Research on the Optimization of Green Travel Modes under the Guidance of intelligent Transportation--A Case Study of the Nanguan District Section of the Yitong River in Changchun City

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Abstract. The scope of this research is focused on the segment of Yitong River in the Nanguan District of Changchun City. Utilizing GIS technology, a thorough analysis of the transportation accessibility in Nanguan District is conducted. Additionally, a survey is distributed to residents to explore their needs. Through this approach, the study aims to analyze the optimization pathways for green commuting under the guidance of intelligent transportation. The research reveals significant traffic pressure in the surrounding area, particularly concentrated in regions close to the city center. Despite residents having some understanding of green commuting methods, there is a need to enhance the application of intelligent transportation technologies. This study provides targeted optimization pathways for the intelligent transportation system at the intersections of Changchun's city center, Yitong River bridges in Nanguan District, and commercial areas. It also proposes promotion plans for the green commuting infrastructure around major commercial zones and Yitong River bridges in the Nanguan District. Connecting Intelligent Transportation Technology to Green Mobility Modes. In conclusion, it is recommended that future urban planning in Changchun should prioritize the transportation nodes in the Nanguan District, with a focus on the directional development of green commuting and transportation management methods.

Keywords: Yitong River; Transportation accessibility; intelligent transportation; Green travel

1 INTRODUCTION

The traffic situation around the Nanguan District section of the Yitong River in Changchun City is one of the most traffic-stressed sections in the city. This section flows through the center of Changchun city and is connected to many major traffic arteries in the city, resulting in increased traffic flow, pollution and traffic congestion.

Therefore, it is important to improve the traffic situation around this section to optimize the traffic and environmental conditions of the whole Changchun city. At the same time, this section flows through the core business district of Changchun, and is also the area where Changchun residents travel frequently in their daily lives, so it is particularly important to improve the traffic conditions around this section in order to enhance the travel experience of the citizens.

As of November 21,2023, according to the Changchun Transportation Bureau's information on the status of the transportation industry in Changchun, the number of motor vehicles in Changchun has been increasing year by year, which has led to more and more serious traffic congestion. There are a total of 52 cruising cab companies in the city, with 15,402 vehicles, including 2,429 individually operated vehicles, and an average daily passenger volume of about 450,000 trips. A total of 124 online taxi platform companies in the city have obtained online taxi operating licenses, of which 52 online taxi platform companies are in operation in Changchun. A total of 15,957 vehicles have obtained network reservation rental car transportation licenses, and 73,035 drivers have obtained network reservation rental car driver licenses. The operation data reported by the 52 online taxi platform companies operating in Changchun shows that the average number of completed online taxi orders per day is about 200,000 orders. And as of July 1, 2023, Changchun is located in the fourth most congested city in China, according to online data. Therefore, the next main problem studied in this paper is how to improve urban transportation, especially during rush hours, while protecting the environment [1].

Considering the typicality and specificity of the section of Yitong River Nanguan District in Changchun City, this paper combines the current travel situation in Changchun City and uses GIS technology to explore the optimization research of green travel modes under the guidance of intelligent transportation. This paper will mainly study how to use the intelligent transportation system to optimize the traffic situation during peak hours and ease traffic congestion [2], and will also guide the public to adopt green travel mode, reduce the number of motor vehicle use, so as to alleviate the phenomenon of environmental pollution, and ultimately form a set of complete and feasible optimization scheme.

2   ANALYSIS OF REGIONAL TRANSPORTATION STATUS

2.1   Regional Overview

As can be seen from Figure 1, the study area of this paper is the Nanguan District section of the Yitong River in Changchun City, Jilin Province, which is connected to a number of major traffic arteries and flows through the downtown area of Changchun City, thus leading to high traffic pressure.
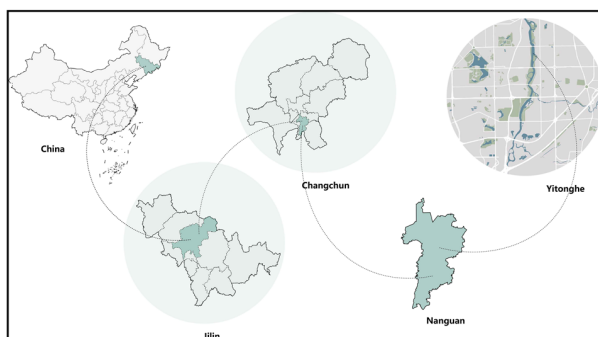
Fig. 1. Location Analysis Map.

2.2   Analysis of the Demographic Situation

According to the 2022 Changchun Statistical Yearbook, at the end of 2021, the household population of Nanguan District was 489,033, with a birth rate of 6.73% for the year. The annual natural growth rate of 4.26%, the family planning rate of 100%, and the mortality rate of 2.46% indicate that the population trend is positive. The number of persons covered by the minimum subsistence allowance for the whole year was 4,218, of whom 4,147 were in urban areas and 71 in rural areas, with urban areas accounting for the majority of the population and rural areas for a smaller number.

According to the data provided in Table 1, the total population of Nanguan District at the end of 2021 was 489,033, with 386,322 males and 410,403 females, a relatively balanced population structure. There is no rural population in the area, and the population is all concentrated in urban areas. It can be seen that future transportation planning in Changchun Nanguan District should not only focus on environmental pollution and traffic congestion within the city, but also promote green travel modes as well as pay attention to the travel needs of economically disadvantaged populations.

Table 1. Statistics on the number of households and population in Changchun Nanguan District in 2021.

Region	Nanguan
total number of households	209171
total population	489033
Male population	386322
Female population	410403
urban population	489033
Rural population	0

2.3   Analysis of Road Network Structure

From Figure 2, it can be concluded that the main arterial roads in Changchun Nanguan District are very closely spaced and the density of the arterial road network near

the center of the city is very high, with an overall form of nine horizontal and six vertical. Because of the huge amount of traffic passing through the area every day, the traffic congestion problem becomes more and more serious, especially during the peak hours. Noise pollution from honking vehicles on the roads around the Yitong River South Passage District has many negative impacts on the health and quality of life of the citizens, and the exhaust fumes emitted also contribute to the air pollution phenomenon.
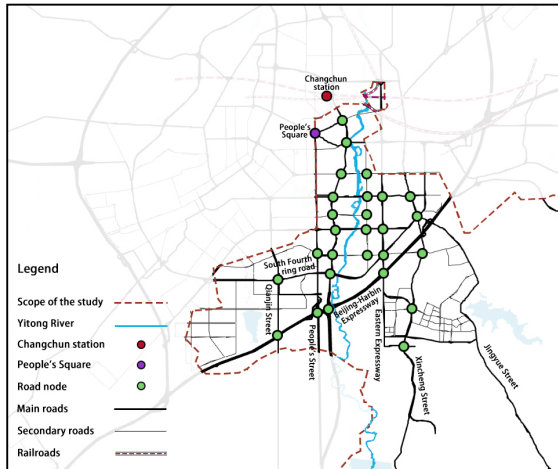

Fig. 2. Road Network Diagram of Changchun Nanguan District.

3   MAIN RESEARCH IDEAS AND RESEARCH METHODS

3.1   The Concept of Intelligent Transportation

The concept of intelligent transportation is a branch of the concept of intelligent city, is through the use of intelligent, information technology and the Internet and other technical methods, optimization and management of urban traffic, improve the efficiency and safety of traffic, reduce environmental pollution and traffic congestion problems, to provide residents with a convenient, safe and green travel path[3]. Intelligent transportation involves many fields, this paper mainly studies its traffic management aspects, the use of advanced technological techniques, such as big data, artificial intelligence, etc., so that the traffic system becomes more intelligent, information technology and adaptive ability, so that the urban traffic becomes convenient, efficient and sustainable development. The role and functions of intelligent transportation in green travel are mainly reflected in optimizing the transportation system, enhancing the efficiency of public transportation, promoting green travel modes and improving traffic safety.

3.2   The Role and Function of Intelligent Transportation in Green Mobility

The role and functions of intelligent transportation in green travel are mainly reflected in optimizing the transportation system, enhancing the efficiency of public transportation, promoting green travel modes and improving traffic safety.

3.3   Research Methodology

GIS analysis method.
In this study, the use of ArcGis geographic information technology system can play an important role, through the spatial analysis of the traffic accessibility analysis[4], and thus the data for visualization of the results of the presentation, which helps to understand in-depth the current situation of the traffic around the section of Changchun Yitong River Nanguan District, as well as the potential problems.

Questionnaire method.
By designing and distributing questionnaires, we understand the attitude, willingness and demand of the public towards transportation modes and towards green travel, etc. By understanding the needs and expectations of the residents as well as the current status of the study, the best optimization plan for green travel modes and traffic congestion applicable to the section of Yitong River Nanguan District in Changchun City will be guided in a targeted manner.

3.4   Transportation Accessibility Analysis

Firstly, before preprocessing the SHP vector data of the road network in Nanguan District, Changchun City in 2023 with GIS, firstly, a suitable geographic coordinate system is selected, the road network is projected and screened to export highways as well as primary, secondary and branch roads, and then all the intersecting lines of the network are interrupted to perform topological complementary processing. After adding the network dataset, the OD cost matrix is established and calculated. That is to say, the shortest distance between any two points in a number of grids dividing Changchun Nanguan District is calculated, so as to derive the results of the matrix, which also takes into account elements such as travel time and various types of transportation, reflecting the traffic accessibility situation in different areas. Immediately after that, the inverse distance weighting method is applied to interpolate the calculation, which makes the spatial distribution of traffic accessibility more intuitive and obvious, and estimates the traffic accessibility of the whole Nanguan District. Through the GIS analysis method, the transportation accessibility of each area within Changchun Nanguan District is shown. The accessibility of each area is shown by the color scale, the darker the color means more convenient transportation, on the contrary, the lighter the color means poor transportation accessibility. Understanding the traffic situation of each area can be concluded by observing the value of the color scale. In Figure 3, it can be seen that the worse the accessibility of the place, the closer it is to the central part of Changchun, the less convenient it is for the citizens to

reach their destinations through all kinds of transportation. In summary, the spatial difference of transportation accessibility in Changchun's Nanguan District is very obvious, especially the poor transportation accessibility in the areas close to the city center and around the Yitong River, which will surely reduce the transportation efficiency and travel experience of the residents in this area. Therefore, for the traffic accessibility problems of different attribute areas, it is necessary to adopt their own targeted optimization schemes and traffic planning, so as to improve the traffic efficiency and travel experience of the residents.
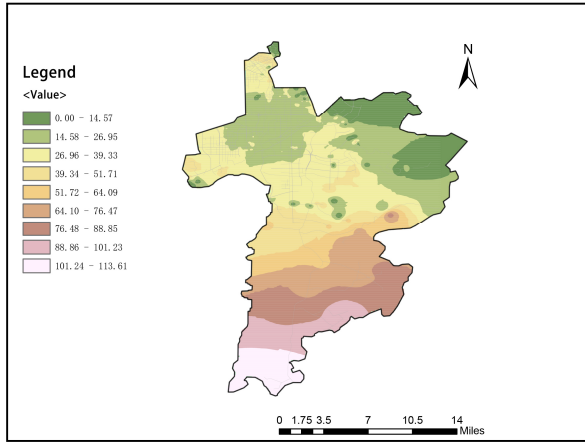

Fig. 3. Changchun Nan Guan District Transportation Accessibility Analysis Map.

4   SURVEY AND ANALYSIS OF RESIDENTS' NEEDS

4.1   Questionnaire Design and Implementation

Questionnaire Design.
The purpose of this questionnaire is to understand the expectations of the residents around the section of Yitong River Nanguan District in Changchun City about green travel modes and the demand for intelligent transportation technologies. In addition to collecting basic information, the perception of green travel modes and intelligent transportation technologies is also collected, with special attention to the application of green travel modes around the section and their actual use. By examining the existing challenges of green travel modes and suggesting solutions to them, and understanding how convenient it is for residents to ride, walk, and other forms of public transportation, it is important to delve deeper into the stance of green travel modes oriented towards intelligent mobility and the possibility of choosing to try out these modes based on the concept of intelligent mobility. Ultimately, it will also be necessary to adopt residents' suggestions on how to promote the development of green mobility and intelligent transportation in Changchun City in the future.

Questionnaire Implementation.

The questionnaire was administered online using the Questionnaire Star platform, and the link to the questionnaire was sent to residents of different ages, occupations, and educational levels around the Nanguan District section of the Yitong River in Changchun City, and the responses were anonymized in order to protect the privacy of the information. After enough questionnaires were submitted, the data were processed statistically to provide targeted recommendations for the development of green travel in the region.

4.2   Presentation of Questionnaire Results and Data Analysis

A total of 500 questionnaires were returned. The survey on intelligent transportation and the perception of green travel modes around the Nanguan District section of the Yitong River found that most of the residents are somewhat aware of it, and 202 respondents believe that green travel is important. In terms of the level of understanding of the application of intelligent transportation technology, most of the respondents have a very shallow understanding, but there are a few who have a basic understanding. In terms of the role of intelligent transportation technology in optimizing and promoting green travel modes,175 respondents believe that the technology can alleviate traffic congestion, 157 respondents believe that it can lead to an increase in travel efficiency, and 104 respondents believe that it can reduce the environmental pollution caused by motor vehicle travel. In terms of the use of green travel tools,401 respondents considered buses and subways to be the most commonly used modes, while 99 respondents chose bicycling and walking because these modes are more environmentally friendly and convenient. In terms of convenience of green travel modes, 338 respondents considered bicycling and walking to be more convenient, while 162 respondents considered buses and subways to be more convenient. Existing problems with green mobility as perceived by the respondents include lack of infrastructure, high time cost, and safety. In order to solve these challenges, the main paths include increasing the safety management tools and the construction of related infrastructure. In terms of optimizing green travel modes under intelligent transportation, providing real-time traffic information to help residents choose the best travel paths was approved by 407 respondents, 93 respondents approved of strengthening the penetration of new energy vehicles and the development of shared electric vehicles, and 490 respondents indicated that they would be willing to try to use green travel modes under intelligent transportation. In terms of future urban development in Changchun City, the most common suggestion is to increase the promotion and investment in scientific and technological innovation, followed by raising the awareness of the masses and actively encouraging green travel modes. In summary, residents around the Nanguan District section of the Yitong River in Changchun City consider green travel modes to be important and are aware of them, so intelligent transportation technologies have great potential to optimize and promote green travel. However, there are still challenges such as lack of infrastructure. In order to promote the development of green mobility, the region should invest more in science and technology innovation and raise public awareness to encourage residents to practice green mobility [5], and in

particular, the lack of infrastructure in Nanguan District needs to be addressed in a targeted manner.

5   OPTIMIZATION OPTIONS FOR TRAVEL MODES

5.1   Intelligent Transportation System Optimization

The use of intelligent traffic system around the section of Changchun Yitong River Nanguan District requires focusing on the traffic organization of the following three important nodes. The first is the intersection in the city center: the intelligent traffic signal control means to optimize the traffic flow rate, and thus slow down the road congestion. The second is the bridge over the Yitong River: the implementation of the intelligent guide system program provides real-time information on the status of traffic on the bridge, which in turn guides vehicles to choose the best path. Thirdly, around the commercial area: the intelligent parking guidance system is installed to improve the efficiency of parking and thus reduce traffic congestion.

5.2   Green Travel Mode Promotion

Construction of green travel facilities in nodal areas.
The first is the main commercial area: cycling and walking safety has been greatly improved through the construction of bicycle and pedestrian lanes. The second is the perimeter of the Yitong River bridges: by installing pedestrian bridges, thus facilitating pedestrians to cross the Yitong River and encouraging walking as a mode of travel.

Green Transportation Orientation Service.
The green transportation-oriented services introduced through the integration of intelligent transportation systems focus on the following two areas. The first is the commercial area: by providing the best paths for cycling and walking, it reduces the dependence of residents on motorized vehicles. The second is the residential area: by promoting new energy vehicles and electric vehicles, it provides shared mobility options, thus reducing the negative impact on the environment.

6   CONCLUSIONS

Firstly, it combines the traffic status quo around the section of Changchun Yitong River Nanguan District and the characteristics of the key nodes, and then puts forward the specific green travel mode and traffic management optimization measures. In Nanguan District of Changchun City, which has special regional characteristics, this paper proposes traffic optimization measures with obvious specificity. Through the introduction of intelligent transportation systems, especially in combination with the geographical conditions of the river crossing, the traffic flow can be effectively guided and the efficiency of traffic travel can be improved. The optimization of green

travel modes is particularly focused on improving cycling and walking conditions in order to more effectively match the characteristics of Changchun's plains city and thus improve accessibility.

The next recommendations are divided into two areas, namely green travel modes and traffic management. By optimizing the intelligent transportation system, intelligent guide services are implemented for the node areas, which in turn effectively improves traffic mobility. In terms of green travel, through green traffic guidance services and the construction of green travel infrastructure in the nodal area, thereby encouraging residents to ride, walk, and use environmentally friendly means of transportation, thereby reducing the demand for motor vehicles by residents.

Finally, it is suggested that future urban planning in Changchun's Nanguan District needs to pay more attention to the transportation nodes around the Yitong River section, emphasize the importance of the transportation characteristics of the node area, and target the development of green travel modes and traffic management. Such a direction of development will not only help Nanguan District, but also make the entire Changchun City's transportation and urban environment more livable and walkable.

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