Advances in Computer, Signals and Systems (2023)
Clausius Scientific Press, Canada

DOI: 10.23977/acss.2023.070814
ISSN 2371-8838 Vol. 7 Num. 8

Design of an Intelligent Travel Path Recommendation System Based on Dijkstra Algorithm

Xiaoli Jiang*

Henan Vocational College of Agriculture, Zhengzhou, Henan, China
18751809036@163.com
**Corresponding author*

Keywords: Dijkstra Algorithm, Intelligent Design, Tourism Planning, Path Recommendation, System Design

Abstract: The design background of the intelligent travel path recommendation system based on Dijkstra algorithm is to solve the problem of users choosing suitable routes among numerous tourist destinations. With the rapid development of the tourism industry, people's demands for tourism experience are also increasing. However, facing numerous tourist attractions and complex transportation networks, users often find it difficult to determine the best travel route, which consumes a lot of time and energy. In order to solve this problem, an intelligent travel path recommendation system has emerged. The system utilizes the Dijkstra algorithm to quickly find the optimal route between the user's location and destination by calculating the shortest path. At the same time, the system could also consider the personalized needs of users. Through experimental analysis, it can be seen that the evaluation is tested in five aspects: budget planning, route planning, clothing, food, housing and transportation planning, system overall, and system processing speed. The number of experimental participants is 400, and the satisfaction rate is above 308. It can be seen that the role of the system is to provide efficient and convenient tourism route recommendations, helping users save time and energy. Through this system, users can better plan their travels, reduce the occurrence of getting lost and wasting time, and improve the quality of their travel experience.

1. Introduction

In today's digital age, the rapid development of technology is bringing profound impacts to various fields. Among them, the research on intelligent design methods has emerged as the focus of technological innovation [1], injecting new vitality and ways of thinking into sustainable urban development [2]. In this context, urban tourism planning has become a core part of the national spatial planning system [3] and is also facing new opportunities and challenges. Tourism planning is not only the superposition of technology, but also the perfect integration of knowledge, sensibility and rationality, art and technology [4]. In order to better meet the needs of tourists, how to effectively plan tourism routes has become a core issue in the industry [5]. At this point, the emergence of the Dijkstra algorithm provides a new solution to this problem [6]. This algorithm also exhibits its local optimality in solving the shortest path problem in directed graphs [7]. With the

help of Dijkstra algorithm, the design of an intelligent tourism path recommendation system has become possible. It can provide tourists with more reasonable and efficient tourism suggestions, thereby promoting the development of tourism planning towards a more modern and intelligent direction.

In summary, the combination of technology and tourism planning has opened a brand new door. The application of Dijkstra algorithm is not only a technological innovation, but also an upgrade and improvement of the tourism experience. With the continuous in-depth research and application of intelligent design methods, it is hoped that future tourism planning could be more forward-looking, efficient, and user-friendly, bringing every tourist a better and unforgettable travel experience.

2. Intelligent Travel Path Recommendation

2.1. Highlights of Recommended Travel Routes

Intelligent design is an important aspect of the development of internet information technology [8], and intelligent travel path recommendation is a convenient way to help travelers plan their itinerary. When using intelligent travel path recommendation, there are several aspects that need to be noted. The first step is to ensure the use of reliable applications or websites to obtain accurate data and information. Secondly, it is important to consider personal interests, preferences, and needs in order to receive personalized advice. In addition, time and budget constraints, as well as transportation convenience, should also be considered. Most importantly, intelligent travel path recommendation is only a reference, and the final decision should still be made by travelers themselves. It is necessary to maintain flexibility and an open mindset, and enjoy the exploration and adventure during travel.

Intelligence has become a fundamental trend in the development of various industries [9]. When recommending intelligent tourism routes, key points to pay attention to are shown in Figure 1:

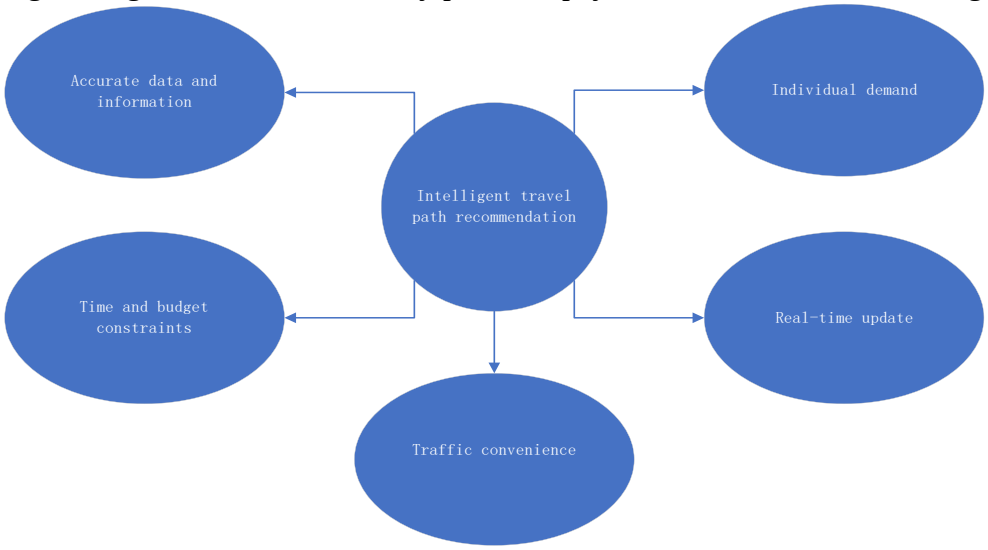

Figure 1: Key recommendations for intelligent tourism routes

Tourism planning is a specialized course in regional development [10]. The accurate data and information representation in Figure 1 ensures that the data and information used are accurate and up-to-date. This includes the opening hours of scenic spots, traffic conditions, weather forecasts, etc. Reliable tourism planning applications or websites are required to obtain accurate information.

Personalized needs: It is very important to consider everyone’s interests, preferences, and needs.

Intelligent travel path recommendation should be able to provide personalized suggestions based on personal preferences and needs. For example, if people enjoy cultural heritage, the system should recommend visiting historical sites and museums.

Time and budget constraints: Considering travel time and budget constraints, intelligent travel path recommendations should be able to provide reasonable itinerary arrangements. The system should be able to recommend the best travel route based on your time and budget.

Transportation convenience: The recommendation of intelligent tourism routes should consider the convenience of transportation. The system should be able to recommend the best transportation methods and routes based on your departure and destination.

Real-time updates: Travel plans may be affected by various factors, such as weather changes, traffic delays, etc. Intelligent travel path recommendations should be able to be updated in real-time and provide relevant information and suggestions.

From this, it can be seen that intelligent travel path recommendations should be accurate, personalized, reasonable, and able to be updated based on real-time situations.

2.2. Intelligent Travel Routes

Tourism planning is a planning process carried out to meet spiritual and cultural needs, and the construction of an urban cultural ecosystem should be an important goal [11]. The intelligent tourism path is a comprehensive concept that needs to combine three aspects: intelligent service tourism, intelligent business marketing, and intelligent government management. Firstly, service tourism intelligence refers to the use of intelligent technology and data analysis to provide a better tourism service experience. Through intelligent booking systems and recommendation algorithms, travelers can more conveniently find and book services such as hotels, air tickets, and scenic spot tickets. At the same time, personalized travel suggestions and recommendations can also be obtained based on personal interests and needs, as shown in Figure 2.

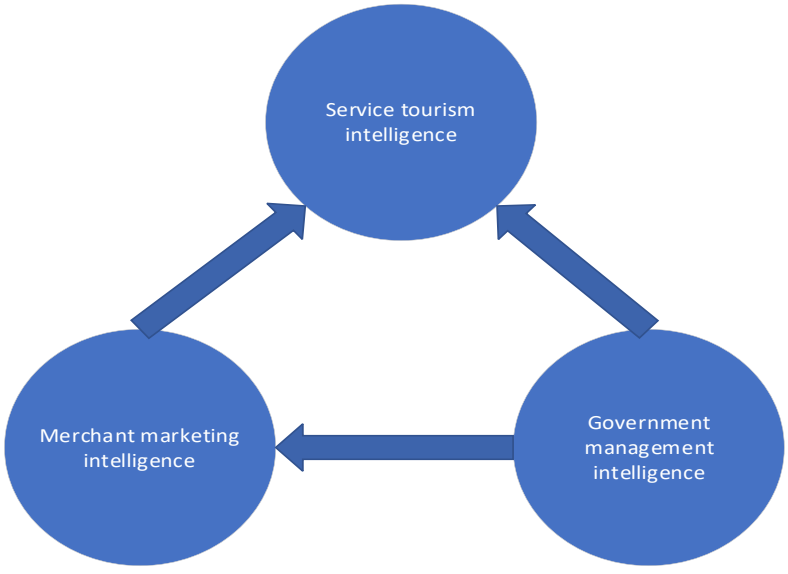

Figure 2: Key aspects of intelligent tourism routes

Intelligence has become a fundamental trend in the development of various industries [12]. In Figure 2, merchant marketing intelligence refers to the use of intelligent technology and data analysis to improve the marketing effectiveness of tourism merchants. Through intelligent market research and user behavior analysis, businesses can more accurately understand the needs and preferences of target customers, thereby formulating more accurate marketing strategies.

Meanwhile, intelligent advertising and promotion methods can help businesses more effectively attract and guide potential customers, enhance sales and brand awareness.

Intelligent government management refers to the use of intelligent technology and data analysis to improve the management efficiency and service quality of the tourism industry. Through intelligent data monitoring and analysis, the government can timely understand the dynamics and problems of the tourism market, and thus take corresponding policies and measures. At the same time, intelligent regulatory and service platforms can provide more convenient government services, strengthen the supervision of tourism practitioners and tourism products, and improve the overall management level of the tourism industry.

In summary, the intelligence of tourism paths requires a combination of three aspects: service tourism intelligence, merchant marketing intelligence, and government management intelligence. Through intelligent technology and data analysis, people can provide a better tourism service experience, improve the marketing effectiveness of merchants, and enhance the management efficiency and service quality of the tourism industry. This could bring travelers a more convenient and personalized travel experience, while also promoting the sustainable development of the tourism industry.

3. Dijkstra Algorithm Intelligent Travel Path Recommendation System

3.1. System Concept

At present, it is believed that the Dijkstra algorithm is the best method to solve the shortest path problem of a network without negative weight between specified two points or from a specified point to the other points [13], and the Dijkstra algorithm intelligent travel path recommendation system is a graph theory based algorithm used to find the optimal algorithm for the shortest path. In the travel path recommendation system, the Dijkstra algorithm can be applied to travel path planning to help travelers find the best travel route.

The Dijkstra algorithm is one of the most important methods in current social research [14]. In an intelligent tourism path recommendation system, it focuses on the following four aspects: tourism services, comprehensive control, tourism e-commerce, and tourism big data. The system architecture is shown in Figure 3.

The Dijkstra algorithm continues to improve by exploring the shortest path to solve real-life problems, providing convenience for production and daily life [15]. The architecture in Figure 3 is as follows:

Tourism services: An intelligent tourism path recommendation system should provide comprehensive tourism services, including hotel reservations, transportation planning, and scenic spot recommendations. By integrating data and information from various tourism service providers, the system can provide personalized travel suggestions and recommendations to users based on their needs and preferences.

Comprehensive control: The intelligent tourism path recommendation system should have a comprehensive control function, which can monitor the utilization of tourism resources and the dynamics of the tourism market in real-time. Through intelligent data analysis and monitoring, the system can assist governments and relevant institutions in the rational planning and management of tourism resources, improving the overall efficiency and sustainable development of the tourism industry.

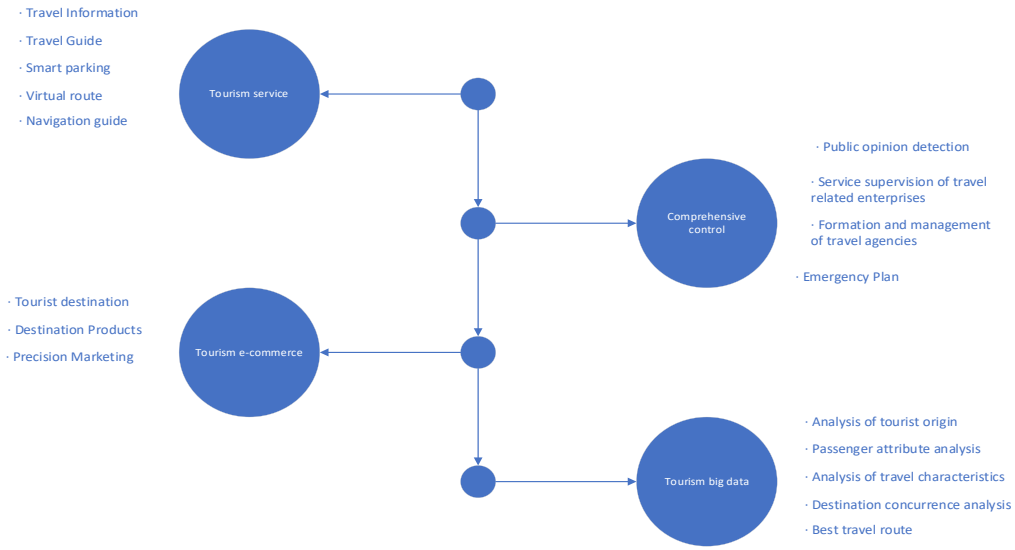

Figure 3: Dijkstra algorithm intelligent tourism system architecture

Tourism e-commerce: The intelligent tourism path recommendation system should seamlessly integrate with the tourism e-commerce platform to achieve online booking and trading of tourism products. Through intelligent recommendation algorithms and personalized services, the system can help users more conveniently choose and purchase tourism products, improving their shopping experience and satisfaction.

Tourism big data: An intelligent tourism path recommendation system should utilize tourism big data for analysis and mining, in order to provide more accurate and real-time tourism path recommendations. By analyzing user behavior data, tourism resource data, and market data, the system can continuously optimize recommendation algorithms and improve the accuracy and personalization of path recommendations.

The design of tourism routes is an extremely important part of tourism problems [16]. Combining with Figure 3, the Dijkstra algorithm intelligent tourism path recommendation system should focus on four aspects: tourism services, comprehensive control, tourism e-commerce, and tourism big data. Through intelligent technology and data analysis, it can provide travelers with better tourism experiences and services.

3.2. Structure of Dijkstra Algorithm Intelligent Travel Path Recommendation System

In the context of the continuous development of information technology, intelligent design has received more attention [17], and the Dijkstra algorithm intelligent travel path recommendation system is a graph-based algorithm aimed at providing personalized and accurate travel path recommendations for travelers. The system focuses on integrating online tourism services, offline tourism services, and route planning to meet the various needs of users during the tourism process. Through intelligent data analysis and recommendation algorithms, the system can help users plan the best travel routes, while providing convenient online booking services and real-time offline travel information. Taking into account the personalized needs of users and the actual tourism resources, the Figure 4 system is committed to improving the travel experience of travelers and creating an unforgettable journey for them.

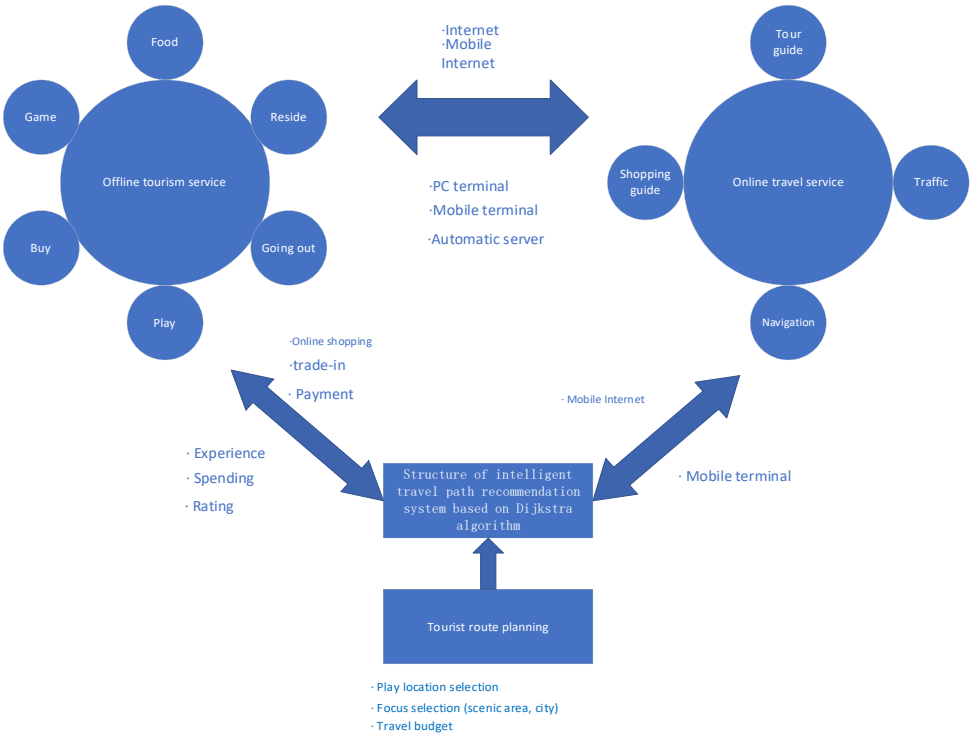

Figure 4: Structure diagram of Dijkstra algorithm intelligent tourism path recommendation system

In recent years, with the development of social networks, how to design path recommendation methods that meet the personalized needs of users has become an important research hotspot [18]. The main introduction architecture in Figure 4 is as follows.

Data collection and processing module: This module is still responsible for collecting and processing tourism related data, including scenic spot information, transportation information, hotel information, etc. At the same time, it is also necessary to consider the data of online tourism service platforms, such as online booking information, user reviews, etc., and translate data into usable formats for the system through data cleaning, integration, and preprocessing.

User demand analysis module: This module is still used to analyze users' travel needs and preferences. In addition to the information and historical behavioral data input by users, it is also necessary to consider their behavior and preferences on online tourism service platforms, and provide personalized travel path recommendations for users by analyzing their travel purposes, time constraints, budget constraints, and personal interests and hobbies.

Route planning module: This module still uses the Dijkstra algorithm for path planning. Based on tourism related geographic network maps, including scenic spots, transportation nodes, and hotels, the system can calculate the shortest or optimal path. Considering the needs and preferences of users, the system can weight paths, such as considering factors, that is, traffic congestion, popularity of scenic spots, and recommendations from online tourism service platforms. Path recommendation is one of the important research contents [19].

Online tourism service module: This module is responsible for interacting with the online tourism service platform to obtain online booking information, user reviews, and other data. By connecting with online tourism service platforms, the system can provide online booking functions, allowing users to directly book hotels, air tickets, scenic spot tickets, and other services in the system.

Offline tourism service module: This module is responsible for interacting with offline tourism service providers to obtain real-time traffic information, attraction opening hours, and other data.

By connecting with offline tourism service providers, the system can provide real-time transportation planning, scenic spot opening time reminders, and other services.

The system design determines the selection of parameters used in the design process, which can significantly affect the final result [20]. Figure 4 shows that the system can better integrate online tourism services, offline tourism services, and route planning, providing users with comprehensive tourism services and personalized travel path recommendations.

4. Dijkstra Algorithm Intelligent Travel Path Recommendation System Formula and Experiment

4.1. Formula

Formula for calculating path weight:

$$L = \alpha \times DW + \beta \times CW + \gamma \times PW \quad (1)$$

In Formula (1), L represents the path weight, and α, β, and γ are weight coefficients used to balance different factors. DW represents the distance weight between two nodes, which can be calculated using a specific distance calculation formula. CW represents the congestion weight on the path, which can be estimated based on real-time or historical traffic data. PW represents the heat weight of a tourist attraction, which can be calculated based on user ratings, number of tourists, etc. User preference calculation formula.

$$Y = \delta \times RW + \epsilon \times IMW + \vartheta \times TLW + \mu \times BLW \quad (2)$$

In Formula (2), Y represents user preferences, and δ, ϵ, ϑ and μ are weight coefficients used to balance different factors. RW represents the evaluation weight of attractions and services, which can be calculated based on user ratings, comments, etc. IMW represents the weight of the matching degree between user preferences and scenic spots, which can be calculated based on user interest labels, historical behavior, etc. TLW represents the weight of travel time restrictions, which can be calculated based on the user's travel time period, stay time, etc. BLW represents the weight of travel budget restrictions, which can be calculated based on the user's budget range, expense information, etc.

By calculating user preferences, the system can generate the most suitable travel path recommendations based on the personalized needs and preferences of users.

4.2. System Usage Experiment

The experiment randomly selected 400 tourism enthusiasts and 400 tourism professionals as the experimental subjects. The experimental subjects evaluated the system through 5 trips, including budget planning, route planning, clothing, food, housing and transportation planning, overall system performance, and system processing speed. By collecting the experimental subjects' feelings and analyzing the overall effectiveness of the system, the experimental data is shown in Figure 5.

From the analysis results in Figure 5, it can be seen that the intelligent tourism path recommendation system has achieved high satisfaction in budget planning, route planning, food, clothing, housing and transportation planning, overall system and system processing speed. The number of tourism professionals who are satisfied with budget planning is over 321, route planning is over 318, clothing, food, housing and transportation planning is over 308, the overall satisfaction of the system is over 315, and the system processing speed is over 332.

These results indicate that tourism enthusiasts and professionals are generally satisfied with the effectiveness of the system. The system can provide accurate and efficient travel route

recommendations, helping users make reasonable plans in terms of budget, route, and daily life. Users also gave high praise to the overall performance and processing speed of the system.

It can be seen that the intelligent travel path recommendation system has shown good results and user satisfaction in practical applications. In the future, the system's functions and algorithms can be further improved to enhance user experience and meet the needs of more users.

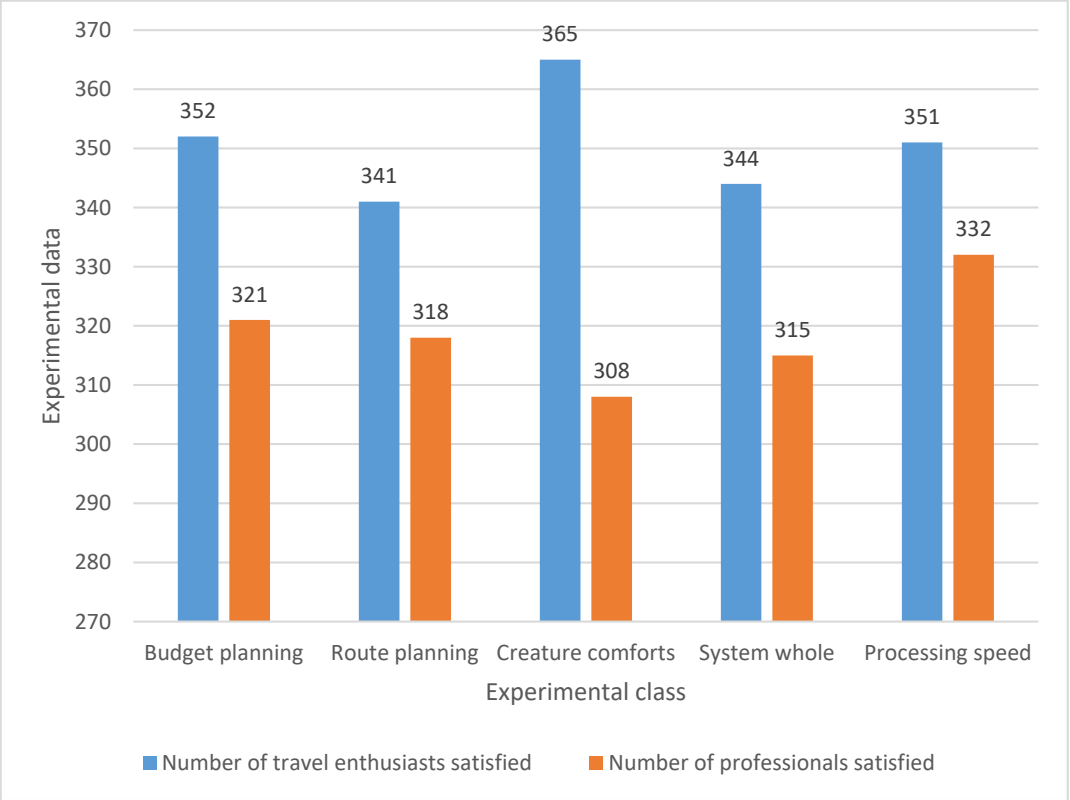

Figure 5: System usage experimental data

5. Conclusions

The intelligent tourism path recommendation system based on Dijkstra algorithm aims to solve the problem of users choosing suitable routes among numerous tourism destinations. With the rapid development of the tourism industry, people's demands for tourism experience are also increasing. However, facing numerous tourist attractions and complex transportation networks, users often find it difficult to determine the best travel route, which consumes a lot of time and energy. The system utilizes the Dijkstra algorithm to quickly find the optimal route between the user's location and destination by calculating the shortest path. Through this system, users can better plan their travels, reduce the occurrence of getting lost and wasting time, and improve the quality of their travel experience. In the future, the system's functions can be further improved, such as adding real-time traffic information and considering weather factors, to provide more comprehensive and accurate travel route recommendations. At the same time, personalized recommendation algorithms can be further optimized by combining user historical behavior and preference data to provide more accurate travel recommendations. In summary, the intelligent travel path recommendation system has broad application prospects in improving user travel experience.

Acknowledgement

2024 General Funding Project for Humanities and Social Sciences Research in universities of Henan Province: Research on the Construction of Henan Province's Homestay Industry Innovation Ecosystem from the Perspective of Cultural and Tourism Integration (Project No.: 2024-ZZJH-463).

References

[1] Wu Bo, Cheng Xiaoming, Ye Yonglin, et al. Research on intelligent design of floating system with special configuration in shallow water. Shipbuilding of China, 2020, 61(2):52-65.
[2] Wang Q, Mu Z, & Jin L. Control method of robot detour obstacle based on eeg. Neural Computing and Applications, 2021, 1-8.
[3] Yin Min. Positioning and transformation of urban tourism planning in the context of territorial spatial planning. Social Scientist, 2021, 000(009):61-65.
[4] Li Qinglei and Wang Hao. The attributes of creative labor in tourism planning and its management implications. Journal of Shanxi Datong University: Social Sciences Edition, 2022, 36(4):80-85. (in Chinese)
[5] Xu Tong and Zhang Yuli. Analysis on the essential characteristics, typical model and content system of global tourism planning. Journal of Sichuan Cuisine College, 2021, 000(002):27-33.
[6] Hou Jingfu. Research on Parallel optimization of Dijkstra Algorithm based on OpenMP. China Science and Technology Information, 2022. 000(011):110-111. (in Chinese)
[7] Zheng Yuqing, Chen Yong, Wang Jinhua, et al. Complex structure acoustic emission location method and its application based on Improved action distance and Dijkstra algorithm. Gold Science and Technology, 2022.030(003): 427-437.
[8] Zeng Bing. Research on the Application of Intelligent Design in the field of Space Design. Artist, 2020, 000(002): 49-49.
[9] Chu Yaling. Analysis of the influence of Building Electrical Intelligent Design on the development of Intelligent Buildings. China Strategic Emerging Industries, 2019, 000(002): 22-22.
[10] Pang Jiao. Discussion on teaching reform of Rural tourism planning curriculum under the background of rural revitalization. Neijiang Science and Technology, 2022, 43(3):92-93.
[11] Cheng Xiangwei. Cultural empowerment: A study on cultural expression strategies in tourism planning of Yangxian Lake in Yixing. Tourism Review, 2022, 000(004):64-83
[12] Yang, X., Li, H., Ni, L., & Li, T. Application of Artificial Intelligence in Precision Marketing. Journal of Organizational and End User Computing (JOEUC), 2021, 33(4), 209-219.
[13] Li Baofeng, Hao Puyu. An improved algorithm for a Class of Longest Path Problems based on Dijkstra Algorithm. Journal of Tangshan Normal University, 2019. 41(3):35-36.
[14] Lu Yi, Cui Yupu, Wang Kun, et al. Research on Improvement of Dijkstra Algorithm for Shortest Path Problems in Management Operations Research. Modern Information Technology, 2021. 5(13):84-86.
[15] Leng Sijia. Research on Optimization strategy based on Dijkstra Algorithm. China Science and Technology, 2019. 000(006):34-35.
[16] Ge Dongmei, Lai Zhizhu, Chen Qunli, Peng Shuiliang. Research on multi-objective model of individual rural tourism route selection. Journal of Guizhou Institute of Engineering and Applied Technology, 2020, 38(4):147-153. (in Chinese)
[17] Song Yue, Li Qinghui. Application of BIM technology in intelligent building design. 2021, 010(002):113-113.
[18] Sun Zhenqiang, Luo Yonglong, Zheng Xiaoyao, et al. An intelligent travel path recommendation method integrating user emotion and similarity. Computer Science, 2021, 48(S01): 226-230.
[19] Duan Zongtao, Ren Guoliang, Kang Jun, et al. Path recommendation method based on frequent trajectory sequence pattern mining. Journal of Taiyuan University of Technology, 2022, 053(002):240-247.
[20] Echeverri J, Dantan J Y, Godot X. Integrated design – multi-view approach for production systems design. Procedia CIRP, 2021, 100(1):217-222.