Smart Tourism Route Planning System Based on Machine Learning Algorithm

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***Abstract*—With the development of economy and the improvement of life quality, people have a deeper pursuit. Therefore, tourism has developed into one of the pillar industries of China's economy. Tourism has gradually become an important part of people's life and entertainment, but people's tourism consumption behavior has undergone significant changes, and they have a higher standard for tourism quality, which is the background of the birth of the concept of smart tourism. This paper analyzes the current situation and existing problems of tourism market route planning, and constructs an intelligent tourism route planning system based on machine learning algorithm to meet the diversified needs of tourists and promote the high-quality development of tourism Through the analysis of the tourism situation of a province from 2016 to 2020, the response time of the system was tested after the intelligent tourism route planning system was put into use. It was found that the response time of the system would increase 0.0005 seconds for every 100000 additional passengers. The increase of people flow will lead to system interface congestion, but the time is very short and can be basically ignored. The research shows that the design of the system can still bring convenience to passengers.**

Keywords—machine learning algorithm, smart tourism, route planning system, tourism industry

I. INTRODUCTION

With the vigorous development of the tourism industry, coupled with the convenient access to general information on the Internet in daily life, travel agencies in the past can no longer meet the needs of travelers in the new era. Travel agencies urgently need to change. In this case, people will not come through travel agencies. To obtain travel information, it is to obtain and extract relevant information suitable for their travel from various travel websites or interactive platforms such as small applications. Browsing travel pages through the Internet has become the main source of information for many travel consumers. If the domestic tourism industry is to develop rapidly, the research on the tourism route planning system has no time to delay.

Many scholars at home and abroad have conducted research on smart tourism route planning systems based on machine learning algorithms, and the research results are good. For example, Wang Chang et al. studied a cloud platform-based smart tourism information push system, using MapReduce under a certain platform the model improves the collaborative filtering algorithm, gradually gains users' interest through interaction, and finally recommends the results of the analysis to users. The research has improved traditional tourism information services, but it has failed to reflect the connotation of smart tourism and lack of autonomous feature learning function [1]. A scholar proposed an intelligent travel information service, which uses Agent technology with a semantic Web environment to help customers coordinate services between multiple transmission networks, use multiple transportation vehicles, and achieve end-to-end route planning, according to user needs and travel preferences recommend suitable travel itineraries to them [2]. Although the research results of the smart tourism route planning system based on machine learning algorithms are good, there are few high-level ones. It is necessary to design a smart travel route planning system to enable travel enthusiasts to get the best travel experience in the shortest time and expense.

At this stage, machine learning has been successfully applied to many fields, while tourism has been criticized for its single route design and tourists' lack of independent choice. The introduction of machine learning technology in tourism planning can provide accurate suggestions according to users' conditions, so that users can obtain more personalized travel plans; At the same time, the tourism focus is predicted and controlled to accelerate the development of tourism. Through the analysis of the mode of integrating machine learning with tourism route planning, this study establishes the importance and practical significance of machine learning in the tourism field. Machine learning is based on the user's choice of the options recommended by machine learning, and then through the integration of information, the best scheme is selected to facilitate users, improve security and service, and promote industrial development.

This article explains the definition of smart tourism and the content of tourism route planning. By introducing machine learning algorithms, a smart tourism route planning system is constructed, and then machine learning algorithms are used to optimize the details of the system. After the system is put into use, the functional response of the system is tested. I hope that the development of the system can better help tourists plan travel routes, make travel plans and travel decisions.

II. RELATED WORK

A. The Connotation of Smart Tourism

(1) Smart tourism is the application of cloud computing, high-performance information processing, data mining and other technologies in tourism, industrial development, administrative management and other fields, to increase tourism and information resources in a physical way, and serve through system integration and deep empowerment development. The public, enterprises, etc, are a new form of tourism with broad development prospects in the future. However, it is inappropriate to call smart tourism a new form of tourism, because smart tourism cannot exist independently, but is based on the innovation of traditional tourism [3].

(2) Smart tourism aims to integrate and equip sensors to various tourism enterprises, institutions and tourism business-related objects, integrate them, connect them to tourism destinations, and form the tourism Internet of things, and then the tourism Internet of things combine with the existing Internet to complete the integration of tourism activities and human society, achieve a high degree of integrated integration and interaction between tourism enterprises and society, and then achieve the unity of natural landscape, humanistic spirit and scientific spirit in tourism activities, and realize spiritual joy and naturalness, harmony, social harmony, and economic prosperity are a form of tourism [4].

(3) Smart tourism is based on the latest information and communication technology, meets the individual needs of tourists, provides high-quality and satisfactory services, and systematically intensively manages the transformation of the exchange and effective use of tourism and social resources. Its essence is intelligence such as information and communication technology. The application of technology in the tourism industry aims to improve the level of tourism services, innovate tourism management, optimize the utilization of tourism resources, enhance the competitiveness of tourism enterprises, and expand the scale of the industry [5].

(4) Smart tourism is a kind of tourism information service. According to the interests and preferences of tourists, according to their needs, the tourism information that adapts to each tourist is automatically pushed out, and its fundamental purpose is to provide tourists with tourism information services. This type of tourism information service provided by Smart Tourism allows passengers to obtain relevant information services at any time, anywhere and on demand. This type of tourism information service is inconsistent with the information provided by previous travel agencies. It can be low-cost, fast and efficient. Accurately obtain travel information. Smart tourism is designed to provide tourist information services tailored to the needs of tourists, instead of providing consistent information services to all tourists. This breaks the traditional broadcast-style travel information dissemination method and prevents tourists from not getting what they want. Information disrupts travel plans [6].

B. Tourism Route Planning

The planning of tourism routes is a tourism market operation mode. However, the most economical benefit of all tourism activities is nothing more than its regional characteristics. At the same time, one of the important indicators to measure the basic business capabilities of a region's tourism industry is to judge it. Do you have the ability to plan tourist routes? Tourism route design is the core of travel agency operation and management, not just a part of tourism planning [7].

Tourism route planning is a very broad concept, which mainly includes certain analysis and prediction of planned regional resources and market sources, so as to accurately locate its regional planning, development trends and development strategies necessary for planning. At the same time, it is necessary to understand the characteristics and content of the product, as well as the future product development direction, be able to accurately recommend the development scope of key projects, focus on innovation, characteristics and personality, understand the development process and the principles of related components, and outline it from a macro level Ideal design, such as regional tourism development planning [8-9].

The planning of tourist routes is mainly divided into three levels for individual, group and overall analysis. The individual level is mainly for individual tourists. How to provide personalized travel requires consideration of tourists' hobbies and travel restrictions (such as time, expenses, distances and points of interest at the start and destination); at the group level, the size of the appropriate tour group should be considered, how to consider the interests of most travelers in a tour group, and to allocate tours based on the experience of the tour guide; When tourism develops to a certain scale, it is necessary to consider how to recommend tourism based on the overall interests of tourists, that is, to make travel plans to minimize unreasonable tourist spots, such as overcrowding and long queue time [10-11].

C. Introduction to Machine Learning Algorithms

Machine learning is equivalent to humanizing the functions of a computer, which can find and solve problems like humans, so the application of machine learning algorithms to solve practical problems has become a key research direction. The research scope of machine learning is wide, and machine learning can be used to solve problems in many places. It is an interdisciplinary field that covers artificial intelligence, probability theory, operations research and other disciplines. The machine learning algorithm used in this article is the ADMM algorithm.

ADMM was originally proposed based on the extended Lagrangian algorithm. It is an arithmetic unit that solves optimization problems. It mainly deals with distributed convex optimization problems and transforms a relatively complex comprehensive solution problem into two or more simple step-by-step problem that are easier to calculate [12]. Therefore, the ADMM algorithm has the advantages of faster evaluation speed and more accurate calculation results.

The ADMM algorithm is generally used to solve optimization problems of the following form:

$$\min_{x,z} f(x)+g(z)$$
$$s.t. Ax+Bz=c \tag{1}$$

Among them, $x \in R^n$ and $z \in R^m$ are known variables, $A \in R^{p \times n}$, $B \in R^{p \times m}$, and c are known coefficients, and f and g are convex functions. Consider the augmented Lagrangian form of the problem:

$$L_\mu(x,z,y)=f(x)+g(z)+y^T(Ax+Bz-c)+\frac{1}{2}\mu\|Ax+Bz-c\| \quad (2)$$

Among them, y represents the Lagrangian multiplier of the linear equality constraint, and μ >0 represents the penalty factor for not satisfying the linear equality constraint. ADMM is mainly composed of the following three sub-iteration processes:

$$\begin{cases} x^{k+1} = \arg\min\ L\ (x, z^k, y^k) \\ z^{k+1} = \arg\min\ L_\mu(x^k+1, z, y^k) \\ y^{k+1} = y^k + \mu(A\,x^{k+1} + B\,z^{k+1} - c) \end{cases} \quad (3)$$

ADMM obtains the solution of the optimization problem by continuously iterating the above three steps. Where x^k represents the value of the variable x at the kth iteration, and y^k and z^k have similar definitions. If f(x) and g(z) are separable (that is, the objective function can be written in the form of thousands of sub-functions with the same structure, and each sub-function is independent of each other and can be processed in parallel), then the corresponding step of ADMM is Can be parallelized. Therefore, ADMM is often used to design parallel algorithms for large-scale distributed learning problems. In recent years, under the background of big data, ADMM has been applied in many specific applications and problems.

III. Experiment and Analysis

A. Design of Smart Tourism Route Planning System Based on Machine Learning Algorithm

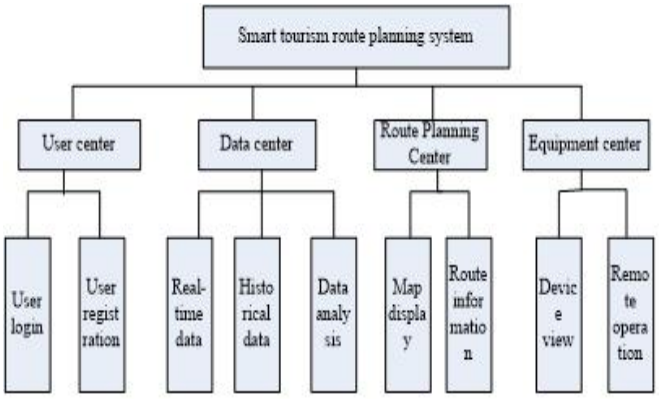

Fig. 1. Functional architecture of smart tourism route planning system.

As shown in Figure 1, the functional framework of the smart tourism route planning system is described as follows:

(1) User center module: mainly includes user login and registration. Through the connection with the database, the user's related information can be stored and read, which is the key to whether the user can enter the system.

(2) Data center module: mainly includes real-time data, historical data and data analysis. The database stores the real-time environmental parameter values collected by the sensor network, and the latest data read by the system is displayed to the user in a concise form. At the same time, it can realize the query of historical data and the curve analysis of various environmental parameters in tourism.

(3) Equipment center module: mainly includes equipment viewing and remote operation. In the device viewing section, you can understand the current status of each tourist attraction and detailed route dynamics. The threshold value of each parameter is determined by the threshold optimization method based on machine learning, and then the corresponding route planning device enablement can be driven adaptively. Realize remote intelligent search of route planning equipment.

(4) Route planning center module: mainly composed of map display part and route information part. By calling the Baidu map interface, the real-time information of the map and the parameters of the route can be displayed in the system interface.

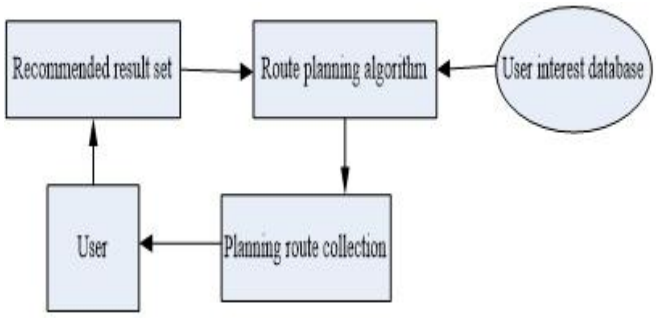

Fig. 2. Route planning module.

Figure 2 shows the detailed route planning function of the route planning center module. According to the output content of the recommended result set and the records in the user interest library, the recommended route is calculated and fed back to the user. The user can adjust the product or weight according to the result. Change the result of the recommendation algorithm and generate a new route plan again until the user is satisfied.

B. Functional Test of Smart Tourism Route Planning System Based on Machine Learning Algorithm

TABLE I. Tourism in a Province from 2016 to 2020

	2016	2017	2018	2019	2020
Number of tourist attractions(several)	4	4	5	7	8
Number of tourists (ten thousand people)	456	783	915	1270	1362

Tourism income(Ten million yuan)	314	569	801	1086	1117

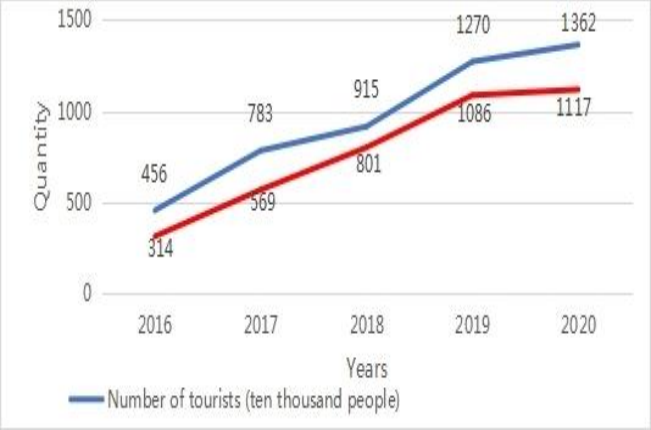

Fig. 3. The number of tourists and tourism revenue from 2016 to 2020.

In order to test the function of the smart tourism route planning system, the tourism information of a province from 2016 to 2020 was collected, as shown in Table I and Figure 3. Among them, the number of tourist attractions increased from 4 to 8 between 2016 and 2020, The number of tourists is also on the rise, from 4.56 million to 13.62 million. Tourism income also increases with the increase in the number of tourists, and it has a linear upward trend during 2016-2019, from 31.4 billion yuan to 11.17 million yuan, it can be seen that the province's tourism is also getting better and better.

TABLE II. RESPONSE TIME OF SMART TOURISM ROUTE PLANNING SYSTEM

Number of people (ten thousand people)	Second
10	0.001
20	0.0015
30	0.002
40	0.0025

As shown in Table II, the system response time tested after the city puts the designed smart tourism route planning system into use, when the number of tourists is 100,000, the system response time when searching for routes is 0.001 second, and when the number of tourists is 200,000 The system reaction time is 0.0015 seconds. When the number of tourists is 300,000, the system reaction time is 0.002 seconds. When the number of tourists is 400,000, the system reaction time is 0.0025 seconds. That is to say, for every additional 100,000 tourists, when they search for routes through the smart tourism route planning system, the system's response time will be 0.0005 seconds slower, indicating that the system's response speed is good.

IV. CONCLUSION

In recent years, with the rapid development of tourism informatization in China, the traditional travel mode is also changing quietly. The in-depth application of information technology makes it possible for tourists to plan their own travel routes. However, while the Internet brings convenience to people, it also brings a lot of redundant information. It takes a lot of time to choose the right information from the vast amount of information. Therefore, intelligent travel route planning also needs to follow the development of the tourism industry and plan a detailed and accurate travel route for tourists, which can not only improve the tourist experience, but also increase the tourists' stickiness to the recommendation system. This paper establishes an intelligent tourism route planning system based on machine learning algorithm through mining tourism big data, calls Internet map service data, extracts relevant factors, and designs a travel route planning algorithm based on neural network with tourist big data information as experimental sample. Transfer and share tourism information between tourism platforms and tourists by means of science and technology, plan tourism routes for users that meet their own conditions, budget costs, time and interest preferences, and provide tourists with multiple sub optimal routes for decision-making, which solves the problems of low decision-making efficiency and inaccurate planning results caused by information overload, authenticity and other factors in the actual tourism planning process, The effectiveness and practicability of the algorithm are verified. The combination of intelligence and tourism is the inevitable direction of the development of the tourism industry, the system built in this research has a broad prospect with personalization, low cost, convenience and speed, trend prediction.

REFERENCES

[1] Wang Chang, Sun Fuming, Li Yang. Research on mufti-algorithm intelligent monitoring system based on the Internet of Things. Electronic technology application, 2017, 043 (011): 7-10.

[2] Chen G, Wu T, Zhou Z. Research on Ship Meteorological Route Based on A-Star Algorithm. Mathematical Problems in Engineering, 2021, 2021 (7): 1-8.

[3] Cheng, Jianhua, Meiling, et al. Research on Nonlinear Comprehensive Calibration Algorithm for the Single-Axis Rotation Inertial Navigation System Based on Modified Unscented Kalman Filter. Journal of Computational and Theoretical Nanoscience, 2017, 14 (3): 1535-1542.

[4] Cheng J, Li M, Guan D, et al. Research on Nonlinear Comprehensive Calibration Algorithm for the Single-Axis Rotation Inertial Navigation System Based on Modified Unscented Kalman Filter. Journal of Computational & Theoretical Nanoscience, 2017, 14 (3): 1535-1542.

[5] Shen Y, Gao L, Tian X. Research on smart substation inner communication queen scheduling based on improved WRR algorithm. Dianli Xitong Baohu yu Kongzhi/Power System Protection and Control, 2018, 46 (12): 85-90.

[6] Sun W. Research on the Construction of Smart Tourism System Based on Wireless Sensor Network. Mathematical Problems in Engineering, 2021, 2021 (18): 1-8.

[7] Chen Yan, Zheng Jun. The Comparative Research on Data Fusion Algorithm Based on Machine Learning Theory. Journal of Guiyang University (Natural Science Edition), 2018, 013 (003): 5-9.

[8] Li Duanchao, Huang Shaoxiong, Wang Wei, etc. Research on Intelligent Optimization of Smart Grid Based on Improved GAGA Algorithm. Power grid and clean energy, 2018, 034 (010): 54-59.

[9] Gan Y, Zhang B, Ke C, et al. Research on Robot Motion Planning Based on RRT Algorithm with Nonholonomic Constraints. Neural Processing Letters, 2021, 53 (4): 3011-3029.

[10] Wang, Fei, Chao, et al. Research on the Algorithm of Measurement Path Planning for Inner Wall of Air-Intake Pipe Based on Spraying Robot System. International journal of pattern recognition and artificial intelligence, 2017, 31 (9): 1759018.1.

[11] Guo K, Yang M, H Zhu. Application research of improved genetic algorithm based on machine learning in production scheduling. Neural Computing and Applications, 2020, 32 (7): 1857-1868.

[12] Xiao Yunlou, Liu Xize, Gu Qiaoxiang, etc. Research of the Selection of Data Compression Algorithm Based on Mobile PDM System. Automation and instrumentation, 2017, 032 (002): 5-9, 26.