Research of Intelligent Public Transportation Service Design in China

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ABSTRACT: In order to build a user-friendly and urban intelligent public transportation service system, this paper, treating the analysis of public transportation system of Beijing as a breakthrough point, provides a perfect service design of public transportation and the optimization of travel route basing on the user's habits, scheduling and health conditions. All the travel data of traffic system and users’ data such as health indicators are obtained from cloud platform. The development and application prospect of intelligent public transportation embodies the user-centered design concept. This paper preliminary develops a user-friendly and efficient design system of urban public transportation services with the trait of intelligence.

1 THE STATUS ANALYSIS OF URBAN PUBLIC TRANSPORTATION IN CHINA

Along with the rapid development of economy and urbanization in our country, a sustainable development of urban public traffic has been booming, but increasing the urban traffic pressure at the same time. How to improving the utilization efficiency of urban public transportation and urban roads has been the major problem of transportation industry in China now. In order to solve the problems of which users encountered and improve the public transportation system in the various services, it is imperative to promote the development of intelligent public transportation service design so that passengers’ green travel and smooth travel experience can be guaranteed.

1.1 China's urbanization and the restriction of transportation

The expansion speed of Chinese cities has been accelerated during the past two decades and this trend will continue in a large scale in the next 20 years. Moreover, the floating population will become the main driving factors. The McKinsey global institute predicted that there should be 221 cities whose population would be more than 1 million in China by 2025. Among those cities, about 23 cities will burden more than 5 million people. Besides, there will be more than ten million living in the cities such as Beijing, Shanghai, Guangzhou, Shenzhen, Tianjin, Wuhan, Chongqing and Chengdu. China's urban population will reach 926 million then and will exceed 1 billion by 2030. It seems that traffic congestion is an inevitable problem in the rapidly development of urbanization.

Figure 1. Population statistics of Chinese large and medium-sized cities in 2015.
1.2 Traffic pressure caused by urban population flow—taking Beijing for example

Taking Beijing for an example, the frequent flow of urban population causes the huge pressure of urban traffic. The Beijing traffic congestion phenomenon has happened frequently since 2010. Population has reached 12.8 million in Beijing downtown at present with its population density in core city maintaining as 24000 people per square kilometer, accounting for about 60% population of the whole city. Beijing downtown provides about 7.5 million positions, accounting for 65% of total employment in the city. The functions of the center region and the people in the center region of Beijing are too concentrated. 70% of floating population is in the center region (12% in the city and 58% outside the city). Those conditions make the center of Beijing city a traffic jam region.

According to statistics of the 2010 China's New Urbanization Report, launched by the sustainable development strategy research group of Chinese academy of sciences, Beijing residents spent the longest commuting time, an average of 52 minutes. The development of Beijing city is in the form of concentric circles spreading outward, from the second ring road to sixth ring road. This kind of development causes that the center of Beijing city are full of residents. But core resources in Beijing such as the jobs, all kinds of market, universities and hospitals are concentrated in the center of the city making the residents commute between central city and the city center. Hence the tidal surge like of pedestrian traffic becomes a heavy burden of the urban public transport system.

1.3 Present situation of urban public traffic service design in the domestic and overseas

Facing the increasingly serious urban public traffic problems, every country puts forward many solutions and measures to inverse this trend. In view of optimizing the city's public transportation system with service design concept, information technology, sensor technology, automatic control and artificial intelligence are all used to implement the intelligent service of the public transport system and perfect the urban traffic service design. This could not only improve the efficiency of the user's travel and but also have become a development trend of the urban public transportation system in the future both in the domestic and overseas.

International cutting-edge research will be the introduction of public transport services to the construction of smart city. A representative case is The Array of Things in Chicago. The Array of Things (AoT) is an urban sensing project, a network of interactive, modular sensor boxes that will be installed around Chicago to collect real-time data on the city’s environment, infrastructure, and activity for research and public use. AoT will essentially serve as a “fitness tracker” for the city, measuring factors that impact livability in Chicago such as climate, air quality and noise.

Intelligent transportation system research in Japan, starting from 1937, has formed an intelligent industrial transportation system chain, which could integrate road traffic effectively. Moreover, it has basically achieved good effects. After the first world Intelligent Transportation System (ITS) conference held in Paris in 1994, Japan had successively organized two world ITS conferences in one decade. ITS communications system includes four aspects as the side of the road facilities communication technology, road vehicle communication technology, inside the car communication technology and car-to-car communication technology. This ITS technology research and development will pay more attention to the following aspects: the road traffic safety (security, peace of mind), traffic continuity and reduce environmental load (environment, efficiency), transport system involved in the convenience of fast (comfortable, convenient), regional transportation convenience fast (comfortable, convenient) and so on.

China is in a transitional period. Road infrastructure has had a more complete system. Locomotive is also rapid growth to 200 million. The traffic efficiency and traffic safety, traffic pollution and other issues, however, are increasingly highlighted as well. Under the current system, traffic system, urban management, and public security departments control China’s transportation information. The information sharing between different departments is rare. In the future we need to make full use of existing facilities, such as traffic, road, establishing a national level of information sharing and coordination channel with the aid of intelligent transportation technology, intelligent transportation service design. It can help to reduce traffic pollution and improve the efficiency of transportation and traffic safety. At present, the intelligent transportation system in China has

![Figure 2. Schematic diagram of population flow in central and non-central urban areas of Beijing.](image-url)
jumped from the exploration to the actual development and application stage. Multiple places has carried on the beneficial attempt in the fields of city transportation and highway and achieved some results. Beijing has built a number of intelligent public transportation management systems, including modern traffic scheduling command system, traffic signal control system, traffic monitoring system, etc.

2 THE CONCEPT AND MEANING OF PUBLIC TRANSPORTATION SERVICE DESIGN

2.1 Design concept of urban public transportation services

Intelligent public transportation refers to the public transportation system based on information technology, which can provide users with accurate real-time traffic information and make it easy for users to arrange travel time.

Urban transportation service can be defined as regarding the users as the center. When users make displacement, the two parts, a series of service activities including bus ticketing services, guide services, operation services, information services, special services and emergency services, and information service providing personalized travel, constitute the whole service process. The process is in the process of interaction between the user and the service personnel and between hardware and software, whose essence is to meet the user's needs and create value for it furthest.

Intelligent public transportation service design is based on the concept of humanized urban traffic service, which played a positive role for improving the capacity of public transportation services. How to implement the intelligent of the urban traffic system user service is one of the important directions that we need to design and research further.

2.2 The significance of public transportation service design

To ordinary people, public transportation is the main choice of travel. Hence the development of public transportation is an important mean to realize social justice and equality. Rely on walking; radius of the user's work or activities is hardly more than five kilometers. When turning to the bike, the radius is difficult to exceed 10 km. When coming to public transportation, it can greatly go beyond the scope of walk or riding. For example, the operation speed of metro in Beijing can reach 60 km/hour, which could fully satisfy people's needs. Public transportation service design, regarding the travel demand of ordinary people as the service concept, can not only provide more thoughtful and convenient public transportation services, but also solves the public transportation problems encountering in the process of urbanization and alleviates the pressure of public traffic system in big and medium-sized city.

Figure 3. Comparison of Beijing public transportation travel mode and travel range.

2.3 The target users of urban public traffic

The target users of urban public traffic can be divided into three categories. (1) Commuters: regular commuters going to work or study. To this kind of users, service system should be designed focusing on the travel distance, change frequencies and the journey duration. (2) The immigrant population includes short-term visiting crowd and business travel. Tourism service design should take the channels in and out the city and the use frequency of transportation hub or hot spots into consideration. Besides, the luggage weight should come into our mind as well. (3) Local crowd travel occasionally owing to holiday outing or retiring. Activities of such users are mainly concentrated in the commercial center of the surrounding traffic so that walking can usually meet the demands. According to different urban public transport users, the users' demands are different leading that the city's public transportation service design has the characteristics of their respective and focus.

2.4 Urban public transportation system

Urban public traffic system contains numerous types, which could be subdivided into three categories. (1) The buses (or electric buses): ordinary bus, bus rapid transit, new bus (new lines, tourist routes, custom bus, and microcirculation bus system). (2) Rail transit: light rail on the ground, underground subway (line transformation, the new line, special line, fully automatic driving). (3) Assistant public transport: taxi, bicycle, ferry, auxiliary BUS (taxi, urban public bicycle, Dede BUS). Successfully management of all kinds of public traffic can save passengers' travel time and improve the efficiency of passengers travel.
Optimizing combination scheme of public transport types makes the urban public traffic service design more humanization, efficiency and intelligence.

3 THE SERVICE DESIGN OF INTELLIGENT PUBLIC TRANSPORTATION BASED ON THE HUMANIZATION

3.1 The technical support of intelligent public transportation based on the humanization

In the developmental times of depending on science and technology, the intelligent public transportation system based on human intelligence technology, the emergence of car networking, cloud computing and big data technology is keeping improving. While the development of intelligent public traffic system relies on the progress of science and technology, on the other hand, the development and application of new information technology promote the progress of the intelligent public traffic system and accelerate the trend of intelligent and humanization of city public transportation system.

3.1.1 Car networking technology

Car networking is the application of Internet of things technology in the intelligent transportation, which uses perceptive equipment inside and outside of the car to get the information of all cars and the static and dynamic environment through the radio frequency identification technology, and then exchange and communicate by the network communication equipment and technology, finally provide effective supervision on all the vehicle's running state and integrated services network of high efficient and intelligent network according to the different functional requirements through the intelligent information processing equipment and technology.

3.1.2 Cloud computing technology

Cloud computing technology provides important enabling technology and services for the storage of great capacity information and intelligent computing. Cloud computing is a new generation of Internet based on computing mode and idea, which manages a large number of decentralized, heterogeneous IT resources through the Internet and huge amounts of information processing to form a large virtual resource pool (hardware and software resources and information sharing), so as to provide to the users by the network and the form of service.

3.1.3 RFID tag technology

RFID, as a new automatic identification technology, is proper to use in intelligent traffic and parking management because of the long-distance identification, carrying more information, reading quickly and wide scope of application. It is also a kind of sensor technology, RFID technology combines with radio frequency technology and embedded technology, which is a integrated comprehensive technology. So RFID has a broad application prospect in automatic identification and ITS.

3.1.4 Intelligent science and technology

Artificial intelligence provides the wise technical foundation for intelligent transportation and supports huge amounts of information in intelligent traffic intelligent recognition, integration, operation, monitoring, processing, and other functions. Artificial intelligence researches and uses the method of artificial technology and imitation, extending and expanding the intelligent human to achieve machine intelligence. At present, the important application of key technologies include: intelligent science subject technology, machine learning and data mining, semantic grid and knowledge grid computing, autonomic computing, cognitive informatics and content, etc.

3.2 Based on the humanized public transportation intelligent node

For humanistic demand of users’ travel, it builds the various nodes of intelligent public traffic system and increases shared services, intelligent information system, the optimal route and service site selection in the walking node location; it also builds compound and convenient service, collect user health data and location services, and provides the optimal transfer and route choice in ride node; it provides exchange information in bus and subway node, location-based services and remind, convenient services such as intelligence and the surrounding information push service node.

It provides users with a series of more efficient, convenient, green and safe travel arrangements from the perspective of improving the user experience by building public transport intelligent node design services.
3.2.1 The walk of intelligent public transportation service design
When the users choose walking in the initial, the application of big data cloud platform will plan preliminary planning of optimal combination, route and transport and predict time needed for full travel for users, according to the traffic network based on traffic congestion data information and user trip plan. And it will check out the nearest public bike stations, bus stops or subway stations for users, and simultaneously measure the users walking, breathing rate and pulse beat to forecast users' health conditions to customize personal exercise health system and provides the corresponding Suggestions. It provides location services for children, the elderly, and the disabled, which they can share with family in case of the lost or getting lost.

3.2.2 The ride of intelligent public transportation service design
When the users select the public bicycle as travel mode, according to the large network data cloud platform query user nearest subway stations and bus stops or the fastest train or bus station, they can choose optimal route and transportation planning according to the cloud platform provides the congestion of data information. Public bicycle sites provide smart card services (such as in a fixed time to use public bicycles, free overtime fee, etc.) and the smart IC card will bind the service function of public transportation and facilities. It provides cycling route navigation, destination and locates the nearest public bicycle sites in order to choose the nearest parking sites for the users and measures the user steps cycling, breathing rate, pulse rate, fitness evaluation to predict user's health, and synchronized to the users' personal health system. It provides location services for children, the elderly, and the disabled, which they can share with family in case of the lost or getting lost.

3.2.3 The bus and subway of intelligent public transportation service design
When users are in the bus and subway, they can query the user expected pit stop time of bus, subway and expected arrival station number according to the cloud platform to provide data information such as traffic congestion, getting the optimal route and combined transportation. Users can query the bus, the subway station time, distance and predict the distance to the nearest public bicycle site, the bus stations, subway stations and bus stops or arrival time, and positioning the surrounding tourist attractions, scenic spots, shops, food service, etc. and custom personal travel and entertainment system. At the same time, it is concerned about society people like children, the elderly, and the disabled, providing them with location-based services, which they can share with family in case of lost or getting lost. For big luggage or disabled passengers, it provides ladder or other convenient transportation services (for the elderly, visitors or people with disabilities, etc.). It also provides users with arrival remind information inside the bus and subway system and guides the users to select the fastest circuit transfer or to export the direction, guides passengers to reach the final destination for the smooth travel.

3.3 The intelligent urban public transportation service system based on humanization
Humanized intelligent urban public transportation service system is user-centred, the cloud platform decided the traffic network optimal routes and transportation by collecting users travel habits, travel arrangements, such as health according to the users travel big data sets and health indicators data collection building conforms to the user's personalized travel plans, and combined with large data ultimately. At the same time it also provides users with service design in each node in the process of travel, and return the user’s evaluation and feedback to the cloud system.

Cloud system stores the user’s every travel records and all kinds of information to construct users travel related information database and the cloud platform will integrate data in order to prepare the next travel choice for the users and provide more intelligent, humanization and efficient service system.
4 CONCLUSIONS

Intelligent public traffic system is the efficient solution to the problems such as traffic congestion caused by urbanization. Intelligent urban public transport service system based on the humanized is also the development trend of urban traffic in the future. The construction of urban public traffic service cloud system, the combination with large data traffic technology and user-centered server provide more personalized, humanization, intelligent and highly effective public transportation services. In the future, with the wise city sustainable development, urban development pattern, the travel mode and travel culture transformation, intelligent public traffic service design system will effectively alleviate and gradually solve the urban traffic congestion, build green unimpeded city public traffic environment, and provide better services for each passenger to experience intelligent public transportation service.

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