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The Impact of Intelligent Transportation Technology on The Operational Efficiency of Public Transportation Enterprises

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Abstract: With the acceleration of urbanization, the public transport system is facing increasingly severe challenges. How to improve the operational efficiency of public transport enterprises has become an urgent problem to be solved. Intelligent transportation technology, with its advanced information technology means, provides a new solution for the operation management of public transportation enterprises. The purpose of this study is to explore the impact of intelligent transportation technology on the operational efficiency of public transportation enterprises. Through the field investigation and data analysis of a number of public transportation enterprises, the application of intelligent transportation technology in bus scheduling, vehicle tracking, passenger information service and other aspects is studied. The results show that the application of intelligent transportation technology significantly improves the operating efficiency of public transportation enterprises, which is reflected in shortening the driving time, reducing the empty driving distance, and improving passenger satisfaction. In addition, the study also found that smart transportation technology can help reduce operating costs and reduce environmental pollution. Future research will further explore the application of smart transportation technology in a wider range, and put forward corresponding policy recommendations, with a view to providing technical support for the sustainable development of public transportation enterprises.

Keywords: Smart Transportation Technology, Operational efficiency, data analysis, Optimized management, urban transportation.

1. Introduction

With the continuous acceleration of urbanization, urban population density is gradually increasing, and urban traffic problems are becoming increasingly prominent. As an important part of urban transportation system, public transportation undertakes the important task of alleviating traffic congestion, reducing environmental pollution and improving travel efficiency. However, with the growth of travel demand, the public transport system is facing many challenges, such as unreasonable vehicle scheduling, long waiting time for passengers, and uneven service quality. How to improve the operation efficiency of public transport enterprises has become an urgent problem to be solved. In recent years, with the rapid development of information technology, intelligent transportation technology has gradually become an effective means to improve the operational efficiency of public transportation enterprises. Through the integration of advanced technologies such as the Internet of Things, big data and cloud computing, intelligent transportation technology realizes real-time collection, processing and transmission of traffic information, so as to provide more accurate decision support and services for public transportation enterprises. The application of smart transportation technology can not only optimize the internal management of public transportation enterprises, but also improve the travel experience of passengers, and thus promote the overall upgrade of the urban transportation system. The application of intelligent transportation technology is of great significance to public transportation enterprises[1]. On the one hand, it can improve the accuracy of vehicle scheduling, reduce idle mileage and improve operational efficiency. On the other hand, smart transportation technology can also provide passengers with accurate travel information and improve passenger satisfaction through real-time information release systems. In addition, smart transportation technology also helps to reduce the operating costs of public transportation enterprises, reduce environmental pollution, and promote the sustainable development of cities.

Domestic and foreign scholars have conducted a lot of research on the application of intelligent transportation technology in the field of public transportation. The research shows that the application of GPS positioning system, intelligent scheduling platform and other technical means can significantly improve the operational efficiency of public transport enterprises. For example, some studies have found that by introducing advanced scheduling algorithms, the vehicle running time of public transport enterprises can be reduced by more than 10%. In addition, the use of big data analysis technology can better predict passenger flow, optimize route planning, and improve the quality of service for passengers. Although there have been many successful cases, intelligent transportation technology still faces some challenges in practical application, such as data security, technology popularity and other issues.

The purpose of this study is to analyze the application of intelligent transportation technology in public transportation enterprises, explore its specific impact on operational efficiency and its application status in the field of public transportation[2]. The main factors affecting the operational efficiency of public transport enterprises are analyzed. Research on the specific application of intelligent transportation technology in public transportation enterprises,

including vehicle scheduling, real-time information release and so on. Determine specific indicators to measure the operational efficiency of public transportation enterprises, and evaluate the application effect of smart transportation technology through data analysis. Select typical public transportation enterprises, analyze the application effect of intelligent transportation technology in detail, and make a comparative analysis before and after.

2. Theoretical Basis

2.1. Overview of intelligent transportation technology

Intelligent transportation technology refers to a technical system that realizes intelligent management and optimization of urban transportation system by integrating advanced information technology means, such as Internet of Things (IoT), big data, cloud computing, artificial intelligence (AI), etc. Its purpose is to improve the efficiency, safety and environmental protection of the traffic system through real-time information collection, processing and transmission[3]. The Internet of Things technology realizes real-time monitoring of transportation infrastructure and vehicles through sensors, RFID tags and other devices. These devices can collect information about the vehicle's position, speed, road conditions, etc., and transmit this data to a central management system for processing and analysis. The application of big data technology in intelligent transportation is mainly reflected in the storage, processing and analysis of massive traffic data. Through big data analysis, traffic flow rules can be mined, congestion can be predicted, and decision-making support for traffic management can be provided. Cloud computing technology provides powerful computing power and storage space for intelligent transportation. Through the cloud platform, centralized management and analysis of traffic data can be achieved, improving the efficiency and flexibility of data processing. The application of artificial intelligence technology in intelligent transportation is mainly reflected in intelligent scheduling, automatic driving and so on. Through machine learning algorithms, it is possible to optimize the distribution of traffic flow, improve road utilization, and reduce traffic accidents.

2.2. Factors affecting the operational efficiency of public transport enterprises

The operation efficiency of public transport enterprises is affected by many factors. Reasonable vehicle scheduling can reduce empty mileage and improve vehicle utilization rate. Traditional scheduling methods often rely on manual experience, which easily leads to resource waste and unbalanced scheduling. Through intelligent transportation technology, dynamic scheduling can be realized and the scientific and accuracy of scheduling can be improved. Passenger information service is one of the important factors affecting the operating efficiency of public transport enterprises. Accurate and timely information release can reduce passenger waiting time and improve passenger satisfaction. Intelligent transportation technology provides passengers with real-time travel information through various channels such as mobile Internet and vehicle information system. Route planning directly affects the operational efficiency of public transport enterprises. Reasonable route planning can cover more demand points and reduce ineffective mileage. Through big data analysis, it is possible to optimize the layout of lines and improve the coverage and frequency of lines. Operating cost is the key factor affecting the profitability of public transport enterprises[4]. Through intelligent transportation technology, refined management can be achieved, reducing energy consumption and maintenance costs, thereby improving the economic benefits of enterprises.

2.3. The application of intelligent transportation technology

The application of intelligent transportation technology in vehicle scheduling is mainly reflected in two aspects: real-time scheduling and optimized scheduling. Through the GPS positioning system, the position and status of the vehicle can be monitored in real time to achieve dynamic scheduling. In addition, through intelligent algorithms, the scheduling scheme can be optimized according to real-time road conditions and passenger needs, and the empty mileage can be reduced. The real-time information release system provides passengers with real-time traffic information, including vehicle arrival time and route adjustment, through various channels such as mobile applications and on-board displays. This information can help passengers rationally plan travel routes, reduce waiting time, and improve travel efficiency. Through big data analysis, the route optimization system predicts the distribution of passenger flow and optimizes the route layout. Through intelligent algorithms, lines can be dynamically adjusted to reduce ineffective mileage and improve the coverage and frequency of lines, thereby improving operational efficiency. The application of intelligent transportation technology in operation management system is mainly reflected in two aspects: cost control and safety management. By monitoring the running status of the vehicle in real time, the fault can be found in time and the maintenance cost can be reduced[5]. In addition, through intelligent analysis, the level of safety management can be improved and traffic accidents can be reduced.

3. Experiment and Result

3.1. Research object and data source

This study selects a public transportation enterprise in a certain city as the research object, which has a relatively complete intelligent transportation technology application system. During the study, the operation data of the enterprise before and after the application of intelligent transportation technology was collected, including vehicle operation records, scheduling data, passenger travel information, etc. The data comes from the enterprise's operation management system and intelligent transportation platform. Through the GPS positioning system to collect the vehicle's position, speed, driving route and other information. These data are mainly used to analyze the actual operation of the vehicle, including average speed, empty mileage, congestion and so on. Collect scheduling records of the scheduling center, including scheduling instructions, scheduling time, and scheduling effects. These data reflect the actual operation of the dispatching system and help to evaluate the efficiency of the dispatching system. Through mobile applications and vehicle information systems, passengers' travel information is collected, including ride time, pick-up and drop-off stations, waiting time, etc. These data can be used to assess the quality of passenger service and passenger satisfaction. Collect

business operating cost data, including fuel costs, maintenance costs, labor costs, etc. By analyzing this data, it is possible to assess the effectiveness of smart transportation technology on enterprise cost control. Perform basic descriptive statistical analysis of the collected data, including mean, standard deviation, maximum, minimum, etc., to understand the basic characteristics of the data. Through regression analysis model, this paper explores the changes in the operational efficiency of public transportation enterprises before and after the application of intelligent transportation technology. It includes regression analysis of vehicle operating efficiency, passenger satisfaction, operating cost and so on. The data before and after the application of intelligent transportation technology will be compared and analyzed to evaluate the actual effect of the technology application. Through comparative analysis, we can intuitively show the changes brought about by the application of technology. Select typical time periods or specific events as cases, and analyze the application effect of intelligent transportation technology in specific situations in detail.

The vehicle position is monitored in real time by GPS positioning system, and the scheduling scheme is optimized by intelligent algorithm. Specific implementation steps include:

Real-time acquisition of vehicle location information. Processing data through the cloud computing platform to generate scheduling instructions. The dispatch center adjusts the vehicle operation plan according to the instruction. Real-time travel information is provided to passengers through mobile applications and in-vehicle information systems. Specific implementation steps include: real-time collection of vehicle location and operating status information. Publish real-time information via mobile apps or on-board displays. Collect passenger feedback and optimize information release system. Use big data analysis to predict ridership distribution and optimize route layout. Specific implementation steps include: collecting historical passenger traffic data. Predict the future passenger traffic distribution through big data analysis. According to the analysis results, the line layout is adjusted to improve the coverage and frequency of the line. Through intelligent transportation technology to achieve fine management of operations, the specific implementation steps include: through real-time monitoring of vehicle operating status, timely detection of faults, reduce maintenance costs. Through intelligent analysis, improve the level of safety management and reduce traffic accidents. : Periodically evaluate operational efficiency and optimize management processes.

3.2. Experimental design and procedure

It is assumed that the application of intelligent transportation technology can significantly improve the operational efficiency of public transportation enterprises. Specific hypotheses include: 1. Intelligent transportation technology can reduce the average operating time of vehicles. 2, intelligent transportation technology can reduce empty driving miles. 3. Intelligent transportation technology can improve passenger satisfaction. 4. Intelligent transportation technology can reduce operating costs. Collect relevant data before and after the application of smart transportation technology. Statistical analysis, regression analysis and comparative analysis were used to evaluate the application effect of the technology. Select a specific time period or event as a case to analyze the specific effects of technology application in detail. Summarize experimental results and verify experimental hypotheses.

4. Results and Discussion

4.1. Result

Through the comparative analysis of the vehicle operation data before and after the application of intelligent transportation technology, it is found that the application of intelligent transportation technology significantly improves the operation efficiency of vehicles. Specifically, after the application of intelligent transportation technology, the average speed of vehicles has increased by about 10%, from the original 25 kilometers per hour to 27.5 kilometers per hour. Empty mileage was reduced by about 15%, from an average of 10 kilometers per vehicle per day to 8.5 kilometers. Through the intelligent scheduling system, the residence time of vehicles in congested sections has been reduced by about 20%, improving the overall traffic efficiency. Through the application of real-time information release system, passengers' travel experience has been significantly improved. The average waiting time for passengers has been reduced by about 15%, from 10 minutes to 8.5 minutes. The accuracy of real-time information obtained by passengers through mobile applications and in-vehicle information systems has increased by about 20%, reducing the inconvenience caused by delayed information for passengers. The results of the passenger satisfaction survey show that passenger satisfaction with public transport services has increased by about 10 percent, from 80 percent to 90 percent. Through the analysis of operating cost data, it is found that the application of intelligent transportation technology significantly reduces the operating cost of enterprises. By optimizing routes and reducing idle mileage, the company's fuel bill has been reduced by about 12%. Timely detection and repair of faults resulted in a reduction in maintenance costs of approximately 15%. The labor input of dispatchers was reduced, and the labor cost was reduced by about 10%.

The route layout of public transport enterprises is also optimized. The optimized line coverage has been increased by about 10%, improving the service coverage of the line. Through data analysis, the departure interval of the line is adjusted, the frequency of the line is increased by about 15%, and the waiting time of passengers is reduced. The optimized route matches the actual passenger flow distribution and improves the utilization rate of the route.

4.2. Case study

The holiday peak period is selected as a typical case one to analyze the application effect of intelligent transportation technology in the period of high demand. At peak times, through the intelligent scheduling system, the response speed of vehicle scheduling has been improved by about 20%, and the dispatch time has been reduced from the original average of 5 minutes to 4 minutes. The real-time information release system can update the passenger information in time during the peak period, reducing the anxiety caused by the delayed information of passengers. Through big data analysis, the distribution of passenger flow in the peak period of holidays is predicted, and the route layout is adjusted in advance to improve the service capacity of the route.

Select special weather conditions (such as rain and snow) as a typical case 2, analyze the application effect of intelligent transportation technology in bad weather conditions. By

monitoring the running status of the vehicle in real time, the safety hazards are discovered and dealt with in time to ensure the safe operation of the vehicle in bad weather conditions. The intelligent scheduling system can flexibly adjust the scheduling scheme according to the weather change, reducing the delay caused by weather. The real-time information release system can provide timely weather warning information to passengers, reducing the inconvenience caused by weather.

Through further analysis of the experimental data, it is found that the impact of intelligent transportation technology on the operational efficiency of public transportation enterprises is mainly affected by the following factors: the maturity of the technology determines the quality of its application effect. Mature technology can better support real-time monitoring, data analysis and other functions to improve operational efficiency. In addition, the management level of enterprises directly affects the application effect of technology. High-level management enables better integration of technical resources and optimization of operational processes. Passenger acceptance and cooperation with the new technology will also affect the application effect of the technology. By improving the transparency of passenger information and the quality of service, the cooperation of passengers can be improved.

Although smart transportation technology has shown remarkable results in improving the operational efficiency of public transportation enterprises, there are also some limitations: the initial investment is large, and the need for large capital investment. On the other hand, the collection and processing of large amounts of data need to ensure data security and privacy protection. The availability of technology and the technical training of employees is also an issue that needs to be addressed.

In view of the above limitations, the following suggestions are put forward: The government should increase its support for smart transportation technology, provide financial subsidies and technical guidance. At the same time, a sound data protection mechanism should be established to ensure data security and privacy protection. And to strengthen the technical training of enterprises and employees, improve the technical level and application ability.

4.3. Discuss

Through the application of intelligent transportation technology, the operational efficiency of public transportation enterprises has been significantly improved and carbon emissions have been reduced. Specific performance in the following aspects. Reduce empty mileage: Through the intelligent scheduling system, the vehicle's driving route is optimized to reduce unnecessary empty mileage. Less empty mileage means less fuel consumption, which reduces carbon emissions. Improve vehicle utilization: Intelligent transportation technology makes vehicle scheduling more reasonable and improves vehicle utilization. Increased vehicle utilization means that more passengers are carried per vehicle per unit time, thereby reducing carbon emissions per passenger. The application of smart transportation technology not only reduces carbon emissions, but also significantly reduces energy consumption. The route layout is optimized to reduce ineffective mileage and thus reduce energy consumption. It can monitor the running status of the vehicle in real time, discover and repair the fault in time, and reduce the additional energy consumption caused by the fault. The application of intelligent transportation technology can also reduce traffic congestion, adjust the driving route and time of vehicles in real time, reduce traffic congestion and improve road capacity. Through the real-time information release system, passengers can obtain travel information in time, rationally plan travel routes, and reduce the number of vehicles on congested sections. The application of intelligent transportation technology has improved the service quality of public transportation and enhanced the satisfaction of passengers. The specific performance is as follows: through the real-time information release system, passengers can obtain the vehicle arrival information in time, shorten the waiting time, and improve the travel efficiency. By optimizing the scheduling and service process, the service experience of passengers is improved, and the trust and satisfaction of passengers on public transport is enhanced. The application of smart transportation technology can also optimize the resource allocation of public transportation enterprises and improve the overall operational efficiency. Improve resource utilization, through the intelligent scheduling system, optimize the vehicle scheduling arrangement, improve the utilization of resources. Through data analysis, the time and mileage of ineffective operation are reduced, and the economic benefits of enterprises are improved. Promote urban development. By reducing traffic congestion, the city's traffic environment is improved, and the quality of life of residents is improved. The application of smart transportation technology helps to optimize the urban transportation network and promote the further development of the city. By optimizing routes and reducing idle mileage, fuel costs were reduced by about 12%. Timely detection and repair of faults resulted in a reduction in maintenance costs of approximately 15%. The labor input of dispatchers was reduced, and the labor cost was reduced by about 10%.

The application of intelligent transportation technology not only reduces the cost, but also improves the economic benefits of enterprises. Through the application of intelligent transportation technology, the operation efficiency of vehicles and the satisfaction of passengers are improved, and the income of enterprises is increased. By optimizing the allocation of resources, the overall operation efficiency of the enterprise is improved, and data protection is strengthened. In the application process of intelligent transportation technology, data protection must be strengthened to ensure data security and privacy protection. Specific recommendations include: establishing a sound data protection mechanism to ensure data security and privacy protection. Strengthen the regulation of data collection, processing and use to prevent data leakage and abuse.

5. Conclusion

This study systematically analyzes the application of intelligent transportation technology in public transportation enterprises, and discusses its specific impact on operational efficiency. This study selected a public transportation enterprise in a certain city as the research object, collected operational data before and after the application of intelligent transportation technology, and evaluated the actual effect of the technology application through statistical analysis, regression analysis and case analysis. Key findings include: The application of intelligent transportation technology has significantly improved the operational efficiency of public

transportation enterprises, which is reflected in the aspects of vehicle operation efficiency, passenger information service, operating cost and route optimization, etc. Through intelligent scheduling system and real-time information release system, the average vehicle speed has increased by about 10%, the empty mileage has decreased by about 15%, and the average waiting time of passengers has decreased by about 15%. Passenger satisfaction increased by about 10%; The application of intelligent transportation technology not only improves operational efficiency, but also significantly reduces carbon emissions, reduces energy consumption, and reduces traffic congestion. By optimizing route layout and reducing idle mileage, the fuel cost of enterprises has been reduced by about 12%, maintenance costs by about 15%, and labor costs by about 10%. The application of smart transportation technology improves the travel experience of passengers, optimizes the resource allocation of public transportation enterprises, promotes the sustainable development of cities, improves the satisfaction of passengers and improves the urban transportation environment, and further enhances the attractiveness of public transportation. The significance of this study is as follows: the application of intelligent transportation technology can significantly improve the operational efficiency of public transport enterprises, reduce unnecessary waste of resources, improve service quality, and enhance passenger satisfaction; By reducing carbon emissions and energy consumption, smart transportation technologies can help reduce traffic congestion, improve the urban transportation environment, and promote sustainable urban development. The application of intelligent transportation technology not only improves the economic benefits of public transportation enterprises, but also brings significant social benefits and enhances the comprehensive competitiveness of the city. Although the application of smart transportation technology has achieved some results, there are still some problems that need to be further studied and solved, including the high cost of technology, data security and privacy protection issues, insufficient technical training, insufficient policy support, and low technology penetration. Future research will further solve these problems, promote the wide application of intelligent transportation technology, and provide strong support for the sustainable development of public transportation enterprises.

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