Construction of the Intelligent Tourism Application Model System under the Big Data Background

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Keywords: Big data; Application model system; Intelligent tourism

Abstract: With the constant development of innovation-driven development strategy, intelligent tourism development based on the big data platform is increasingly concerned by stakeholders of tourist industry. The extensive application of Internet of Things, communication network and cloud computing enables China's intelligent tourism to realize sustainable development. In this paper, based on connotative elaboration of big data and intelligent tourism, the author analyzes problems faced by intelligent tourism development under the big data background and constructs the intelligent tourism application model based on the big data platform. The model is divided into the sub-platform of governmental tourist department, sub-platform of travelers, sub-platform of tourist enterprises and sub-platform of community residents. Each sub-platform is based on big data to fulfill their duties. Under the big data background, realization of the intelligent tourism application model is good for achieving the cooperative win-win results for stakeholders of tourist industry and provides theoretical basis for comprehensive, coordinative and sustainable development of China's tourist industry. At last, the author proposes the status and role of the intelligent tourism development under the big data background.

1. Introduction

Big data refer to the information storage and analysis mode based on cloud computing. It is stored through lots of variable non-structural data for calculation and analysis at anytime. According to computed results, it can provide the corresponding decision-making suggestion for governmental tourist departments, tourist enterprises and travelers. Intelligent tourism uses Internet of Things, internet, cloud computing, information processing and data mining in tourist management process and further corresponds to the tourist information framework and infrastructure, so that governmental departments, tourist enterprises and travelers will make a diversified and wise choice. Construction of the intelligent tourist management mode is based on the big data platform and it is assisted by cloud computing technology to construct the tourist prediction and feedback service platform and form mass data of tourist industry. It is contributed to form individualized tourism and digital tourism for travelers.

2. Application of Big Data in Tourist Industry

2.1 Application analysis of big data in tourist industry

The core competition of tourist industry is innovation. Product innovation and services become important factors to attract travelers. With the development of today's science technology, homogenization phenomenon of tourist products is severe and can't satisfy the diversified demands of travelers anymore. As a result, tourist products need innovation. Tourist enterprises analyze big data information of travelers, explore preference of travelers, develop new tourist products with pertinence, and formulate corresponding subjects, so as to promote innovative updating of tourist industry products. Big data refer to non-structural data, including audios, videos, pictures and relevant equipment. Victor·Mayer—Schoenberg introduced the big data concept into the regional

tourist development system to promote harmonious development of regional tourism, form the "cloud safeguard" of sound regional tourist development and construct the big data platform of regional tourist prediction and feedback mechanism. Through the cloud computing technology, lots of variable terminal data relating to non-structural tourism will be stored and analyzed effectively. According to computed results, decision and proposal are provided for stakeholders, including governments, tourist destinations, tourist attractions, tourist enterprises and travelers. Construction of the big data platform is good for tourist stakeholders to achieve tourist information sharing, so as to provide a new idea of tourist development for the development of regional tourist industry and construction of tourist destinations. Tourist industry has the strong comprehensiveness and covers tourist traffic, tourist accommodation, tourist attraction visiting, tourist hotel and catering, tourist shopping and various leisure entertainments. Tourist industry is involved in lots of information, including all tourist information of tourist activities covered in 6 elements, such as "eat, live, accommodation, tourism, shopping and entertainment". As a result, it is also very complicated. From the perspective of tourist resources, according to classification standards in Classification, Investigation and Evaluation of Tourist Resources(GB/T18972-2003), types of tourist resources contain 8 main categories, 31 sub-categories and 155 basic types. There are more types and huge quantity. In terms of tourist resources, introductive texts, quantity indexes, pictures, audios, videos, literatures or other data of tourist resources are foundations of big data. The data can be divided into structural data and non-structural data. Three pillar industries of tourist industry respectively include travel agency industry, tourist transportation and tourist hotel industry. Therefore, in this paper, the author will classify mass data involved in tourist industry from the perspective of three pillar industries, tourist resources and travelers in tourist industry (see the form below).

Table 1 Big Data Classification Involved in the Tourist Industry

Tourist industry	Structural data	Non-structural data
Tourist resources	Types, distribution, level and quantity indexes	Texts, pictures, videos, audios, and development degree
travelers	Gender, age, education, disposable incomes and consumption capacity	Travel planning, planned consumption, tourist preference, search tracing before traveling, geographical position, opinions, and complaint
Travel agency industry	Group tourism price, passenger source market, number of travelers, travel time, tourist destination, age level of group tourism and preference.	Consulting services of travelers, real-time monitoring data of group tourism, data of guiding travelers' tourist road lines, and praise and evaluation of travelers
Tourist transportation	Tourist train schedule, traffic price, and traffic roadmap	Real-time status sharing of traffic roads, road weather, traffic congestion degree, tourist traffic road monitoring and early warning
Tourist hotel industry	Tourist accommodation time, person-times, accommodation rate, low season and peak season of accommodation, price, operation incomes and profits	Internal management, preference of travelers' accommodation, travelers' opinions and evaluation, travelers' information sharing, crisis sensing information and emergencies

2.2 Web search index of keywords

Even if Baidu search index of keywords can reveal variation trends of netizens' demands in some periods, there are all kinds of search engines in current stage. In web search, netizens have their own preference for the choice of search engines. Furthermore, it can be observed from statistical data of search engine usage rate that search engine usage rate in Baidu is present on a declining curve (see Figure 1). As a result, Baidu search index of keywords can't comprehensively reveal variation trend of keywords' web search. In order to compensate for the shortcoming that Baidu search index of keywords can't comprehensively reveal variation trend of keywords' web

search, Baidu search index of keywords can be corrected, so that they will tend to the web search tendency of keywords. After correction, Baidu search index refer to web search index. The formula correction is stated as follows:
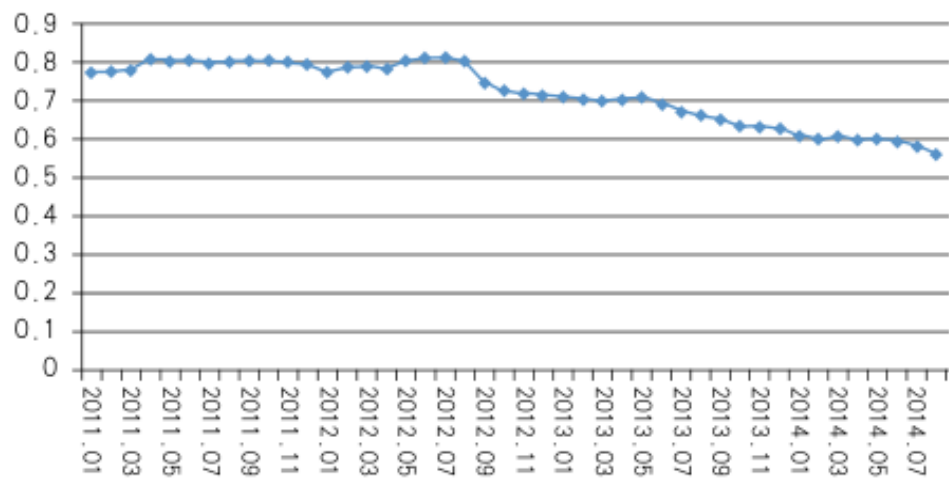
I network=I Baidu/r Baidu usage rate

Fig.1. Usage Rate of Baidu Search Engine

Among which, I network is the Baidu search index of keywords after correction—keywords' web search index; I Baidu is the Baidu search index of Baidu; r Baidu usage rate is the usage rate of Baidu search engine. By comparing with Baidu search index, web search index can eliminate influences caused by constantly changing usage rate of Baidu search index and it can really reveal variation trend of keywords' web search. Big data can be good for tourist enterprises to do the accurate market positioning for travelers. Through analysis and mining of big data, different samples and information can be provided. According to dynamics of tourist industry and consumers' features, tourist products can be developed with pertinence, so as to construct the math model based on big data to predict the future tourist market and provide high-quality services for travelers.

2.3 Predictive design and realization of passenger flow statistics

Table 2 Information Content of Tourist Message Website Platform

Information classification of Beijing tourism message network	Information contents
Public information	Tourist road content introduction Tourist traffic schedule Tourist weather link Safety emergency news
Travel note strategy	Sharing of netizens' travel note
Scenic spots	Introduction of tourist attractions in texts and pictures
Tourist hotel	Respective introduction of hotel situations, attaching telephone and address
Travel agency	Text introduction, attaching telephone and address
Tourist shopping	Text and picture introduction of Beijing specialty
Tourist catering	Text and picture introduction of Beijing gourmet
Rural tourism	Introduction of some agritainment, attaching telephone and address
Tourist e-commerce	Link enters into UU163 tourist online; ticket booking and bus ticket purchase for some scenic areas

Table 3 Functional Demand Analysis Table of DMS Construction

User groups	Demands satisfied	Demands to be perfected	Expected demands
Travelers	Overview of tourist situation Tourist resource guide Dynamic news publication Recommendation of excellent scenic areas Introduction of tourist routes Tourist reminders Weather forecast Photo album videos Ticket booking Travel note strategy Traffic information	Tourist resource guide Dynamic news publication Recommendation of excellent scenic areas Picture album videos Tourist reminders Travel note strategy Line introduction Tourist reminder	Individualized information push Route plan Featured route design Online tourist products Purchase booking Virtual tourism Emergency rescue application Self-help guide Tourist map services Multi-terminal application Comprehensive resource messages Ticket-checking automatic system Interactive review Tourist complaint Travelers' community
Tourist supply	Hotel information Featured restaurant information Tourist shopping information Travel agency information		Market analysis Customer relation management Marketing propaganda channel Accurate marketing Online services Inquiry & offer search Reserve electronic orders Electronic trading Transaction processing end Business bidding management Enterprise business credit evaluation Scenic area tourist safety Safeguard
Government	Policy publication Political affair publication Market information	Policy publication Political affair publication Market information	Document delivery Investment promotion Talent exchange Educational training Travel statistics Tourist complaint Tourist industry management Automatic office Tourist data statistics Integrated marketing Industrial integrated monitoring Public opinion monitoring Passenger flow volume monitoring Safety safeguard Industrial information sharing Interconnectivity Tourist employers Management

The basic thought of passenger flow forecast is to collect, sort out and analyze data relating to scenic areas. Grey correlation analysis theory is used to analyze relevant factors to solve degree of association for sorting, so as to screen out more important influence factors. Then, the grey correlation analysis method is used to get the grey relational degree between the quantitative predicted parameters and predictive targets. Support vector regression algorithm is used to construct the predictive model. Then, according to relevant factors, passenger flow forecast is conducted. Passenger flow volume influence factors are divided into long-term passenger flow volume

influence factors and short-term passenger flow volume influence factors. Long-term passenger flow volume influence factors include internal influence factors, which generally refer to tourist products and their prices in scenic zones, popularity of scenic zones, service quality of scenic zones, and hardware facility conditions of scenic zones. Special events will cause some influences on tourist industry, directly resulting in reduction of passenger flow volume. Special events contain financial crisis, terrorism events, political events, and emergencies, such as earthquakes, etc. Influence factors of low season and peak season are primary factors to determine long-term passenger flow volume influences. Passenger flow curves show up wave crest in the peak season. Short-term passenger flow volume influence factors mainly contain weather factors. Rain, snow and hail cause a great influence on passenger flow volume. Passengers in holidays often cause the peak time, thus travelers should arrange a plan reasonably.

2.4 Fuzzy comprehensive evaluation

Factor weight set is marked as A={a1,a2......an}, meeting $\sum\limits_{i=1}^{n}ai=1$, thus $\bar{B}=A.R=(\bar{b}_1,\bar{b}_2,...\bar{b}m)$ formula 1

After normalization processing, B={b1, b2…bm} is obtained, namely it refers to fuzzy evaluation value of each factor and comprehensive evaluation value. According to weighted sum method A=ω∗B, deblurring calculation is conducted to finally calculate the integrated score of Beijing intelligent tourist development degree as 3.5369 between "satisfaction"(4 scores) and "general"(3 scores), showing that Beijing intelligent tourist development is relatively good in the above average position.

2.5 BP neural network model

The construction philosophy of artificial neural network is generated under the enlightenment of biological neural network function operation. It is the operation model constituted by lots of nodes and their mutual connection. Since BP neural network was proposed by a scientist group represented by Rumelhart and McCelland in 1986, it has been used in multiple fields, including E-communication, speech synthesis, bomb detection and fault detection. The BP neural network topology constructed in this paper is shown in Figure 2.
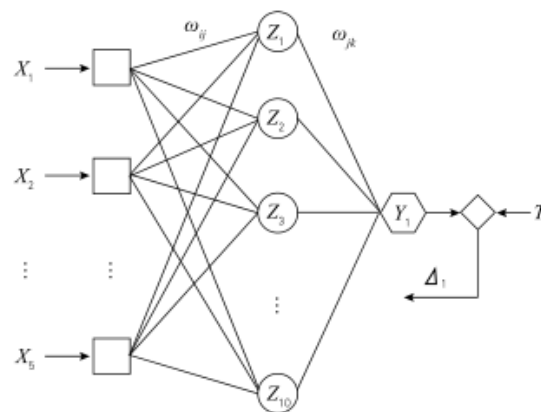

Fig.2. BP Neural Network Topology

In Figure 3, X1, X2,…X5 refer to input values of BP neural network, standing for web search indexes of "Beijing tourism", "Beijing snack", "Beijing tourist map", "Beijing hotel" and "Beijing scenic spot"; Y1 is the predicted value of BP neural network for Beijing domestic travelers; T1 is the actual value of Beijing domestic travelers. This neural network is composed of the input layer, the hidden layer and the output layer. The hidden layer contains 10 nodes. The number of nodes in the input layer and output layer can be properly judged by input data and output data features. Furthermore, in the training process of this neural network, training step length is 100, learning rate is 0.02 and learning target is 0.001, as shown in Figure 3. This model is iterated for 22 times to achieve a learning goal of 0.001. It can be observed from Table 4 that this paper constructs the BP

neural network model and VAR model, which have the predicted results. Both of them basically hold the line for the predicted results of Beijing domestic travelers in June 2014. In predictive aspect of other months, the predicted results of the BP neural network model are more accurate than the VAR model. Besides, this paper uses mean absolute difference (MAD), mean square error(MSE), root-mean square error(RMSE), RMSPE and mean absolute percent error(MAPE) to detect two models respectively. The results are shown in Table 6. In 5 predicted accuracy test indexes, various indexes of BP neural network model are lower than VAR model. The MAD and MAPE of the former are lower than 1/3 of the latter. RMSE is lower than 1/4 of the latter, indicating that the BP neural network model constructed in this paper has the higher predictive capacity for Beijing domestic travelers than the VAR model.
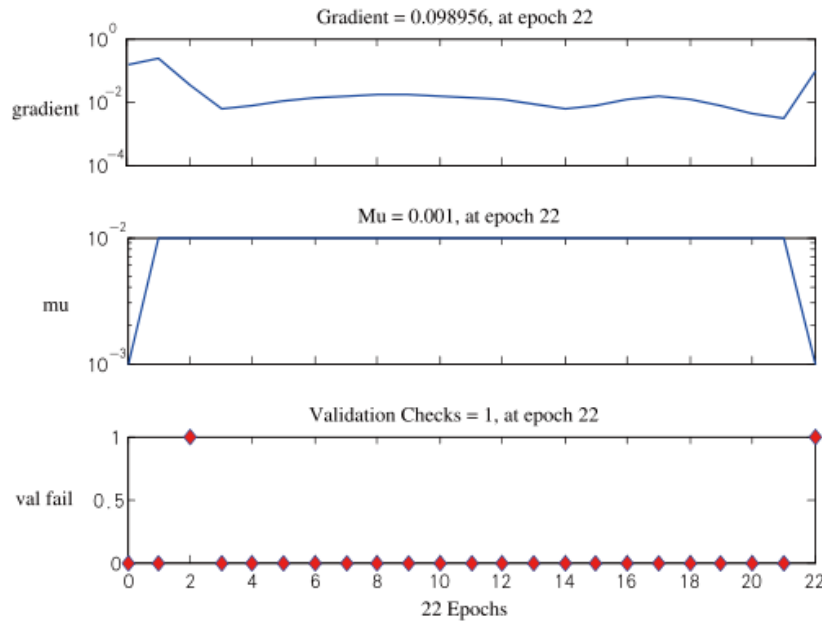

Fig.3. Training Status of the Bp Neural Network

Table 4 Predictive Results of Travelers

Time	Actual value	Predicted value of BPNN model	Predicted error of BPNN model	Predicted value of VAR model	Predicted error of VAR model
May	2652.8	2680.3	27.5	2503.7	-149.1
June	2346.9	2501.4	154.5	2499.2	152.3
July	3042.1	3191.1	149	2687.2	-354.9
August	3362.4	3487.1	124.7	2432.3	-930.1

Table 5 Error Indexes of Predicted Model

	MAD	MSE	RMSE	RMSPE	MAPE
BPNN model	113.925	15594.4	124.8775	4.53%	4.06%
VAR model	396.6	259116.5	509.0349	15.61%	12.86%

The VAR model intuitively indicates that keywords' web search index and Beijing domestic travelers in January-April can be used to predict and estimate domestic travelers in the current month of Beijing. It can provide preventive congestion for urban management departments and urban scenic spot operators to meet timeliness required by prediction.

Table 6 Three Elements of Tourist Industry

Elements	Contents
Tourist resources	Natural scenery, historical site, revolutionary ruins, construction achievements and national customs are attractions to operate tourist industry
Tourist facilities	Tourist traffic facilities, tourist accommodation facilities, tourist catering facilities and tourist entertainment facilities
Tourist services	Combination of labor and management behaviors is the reception capacity to operate tourist industry

By making a comparison on predicted results between the VAR model and BP neural network model, it can be found that the predictive accuracy and stability of the BP neural network model are higher than the VAR model, indicating that web search index of keywords has the non-linear relation with Beijing domestic travelers, thus BP neural network model has advantages in prediction.

In the era of internet, "tourist big data" are generating as time goes by. Tourist information search, tourist product reservation and tourist experience evaluation leave the browse tracing on the network service platform and all of them constantly enrich resources of "tourist big data". Full analysis of "tourist big data" can provide the valuable information and opportunity chances for the tourist industry development. Under the background of the flourishing intelligent tourism construction, "tourist big data" will develop the greater potential.

3. Conclusions

Intelligent tourism construction is the systematic project and can't be separated from the support and cooperation from all sectors of society. Based on Internet of Things and cloud computing, intelligent tourism, as the emerging industry, has the lower public cognition degree and the lower social participation degree. To a large extent, local governments and tourism scenic areas fight independently and can't generate the synergistic effect. As a result, it is necessary to improve publicity strength, guide public cognition and social participation, finally construct the intelligent tourism model system for multi-party cooperation and sharing, and greatly serve for travelers, community residents and the public. To greatly promote the intelligent tourism application model construction based on big data platform has the extremely important significance on promoting China's tourist industry to achieve the strategic goals of intelligent tourism and try to shape the brand image of "China's intelligent tourism". It is the necessary road for China to become the tourist power. Big data era arrives. Intelligent tourism under the big data background also arrives. Through the intelligent mobile terminal, we can know about the world and experience tourism. Intelligent tourism is gradually changing our tourism behaviors, but the current intelligent tourism is the stage in germination. The huge value contained by big data will cause the great influences on intelligent tourism. Construction of intelligent tourism based on big data technology will greatly improve tourist popularity, enhance market competitiveness, and retain or attract more tourists. Even if intelligent tourism construction may have many obstacles, it will realize gradual promotion, bring high-quality services to tourists, and promote tourist industry transformation and upgrading.

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