

Analysis of the Application of Artificial Intelligence in Transportation

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Abstract: With the advancement of the information age, the transportation industry has experienced rapid growth, leading to an expansion in the scale and number of highway constructions. However, this development has also given rise to numerous traffic issues, including frequent vehicle congestion and traffic accidents. To address these problems, it is essential to leverage modern technology for real-time information collection and analysis, providing robust technical support for intelligent transportation systems. This paper focuses on artificial intelligence (AI) technology, explaining its concept and its role in intelligent transportation. It reviews the various application areas and analyzes the use of AI in intelligent transportation. Finally, it proposes strategies for applying AI to promote the healthy development of intelligent transportation systems.

Keywords: Artificial intelligence; Intelligent transportation; Traffic monitoring; Unmanned driving

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1. Introduction

Currently, China's infrastructure construction is continuously improving, and the transportation network is becoming increasingly interconnected. However, traffic problems are also becoming more severe. To effectively address these issues, it is essential to increase investment in urban traffic management, utilizing advanced technologies to support transportation development. Instead of implementing restrictions as the solution to these problems, there is a need to implement intelligent transportation systems. By applying these systems to various areas of traffic management, operational efficiency can be improved, providing safe and convenient travel conditions for the public^[1]. The construction of intelligent transportation aims to enhance transportation efficiency and ensure safe and convenient travel by integrating advanced technology across different areas of traffic management.

2. Artificial intelligence and intelligent transportation concepts

2.1. Connotation of artificial intelligence

Artificial intelligence is based on the theories of human intelligence and neural networks, aiming to replicate

human cognitive processes through advanced technological systems. In China, artificial intelligence is widely applied and integrated with various disciplines and technologies, creating a multifaceted technological landscape. Presently, artificial intelligence can highly simulate human thought and activities, addressing challenges that traditional methods and machines cannot solve. Current AI applications primarily focus on language processing and information acquisition. Additionally, AI is progressing into the deep learning phase, poised to significantly impact various fields as development continues ^[2].

2.2. Definition of intelligent transportation

In view of the current scale of urban transportation in China, intelligent transportation has become an important development trend in the transportation industry as it addresses many problems in transportation ^[3].

3. Application areas of artificial intelligence in intelligent transportation

3.1. Driverless vehicles

Under the background of the information age, artificial intelligence technology has been developed rapidly and gradually applied to various fields. One notable application is the development of self-driving cars, which are advanced vehicles powered by artificial intelligence technology. While similar in appearance to conventional cars, self-driving cars differ significantly in their operation, as they can drive autonomously without human intervention. These vehicles utilize intelligent technology to follow predetermined instructions, ensuring rationality in their routes and improving driving efficiency through sophisticated information acquisition and processing.

3.2. Intelligent traffic command system

The traffic command system is crucial for ensuring smooth transportation operations and requires stringent technological standards. Intelligent transportation systems can enhance traffic management by collecting and analyzing data from traffic routes. Artificial intelligence can monitor multiple intersections simultaneously, summarize traffic information, and provide real-time feedback to drivers through methods like voice broadcasts and display screens ^[5]. This enables drivers to adjust their routes promptly, helping to alleviate traffic congestion. Additionally, can be integrated into traffic intersection robots to manage traffic signals based on real-time conditions. These robots can also record traffic violations and upload the information to the internet, improving the efficiency of law enforcement and reducing the burden on traffic police. Furthermore, intelligent pass lights and voice prompts can be installed at intersections to remind pedestrians to follow traffic rules, contributing to overall traffic safety and efficiency.

3.3. Traffic monitoring system

The application of intelligent technology in intelligent transportation not only records traffic violations but also enables real-time collection of traffic data by monitoring intersections. This approach significantly reduces the need for manual traffic management, thus lowering associated costs and simplifying traffic oversight. Traffic managers no longer need to be constantly present at intersections, easing the burden of traffic control. Additionally, intelligent technology can transmit information to the traffic command center, allowing for timely intervention in emergencies, such as tracking hit-and-run vehicles ^[6]. Moreover, by capturing data on vehicle frequency and movements at intersections, intelligent technology facilitates the optimization of traffic signal timings. This data-driven approach ensures better allocation of traffic control resources, enhancing overall traffic efficiency.

3.4. Electronic toll collection (ETC) system

The development of artificial intelligence (AI) technology has led to the creation of various technical frameworks, including cloud computing, visual recognition, and data acquisition and storage. These technologies can be effectively integrated into the toll collection systems of intelligent transportation. For instance, the implementation of the ETC system allows vehicles to pass through toll stations without stopping, as the system automatically identifies the vehicles and processes the charges via the ETC device installed on them ^[7]. Additionally, the system can record details such as the vehicle's model and color. In cases of toll evasion, the system triggers an alarm, prompting staff to intervene and request payment from the vehicle owner. Although the current ETC system has some shortcomings and instances of toll evasion, it significantly enhances operational efficiency at toll booths and is generally well-received in its applications.

4. Problems in the application of artificial intelligence in transportation

The application of artificial intelligence in transportation is still in its early stages and faces several challenges and deficiencies. These include imperfect data quality control, insufficient interaction between systems, and unscientific technical environment settings. These issues hinder the development and effectiveness of intelligent transportation systems.

4.1. Imperfect data quality

In the context of China's current intelligent transportation construction and development, the application of big data technology is continuously improving and is being increasingly integrated into various traffic management tasks, forming an initial smart management model. This includes managing traffic violations and traffic commands. These technologies rely on sensing and detection equipment. However, despite these advancements, there are still many challenges in the application and management of big data. The quality of the collected data and information often falls short of the requirements for intelligent transportation planning, leading to unscientific traffic management practices.

4.2. Poor system interactivity

System interaction is the main form of technical expression in the application of artificial intelligence technology. The implementation of intelligent transportation systems in traffic management can achieve comprehensive coverage of traffic information, ensure a wealth of management data, enhance interaction and communication between traffic management departments, and facilitate the sharing of traffic information. However, current transportation management faces challenges. Once intelligent transportation facilities are constructed, their subsequent use and maintenance are often inadequate. This results in superficial implementation, making it difficult to apply these systems to daily transportation management. The lack of interactivity also hampers the efficiency of transportation planning, preventing intelligent transportation from fully realizing its operational advantages ^[8].

4.3. Unideal technical environment

As information technology continues to advance, including intelligent technology, big data, cloud computing, and other technical means, the requirements for the technological environment are also evolving rapidly. In the realm of intelligent transportation, these advancements introduce new demands, particularly in enhancing data mining capabilities within traffic management. This is crucial for accurately predicting road conditions and optimizing the operation of intelligent transportation systems ^[9]. However, from the current operational

perspective of transportation in China, artificial intelligence technology has not yet found a robust application space. There are challenges in fully leveraging its technical advantages.

5. Application strategy of artificial intelligence in transportation

5.1. Optimizing the design of the intelligent system

The application of artificial intelligence in intelligent transportation systems requires a systematic approach to optimize the top-level design of information technology. Establishing a scientific management system is essential to create an effective environment where intelligent technology can fully function. Innovative management methods are crucial in the construction of intelligent transportation to ensure efficient traffic management. As the core entity responsible for traffic management, the government must assume corresponding responsibilities. This includes comprehensive transportation planning, optimizing the organization and coordination of traffic management efforts, and fostering the healthy development of intelligent transportation systems. In planning, designing, and managing intelligent transportation, attention should be given to constructing various transportation infrastructures and supervising transportation operations. Furthermore, strengthening the formulation and enforcement of relevant laws and regulations is vital. This legal framework provides a solid foundation for applying intelligent technology in managing intelligent transportation effectively. Government departments should take the lead in information technology construction and data integration, establishing dedicated teams for network security management to support e-government initiatives. This approach will facilitate the implementation and utilization of intelligent technology across transportation management systems.

5.2. Establishing anti-unlicensed vehicles and anti-fee evasion linkage

The application of intelligent technology in the development of intelligent transportation systems offers several benefits, including enhancing information collection, facilitating data sharing among relevant departments, and providing a foundation for effective traffic management. By constructing an information management platform, intelligent transportation can achieve centralized management, which is essential given the modern transportation industry's vast scale and rich data sources. However, managing the rapid growth and large storage requirements of data and ensuring its security and efficiency are critical challenges. For instance, in toll management, intelligent transportation systems can establish networked connections between transportation departments, public security departments, and urban management authorities. This integration enables comprehensive management actions when vehicles evade tolls or when criminals attempt to flee. The intelligent platform allows traffic management departments to record incidents like toll evasion or criminal activities and share this information seamlessly across platforms. This collaboration mobilizes multiple forces to locate and intercept offenders, thereby leveraging a synergistic effect. Moreover, the information recorded on the platform can automatically generate records, which may impact the credit records of responsible individuals, enhancing deterrence against misconduct ^[10]. Furthermore, in transportation road design, the intelligent traffic management platform facilitates information sharing and online communication among departments such as land management, urban planning, and public security. This collaboration enhances the design of traffic models by incorporating diverse opinions and suggestions. By breaking down traditional information silos, intelligent technology enables the automatic synthesis of collected data to propose optimized traffic design solutions.

5.3. Enhancing intelligent safety awareness

The application of intelligent technical means in intelligent traffic management presents significant challenges

due to an insufficient understanding of intelligent technology and operational abilities among personnel, coupled with a lack of an intelligent management mindset. Relying solely on traditional platforms and hardware/software facilities limits the stable development of intelligent transportation systems. To overcome these obstacles, collaboration across societal fields and effective human resource management are essential to create an open environment conducive to advancement.

To effectively implement intelligent transportation systems, it is paramount to enhance awareness of safety management across all stakeholders, leveraging big data and intelligent technologies to ensure the security of information resources. This involves strengthening data security training within the transportation sector, fostering a culture of prevention and professionalism in intelligent operations, and cultivating a supportive environment for intelligent transportation initiatives. Public education efforts must prioritize safety and protection management, advocating for standardized applications of information technology. Establishing a robust data security management information base within modern intelligent transportation systems is crucial in safeguarding the confidentiality of information amidst the big data era's rapid evolution. Implementing an open management model and security guarantee system involves stringent system security management through measures like firewalls, antivirus software, and software upgrade protocols to prevent external breaches. Incorporating confidentiality technologies into intelligent transportation management platforms enhances their capability to manage diverse data characteristics and classify management risks appropriately, ensuring effective protection strategies are implemented across varying security levels.

6. Conclusion

In summary, the application of artificial intelligence technology in intelligent transportation enhances traffic management efficiency, optimizes traffic command capabilities, establishes intelligent detection systems, and constructs big data-sharing platforms to optimize traffic management. This technology helps alleviate road congestion and ensures the safety of both traffic and pedestrians. However, current applications of artificial intelligence in intelligent transportation still have significant shortcomings, limiting the full development of intelligent transportation systems. To address these challenges, there is a need to further optimize artificial intelligence technology, enhance intelligent transportation management and operations, continuously update technological infrastructure, cultivate a skilled workforce, and foster better integration opportunities between artificial intelligence and intelligent transportation. These efforts are crucial for promoting the healthy development of China's transportation industry in the future.

Disclosure statement

The author declares no conflict of interest.

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