

# The Current Development and Optimization of Smart Public Transportation in Taiyuan City

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**Abstract:** "With the development of technology and the smartification of cities, the urbanization process is accelerating rapidly. The population and the number of motor vehicles in cities are increasing rapidly, leading to evident issues such as traffic congestion and air pollution. Smart public transportation, as an integral component of smart cities, can reduce passengers' travel costs, improve travel efficiency to some extent, and provide big data support for the development of smart transportation and even smart cities. It is a cost-effective, convenient, and environmentally friendly mode of transportation. This article first analyzes the current situation of smart public transportation in Taiyuan city. It points out issues such as uneven allocation of public transportation resources, prolonged travel times for passengers using public transportation, and overcrowding during peak hours. Drawing on the development experiences of smart public transportation in cities both domestically and internationally, the article proposes optimization suggestions for the current state of smart public transportation in Taiyuan. These include refined management of public transportation, skip-stop operations, smart resource allocation, and improvement of infrastructure construction. The aim is to provide theoretical guidance for the optimization and improvement of smart public transportation in Taiyuan, enabling more efficient development of 'smart public transportation' in the city."

**Keywords:** Traffic congestion; Smart public transportation; Skip-stop operation.

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## 1. Introduction

Public transportation has numerous advantages compared to private cars, such as lower per capita expenses, significantly higher passenger capacity, minimal utilization of public roads, and energy conservation. According to relevant statistics, the passenger capacity of buses in urban areas is approximately 20 times that of cars, with around 70% of residents willing to use public transportation. However, during the normal operation of buses, there are many factors that can impact their regular functioning, including road congestion, weather changes, traffic accidents, and signal light delays at intersections, all of which can have varying degrees of influence on bus travel.

Currently, challenges in bus operations include passenger congestion, difficulties in accessing bus information during specific weather conditions, delayed updates in bus big data information, and substantial cost consumption, all of which urgently require improvement. In the process of urbanization, there is an inevitable increase in carbon emissions and traffic congestion in cities. Therefore, the smartification of low-carbon travel not only alleviates issues like traffic congestion associated with urbanization but also significantly enhances the well-being of citizens in their daily travels.

Furthermore, Taiyuan City became one of the first national smart city pilot cities in 2013, and the development of smart public transportation can contribute to enriching the progress of smart cities. So, what is the current status of smart public transportation in Taiyuan City? Building upon the existing situation, what are the remaining issues in the development of smart public transportation, and how can these issues be specifically addressed? This paper will explore the aforementioned questions.

## 2. Literature Review

Some scholars have played a significant role in advancing

the development of smart public transportation through the application of big data and GPS technology. Modern information technology provides more accurate information on aspects such as location, scheduling, and passenger travel times in the process of public transportation. Scholars like He Yongjun and Yao Qinghua (2016) have made substantial innovations in personalized transportation services, emphasizing the need for humanized and precise services, regardless of traditional or modern modes. They believe that improving the efficiency of public transportation is fundamentally about addressing the shortcomings in managing both traditional and modern models. Additionally, researchers such as Pang Mingbao, Chen Maolin, and Zhang Ning (2017) not only focus on urban public transportation operation models but also integrate urban and rural public transportation. They utilize big data cloud processing technology to overcome operational obstacles in both urban and rural public transportation. For instance, adjusting the frequency of departures based on the number of passengers in rural areas, thus enhancing operational efficiency. Hu Baitao (2020) proposes a method to increase public transportation efficiency by first investigating real-time data on traffic congestion and passenger density in the city. This method determines whether passenger density is in an abnormal state and evaluates the degree of traffic congestion based on the density of passengers (how many passengers per square meter). Finally, a bus dispatch plan is determined based on the feedback data. Vimal Kumar M N, Palanivelu M, and Rubesh CM (2020) emphasize that passengers in urban areas may experience difficulties in reaching their destinations on time due to not knowing the exact arrival time of buses, the specific location of buses, and the number of passengers on board. In their intelligent public transportation system, they incorporate a GPS module to accurately calculate vehicle speed and location. Passenger numbers are also calculated based on data from on-board ticket machines. Víctor Manuel Padrón Nápoles and Diego Gachet Pérez, among others, believe that

the construction philosophy of smart public transportation should be an inclusive system. The elderly in urban areas are no longer considered a vulnerable group but are part of the population that promotes the development of smart public transportation. Smart cities will manifest in the form of public spaces. Chun Yi Liu and Kuo Tai Tang have studied the issue of passengers' "inaccurate arrival times leading to time costs and poor experiences." They use GPS positioning and public transportation route planning modeling to address these issues, constructing a more accurate and scientific public transportation system.

In summary, existing literature has extensively explored the development of smart public transportation through the use of big data, GPS, 5G technology, and other advancements. Many measures have been proposed to enrich the content of smart public transportation, including feedback mechanisms, precise adjustments to passenger flow and route planning, and scientifically adjusting bus departure frequencies. The ultimate goal is to prioritize a "people-oriented" approach, considering the elderly as a crucial demographic for the development of smart public transportation.

However, the existing literature predominantly focuses on providing recommendations for the macro-level development of smart public transportation relying on information technology. There is limited research that delves into the current status of smart public transportation development in specific regions and proposes tailored recommendations. Therefore, this paper shifts its focus to Taiyuan City, summarizing and analyzing the notable advantages and practical constraints of smart public transportation development in Taiyuan City. It aims to propose targeted practical paths for the future development of smart public transportation in Taiyuan City.

### 3. The Significant Advantages of Advancing the Development of Smart Public Transportation in Taiyuan City

#### 3.1. Favorable Geographic Location for the Development of Smart Public Transportation in Taiyuan

Taiyuan is situated in the northern region of China and serves as the capital city of Shanxi Province. With a history spanning over 2500 years, Taiyuan, formerly known as Jinyang and Longcheng, was historically considered a strategically important location. In the context of the national sustainable development agenda, Taiyuan has become a crucial demonstration area for innovation and is adjacent to the Beijing-Tianjin-Hebei region. Leveraging this geographical advantage, the National Development and Reform Commission has proposed collaborative support for the development of Shanxi Province and the Beijing-Tianjin-Hebei region, aiming to create a mutually beneficial and win-win situation. The development of the "Jing-Jin-Ji" economic circle is expected to bring significant opportunities for Taiyuan's economic growth. In 2013, Taiyuan became a pilot city for "Smart Cities," playing a pivotal role in propelling the development of the "Smart City" initiative. As a branch of the smart city concept, smart public transportation in Taiyuan also requires continuous improvement and optimization.

### 3.2. Steady Progress in the Infrastructure Development of Smart Public Transportation in Taiyuan

As of November 2020, the Ministry of Transport has announced two batches totaling 37 cities as demonstration pilot cities for intelligent applications in public transportation, with Taiyuan included in the second batch. In April 2020, Taiyuan's public transportation company launched the Intelligent Dispatch System platform, introducing "Smart Public Transportation" into the lives of the city's residents. As early as 2013, Taiyuan initiated large-scale road construction projects, including the construction of East Central Ring Road, South Central Ring Street, West Central Ring North Section, and North Central Ring Street. These initiatives have significantly alleviated traffic congestion in the city, ensuring that vehicles from different directions can navigate without interference. Approximately 70% of the urban population is willing to use public transportation, and even during restricted traffic conditions, many car owners choose public transportation as their preferred mode of travel.

**Table 1.** Comparison of Public Transportation Operation Data Between 2022 and 1978

	2022	1978	Growth Factor
<b>Operational Fleet (Quantity)</b>	2533	295	8.59
<b>Operating Routes (Number)</b>	201	31	6.48
<b>Route Length (Kilometers)</b>	3323.08	520.25	6.39
<b>Daily Passenger Volume (Ten Thousand Person-Trips)</b>	101.73	35.09	2.90
<b>Daily Travel Distance (Ten Thousand Kilometers)</b>	29.48	3.58	8.23

Table 1 provides a comparison of public transportation operational data between 2022 and 1978, illustrating the historical evolution of public transportation in Taiyuan. According to the official website of Taiyuan Public Transportation, as of the end of 2022, there are 2,533 operating vehicles and 3,227 total vehicles (including spare ones) in the Taiyuan public transportation fleet. The system operates on 253 routes with a total route length of 4,103.98 kilometers and a network length of 1,328.5 kilometers. The public transportation system covers various districts including Yingze, Xiaodian, Jiancaoping, Xinghualing, Wanbailin, and Jinyuan, and extends to Qingxu County, Yangqu County, and Gujiao City.

In 2022, the total operating mileage reached 95.7167 million kilometers, averaging 262,200 kilometers per day. There were 3.173 million operating trips, averaging 8,700 trips per day. The total passenger volume amounted to 188 million people, averaging 516,300 people per day (including 100,200 free riders per day). Payment methods such as IC

cards, QR codes, and UnionPay accounted for 96.96% of total rides. With the gradual improvement of charging facilities, pure electric buses have become increasingly common in the city of Taiyuan.

**Table 2.** The number of operating urban public buses and passenger volume in Taiyuan City in recent years

year	City bus fleet	Passenger volume (10,000 persons)
2022	2533	18800
2021	3656	30257
2020	3725	21151
2019	3533	34485
2018	2521	36775

Table 2 provides data on the number of urban public transit operational vehicles and passenger volume from 2018 to 2022. From the data, it is evident that despite a significant decrease in the quantity of operational vehicles and passenger volume in 2022 due to the impact of the pandemic, there is a noticeable trend of steady growth in the number of urban public transit operational vehicles in Taiyuan City. This indicates that the infrastructure development for smart public transit in Taiyuan City is progressing steadily.

### 3.3. Taiyuan's Smart Public Transit Keeps Advancing

The new electric buses in Taiyuan are equipped with coin boxes featuring two coin slots, accepting both paper bills and coins. The updated coin boxes also have functions such as identifying counterfeit tickets, checking the denomination of banknotes, and reading the quantity and amount of the bills. After passengers insert coins, the system automatically detects whether counterfeit money is used and displays the amount on the machine. The card reader can automatically recognize various cards like the Taiyuan public transit card, senior citizen card, and student card, deducting the corresponding amount, which is also displayed on the machine. Cash, public transit cards, bank cards, Taiyuan public transit app, Alipay, and other payment methods are fully covered for public transportation in Taiyuan. The

intelligent safety system ensures that the bus cannot start if the doors are not properly closed, preventing accidents caused by prematurely closing doors in crowded conditions. The bus is equipped with seven cameras, providing comprehensive surveillance with no blind spots, ensuring the security of passengers' belongings and personal safety. Emergency window-breaking hammers are placed next to the windows, allowing passengers or drivers to easily break windows in case of danger, facilitating evacuation and operations. The real-time public transit service on Amap significantly reduces passengers' waiting time by allowing them to view the bus's real-time location, the number of stops remaining, and estimated time to reach the destination through the mobile app.

### 3.4. Affordable Fare Rates for Taiyuan's Smart Public Transit

Whether it's the new electric buses or those with air conditioning during the summer, Taiyuan's public transit fares remain unchanged, consistently at one yuan for the entire journey. This is a highly commendable inclusive policy in a provincial capital city. Additionally, the public transit card costs 0.5 yuan, the student card is priced at 0.25 yuan, and the senior citizen card is free of charge. To alleviate congestion, Taiyuan has introduced express buses on top of regular routes, stopping only at stations with many alighting passengers and skipping stations with fewer alighting passengers. These buses, identified by a 'K' in their route numbers, operate at specific times. This greatly facilitates the daily commute during peak hours for some working individuals, addressing issues such as long travel times, extended boarding times, and difficulties in waiting for buses on multiple routes.

## 4. Real Constraints on Advancing the Development of Smart Public Transit in Taiyuan City.

Despite having significant advantages in terms of geographical location, infrastructure, commuting methods, and fare rates, Taiyuan City still lags behind when compared horizontally with various central cities in terms of passenger volume.

**Table 3.** December 2022 partial central city passenger traffic

Region	Total Passenger Volume			(Public Bus and Electric Tram)		
	Begin of the year cumul-ative	this month	growth rate%	begin of the year cumul-ative	this month	the same period %
Beijing	417411	19221	-25.2	172559	9236	-24.9
Tianjin	76696	4790	-34.4	43959	2675	-34.7
Shijiazhuang	30479	1080	-5.9	14370	456	-11
Taiyuan	30921	1202	-23.7	18198	569	-24.1
Hohhot	18762	344	-40.8	12164	157	-34.8

Table 3 provides data on the total passenger volume and the number of public buses and electric trams in some major cities across the country as of December 2022. According to the data from December 2022, the pandemic has indeed impacted the public transportation passenger volumes in major cities. Taiyuan City surpasses cities such as Yinchuan, Xining, Lhasa, Haikou, Hohhot, and Shijiazhuang, ranking seventh in passenger volume. The subsidies provided by the Taiyuan City government for public transit fares have significantly boosted passenger numbers. However, it is undeniable that

factors such as fewer departures, a lack of increased vehicles during peak hours, and slower speeds may deter passengers, leading them to choose alternative modes of transportation.

Based on the analysis of the data above and on-site investigations into the current state of public transportation in Taiyuan, this article provides a detailed exploration of five aspects: the unequal allocation of public transit resources, slow operational speed of public transit, the occupation of public resources by the elderly during morning rush hours, inadequate analysis of passenger flow, and the inability of the

current travel methods to cater to all public transit passengers.

#### **4.1. Unequal Allocation of Public Transit Resources**

During on-site investigations in Taiyuan, the author observed that many bus routes in the city pass through numerous similar stations, and their routes are also very similar. This undoubtedly leads to a certain degree of resource wastage. Moreover, adjustments to bus routes in Taiyuan are often short-term fixes rather than addressing the root issues through proper scientific planning. Additionally, a significant number of residents in Taiyuan exhibit an indifferent attitude towards taking buses, possibly due to the distance between residential areas and the nearest bus stops. The distribution of bus stops lacks scientific planning and fails to benefit the majority of residents. Many buses in Taiyuan see minimal ridership outside of peak hours, yet they adhere to a fixed schedule, resulting in significant resource wastage even when there is high seating availability.

#### **4.2. Slow Public Transit Speed, Excessive Time Consumption**

Despite Taiyuan's advantageous road conditions—flat, wide, and well-connected—the city's buses adhere to very strict speed limits. The slow speed of public transit leads to excessive travel time, causing passengers to opt for faster alternatives such as subways or taxis, especially in urgent situations. Therefore, improving the operational speed of public transit is crucial.

#### **4.3. Elderly Population Seizing Public Resources During Morning Rush Hours**

The recently revised "Taiyuan City Elderly Rights Protection Measures" has been enacted and specifies the age group of elderly individuals eligible for free bus rides in Taiyuan, changing the previous threshold from 70 years to 65 years. This modification reflects a caring attitude towards the elderly population, and this exclusive benefit for seniors has garnered widespread approval. However, with the acceleration of an aging society and urban development, the drawbacks of this exclusive policy for the elderly become increasingly evident. For instance, during peak hours, the elderly often occupy public resources, leading to conflicts over seat allocations during rush hours. These issues affect social efficiency and are gaining attention.

#### **4.4. Inadequate Basis for Passenger Flow Analysis**

Due to a lack of technological support, it is challenging to conduct effective manual passenger flow statistics for each bus stop on every bus route. The absence of guaranteed accuracy in the collected data results in an inability to determine the passenger flow at each bus stop along each route in Taiyuan during specific time periods. Often, a bus route passes through dozens of bus stops within short distances, making manual counting impractical and imprecise. This hampers objective decision-making for bus route planning and stop adjustments, as subjective influences play a significant role.

#### **4.5. Varied Passenger Information Retrieval Abilities**

While younger individuals proficiently use smartphones to

access information about bus operations, estimated arrival times, and optimal transfer options through apps like Amap, many older individuals and those unaccustomed to using smartphones for travel information lack the ability to receive real-time updates on bus operations and transfer details. This segment of the population relies on experience or asking others for travel information, resulting in poor travel experiences and low efficiency. Therefore, there is a need to identify user-friendly methods that cater to all age groups or implement age-specific information retrieval strategies for public transit passengers.

### **5. Practical Pathways for Advancing the Development of Smart Public Transit in Taiyuan City**

Due to the challenges faced by some developed cities, such as air pollution and traffic congestion, they have sought to mitigate these urban issues and enhance the efficiency of public transportation for their residents through smart management practices. The development of smart public transit aims to reduce traffic congestion and air pollution within cities, improve the overall commuting experience for passengers, and maximize the economic benefits of public transit systems. The valuable experiences gained by these cities in the development of smart public transit are precisely what Taiyuan City needs for its current "Smart Public Transit" initiatives.

#### **5.1. Smart Allocation of Public Transit Resources in Taiyuan**

Singapore's initiatives in collecting and processing transportation information are highly commendable and serve as valuable references. In their city, GPS positioning systems are installed on all buses, and there is comprehensive street monitoring for real-time analysis of waiting passengers at each station and road congestion conditions. Shanghai has also advanced the "1+3 model," encompassing a comprehensive platform for public information collection and processing, supported by vehicle GPS information, macro-control of vehicle departure times, and services catering to passenger travel needs. This model has propelled the intelligent development of public transportation in Shanghai.

From this, it can be seen that the allocation of public transit resources is crucial, affecting both passenger travel efficiency and public interests. Through intelligent management, existing transit resources can be integrated into a smart management platform. By deploying on-board GPS devices and station sensing equipment, accurate data on waiting passengers and passenger flow at each boarding and alighting point can be obtained. This enables precise analysis of passenger flow on each bus route. For routes with dense passenger distribution, increasing the number of buses and trips while reducing the time between departures is advisable. For routes with fewer passengers, decreasing the number of trips or reallocating manpower should be considered, paying attention to whether the station layout is problematic. Based on accurate feedback on passenger flow, adjusting the number of trips during peak periods and decreasing departures during off-peak periods can help save resources. This way, relying on actual passenger flow data, a precise secondary allocation of transit resources can be carried out. This ensures that public transit aligns closely with the daily travel needs of passengers, maximizing satisfaction for the majority of commuters.

## 5.2. Strengthening the Construction of Intelligent Public Transportation Infrastructure in Taiyuan

The experiences of Hangzhou and Tokyo in connecting subway lines and bus stops are valuable lessons that Taiyuan can learn from. Hangzhou's Bus Application Line Network Management Platform focuses on optimizing and adjusting routes, analyzing and evaluating aspects such as operating hours, vehicle allocation plans, and passenger flow predictions. The network planning platform has played a significant role in promoting the integration of bus and subway networks in Hangzhou. Prior to the official operation of Line 5 of the subway in Hangzhou, the platform accurately analyzed the fluctuation of passenger flow at subway stations, affected bus routes, and identified impacted bus stops. Tokyo's highly advanced information technology in transportation management has led to the widespread adoption of bus priority measures in Japan, ensuring seamless connections between buses and rail transit, and accurately estimating transfer times to enhance the efficiency of bus travel.

While Taiyuan's public transportation infrastructure has made strides towards intelligent development, there are areas that require improvement, particularly in the timely replacement of bus stops. With the completion of Metro Line 2, there is an opportunity to optimize bus stop locations along the route for better integration with the subway. As the impending completion of Metro Line 1 approaches, Taiyuan can further adjust bus stop locations based on actual needs. Flexibility in modifying bus routes, driven by feedback on passenger volume, is essential. Removing stops with low passenger concentration and adding stops where needed can enhance the efficiency of the bus network.

Efforts should also be directed towards upgrading the existing engine systems to improve speed on suitable road segments, ensuring time savings for passengers and increasing overall travel efficiency. Additionally, deploying specialized personnel at each bus stop for crowd management and maintenance may be reconsidered for a more efficient use of manpower. Upgrading the current engine systems and implementing speed enhancements on appropriate road segments can be followed by relaxing traffic restrictions, allowing buses to further increase speed and reduce passenger travel time.

In conclusion, Taiyuan can enhance its public transportation system by adopting lessons from Hangzhou and Tokyo, particularly in optimizing routes, integrating bus and subway networks, and utilizing advanced information technology for efficient and seamless transportation. Continuous improvements in infrastructure and operations will contribute to a more intelligent and effective public transportation system for the city.

## 5.3. Improving the Welfare Policy of Free Bus Rides for the Elderly

Shanghai officially discontinued the system allowing individuals aged 70 and above to ride buses for free in 2016. Consequently, elderly individuals are now required to purchase tickets or use coins for bus rides. However, a comprehensive subsidy system was implemented for senior citizens. Those aged 65-69 receive a monthly subsidy of ¥75, those aged 70-80 receive ¥150, and those aged 80-89 receive ¥180, with the subsidy increasing with age. According to data

provided by Shanghai, the implementation of this new policy resulted in a significant decrease in the number of elderly individuals using public buses. Seniors are gradually adapting their travel methods, effectively reducing conflicts over seat availability and preventing resource competition during peak hours. The concept of intelligent public transportation should be an inclusive system, where the elderly in the city are not considered a disadvantaged group but rather an integral part of promoting the development of intelligent public transportation.

Therefore, Taiyuan can consider implementing a similar policy. This subsidy policy could impose restrictions on seniors who frequently do not utilize public buses or travel during peak hours. The subsidies provided would also not burden those seniors who genuinely rely on public transportation. Another approach could involve implementing measures such as separate buses for the elderly and the general public during peak hours in the morning and evening for individuals aged 60 and above. This would meet the needs of working professionals and students during their commute, enhancing the public transportation experience for these groups without interfering with the requirements of the elderly. This approach aims to improve the overall efficiency of public transportation services.

## 5.4. Innovating Taiyuan's Public Transit Refined Management Approach

Following the precise calculation of passenger traffic at bus stops through the aforementioned methods, an innovative approach known as "skip-stop operation" can be introduced for buses. Skip-stop operation involves a bus bypassing a specific station on its route based on data obtained from on-board GPS devices and station sensing equipment, including the number of passengers on board and at the bus stop. If there are no passengers waiting at the next bus stop and no passengers planning to disembark, the bus driver, upon receiving this data, can skip that particular station. However, the decision for the next bus to skip the station is contingent upon feedback from the aforementioned information. When determining whether a bus should skip a station, a time parameter related to passenger waiting time can be incorporated. Keeping the calculated time parameters within a specific range can reduce passenger waiting time, enhancing the overall travel experience and satisfaction.

Learning from Hangzhou's comprehensive safety management measures for people, vehicles, locations, and routes is also valuable for Taiyuan. Regarding individuals, constructing a three-dimensional behavioral profile for drivers and conducting a comprehensive investigation into the driver's health code, driver's license information, traffic violations, physical conditions, and security information are important. For vehicles, implementing full-process monitoring and intervention is crucial. Real-time collection of data on bus operation mileage, battery status, maintenance records, tire pressure, and door status is necessary. Any anomalies should be promptly alerted and recorded on the backend once the situation returns to normal. Concerning locations and routes, utilizing a comprehensive station safety management system enables dynamic and static safety control at various points, including drivers, vehicles, stations, and routes. This approach aims to enhance the safety management of each link in the public transportation system in Taiyuan, ensuring a secure and efficient transit experience for passengers.

## 5.5. Expanding Intelligent Channels for Public Transit Information Dissemination

Accuracy in public transit information is fundamental to maximizing the efficiency of bus travel, making it crucial to ensure the accuracy of information received by passengers. Therefore, convenient services should be considered to expand the channels for disseminating travel information, thereby reaching a broader audience. Japan's experience in traffic information broadcast voice prompts is highly commendable and provides valuable insights for Taiyuan. They equip bus stops with comprehensive traffic information voice prompts. Many buses are fitted with multiple display screens that cyclically play information on the bus's route, fare details, preventing passengers from boarding the wrong bus, reminding them to prepare for boarding and alighting, and simultaneously releasing this information on an app. This dual assurance approach significantly enhances passenger travel efficiency. Additionally, large screens at each bus stop display weather forecasts and current news to engage residents while waiting, embodying a human-centric philosophy.

Taiyuan already has platforms such as Amap, Taiyuan Bus App, and a hotline for obtaining public transit information. To expand the reach of travel information dissemination, Taiyuan can draw inspiration from Tokyo, Japan's development experience. This involves increasing the availability of services through websites, electronic display screens at stations, mobile apps, and WeChat platforms for comprehensive services, including information retrieval, consultation services, transfer routes, and route inquiries. It can help waiting passengers choose the best travel tools and transfer options. Furthermore, adding large screens at stations for public transit information and rolling news, onboard Wi-Fi, and other convenient services can both facilitate passengers' travel and provide entertainment. Empowering passengers with more choices ensures access to various travel-related information, such as tourism, weather, road congestion, and unexpected incidents during travel, effectively preventing efficiency delays due to information asymmetry.

## 6. Conclusion

This article investigates and analyzes the current status and issues of the development of smart public transportation in Taiyuan, coupled with the opportunities presented by the development of smart cities. By utilizing methods to monitor the entire process of bus operations through passenger and platform information, the transition from manual to intelligent means is further achieved. Smart public transportation addresses problems such as excessively long waiting times and uncomfortable travel experiences resulting from passengers receiving untimely or incomplete information. It also plays a significant role in advancing the intelligent allocation and refined management of current public transportation resources.

Through intelligent management methods, more accurate passenger flow information for each bus stop and even specific time periods along each bus route can be obtained. This allows for timely adjustments to bus routes, addition or removal of specific bus stops, or the introduction of new bus routes based on Taiyuan's strategic development and the actual progress of smart public transportation. This approach enables a scientifically balanced distribution of passenger

flow, enhancing the comfort of the commuting environment.

Smart public transportation effectively utilizes existing transportation infrastructure, reduces traffic congestion and environmental pollution, ensures traffic safety, and improves transportation efficiency. It is also an essential branch of smart cities and currently receives strong support from the government as part of the nation's future development plans. This innovative initiative aligns with the direction of significant investments in smart construction in the future. The optimization recommendations proposed in this article are based on the existing state of smart public transportation in Taiyuan, considering resident needs and urban development requirements. The suggestions range from infrastructure improvements to setting up query methods tailored to each passenger's needs, driving the progress of smart public transportation construction in the city. With the goal of enriching the city's intelligent attributes, enhancing the comfort of urban residents, and facilitating convenient public services, these recommendations hold great inspiration and reference significance for the future development of smart public transportation in Taiyuan.

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