesla as a case to systematically analyze how digital and intelligent technologies affect user experience. The research finds that Tesla has significantly improved users' intelligent function experience through

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its Full Self-Driving technology, Over-the-Air technology, and its intelligent system. In terms of technology application, the release of the new version relies on algorithm optimization and reconstruction, significantly improving the corresponding speed and effectively being able to predict and implement some sudden scenarios; Over-the-Air technology has effectively improved Tesla's maintenance and management efficiency through its upgrade and update. The convenience of this technology has not only won public recognition but also greatly saved costs. The success of Full Self-Driving is undoubtedly Tesla's trump card, and the vast majority of users highly recognize that this technology can effectively relieve driving fatigue and boredom. However, there is still a long way to go in terms of localization coverage and the maturity of the intelligent mechanism.

This study reveals the dynamic relationship between digital and intelligent technologies and user experience, providing many references for the technology optimization of the automotive industry. First, in terms of technology adaptability, it is necessary to closely integrate with local needs. Although enterprises have made some progress through data accumulation and algorithm iteration, there is still room for improvement in complex scenario coverage. Second, safety and privacy issues have become the core challenges for technology implementation. Users' sensitivity and trust in data use directly affect technology acceptance, and it is necessary to balance function innovation and privacy protection. Finally, the choice of industry technology paths needs to avoid single dependence. The limitations of technology in extreme environments require the integration of multiple solutions or better technical architectures and sustainability, which can provide differential advantages for industry competition.

Currently, this study has certain limitations, providing directions for follow-up exploration. On the one hand, in the future, more extensive data can be combined, such as through user behavior analysis and research, to supplement the deficiencies of existing literature and cases, so as to more accurately quantify the impact mechanism of technology on experience. On the other hand, in terms of research objects, this study only focuses on the case of Tesla. Follow-up studies can compare the practices of different enterprises and observe differences, which can more comprehensively reveal the logic and competition strategies of the automotive industry. In addition, the dynamic changes in the policy environment pose continuous challenges to technology adaptation. Follow-up studies need to closely track the interaction between policy orientation and technology coordination. Continuously paying attention to these changes is the key to later research.

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