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Construction of Smart Tourism Big Data Mining Model under the Edge Effect

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Abstract Due to the rapid development of current computer technology, the Internet of Things (IoT) has also received good development opportunities, which has promoted the advancement of Big Data (BD) and artificial intelligence technology to a certain extent, and also made people put forward different requirements for travel. To better satisfy the new demands of current tourists and provide better and thoughtful services for tourists, this paper has conducted an in-depth discussion on smart tourism BD and established a set of smart tourism BD mining model based on edge effects. Through experiments, it was found that the model is more powerful for information mining. Compared with the traditional model, the coverage of resources, transportation, food, accommodation, entertainment and other information in this model has increased by 11656, 13797, 9052, 11013, 13663 and 7388 items respectively. In addition, the improvement of the accuracy of information mining in this model is more conducive to the tourism platform to develop marketing plans, improve user satisfaction with tourism services, and enhance the better growth of smart tourism and the improvement of tourism economic benefits. Among them, the building of the BD mining model under the edge effect in this paper can better enrich the scope of the IoT technology and promote its better development.

Index Terms Big Data Mining Model, Edge Effect, Smart Tourism, Model Construction

I. Introduction

With the gradual maturity of the IoT technology, massive BD has also been born. How to extract effective information from a large amount of data has become an important topic in the field of data processing and data analysis. People have also put forward the concept of smart tourism in the tourism industry, but the mining of smart tourism BD has not been widely carried out and studied. This poses a great challenge to the construction and calculation of BD mining models. At present, the information resources of tourism platform need to focus on platform for application support services, while the smart tourism services proposed on the basis of promoting customized tourism services contain more content and are more suitable for the current tourism development needs. Therefore, the establishment of smart tourism BD mining model and the acceleration of intelligent analysis of tourism data are the inevitable trend. This paper attempts to establish a BD mining model based on edge effects in combination with the existing problems in the development of smart tourism. This paper also hopes that the model can better solve the mining and processing of tourism resource data, and the attention to the edge effect can better solve the problem of the scattered and difficult integration of tourism resource data.

For smart tourism BD, many scholars have conducted different studies and said that the application of smart tourism BD can help improve user satisfaction. Ardito Lorenzo studied BD in smart tourism. He put forward new theoretical research framework, indicators and key dimensions, as well as empirical research methods of using BD in different tourism environments, and said that using BD in tourism can better predict tourists' needs, achieve better decision-making, provide the best service in a more efficient and effective way, and improve customer satisfaction [1]. Del Vecchio Pasquale studied the process of cultivating the value creation of smart tourism destinations with a large amount of social BD. He said that BD provided new models and opportunities for the value creation of tourism industry, which helped decision-makers make better decisions and improve user satisfaction [2]. Wang Wei said that efficient data transmission based on the fifth generation mobile communication technology and intelligent data processing based on artificial intelligence technology are of great significance for unlocking intelligent tourism applications based on the IoT to promote intelligent decision-making and improve service satisfaction [3]. Krisna Dina Febrianti discussed the use of tags and geographical tags in smart tourism. He used the structural equation model based on covariance to analyze tourism data and said that using tags and geographical tags in tourism can improve tourist satisfaction [4]. These scholars' research on smart tourism BD can enrich its theoretical content, but there are also certain deficiencies.

However, some scholars have discussed it from the perspective of tourism data mining model and put forward different views. Shapoval Valeriya studied data mining in tourism data analysis. He built a tourism data model based on decision tree through data mining tools to analyze the behavior of inbound tourists, and said that the model could provide more tools for the government and destination marketing organizations to better formulate effective destination marketing strategies [5]. Nata Gusti Ngurah Mega studied the use of data mining technology for tourism promotion. He said that the data mining model based on association rules can quickly recommend tourist attractions and promote tourism promotion and marketing by performing data analysis and search models [6]. Scholars' discussion of the tourism data mining model can enrich the theoretical support for the construction of this model. However, because its research focus is not on smart tourism, and it does not conduct in-depth analysis on the construction of BD mining model in combination with the edge effect, this makes the research of little reference value. It can be seen that the application of edge effect to the construction of smart tourism BD mining model is a relatively new field at present, and its theoretical research is relatively blank. Further discussion is needed.

In order to better improve the performance of smart tourism BD mining model, this paper constructed a new smart tourism BD mining model based on the theoretical analysis of smart tourism and edge effects and the discussion of previous scholars on tourism data mining model. Through empirical research, it was found that the new model built in this paper was more correct for tourism information mining. More tourism information coverage can better promote the promotion of tourism economic benefits. Compared with the traditional BD mining model, the innovation of this model is to pay attention to the importance of the edge effect and use it in the model construction, which would help promote the better improvement of the ecological effect of the scenic spot and ultimately achieve sustainable development.

II. Theoretical Evaluation on Smart Tourism BD Mining Model

II. A. Overview of Smart Tourism

II. A. 1) Meaning of Smart Tourism

Smart tourism, also known as smart tourism, is a form of real-time access to tourism resources, tourism destinations and tourism economic information through the Internet, intelligent data mining and processing, and portable terminal internet devices based on IoT, cloud computing and other technologies [7]. Users of smart tourism can use intelligent data mining and efficient information processing to actively perceive tourism resources, tourism destinations and tourism activities, providing convenience for tourism planning [8]. The specific formation factors of smart tourism are shown in Figure 1:

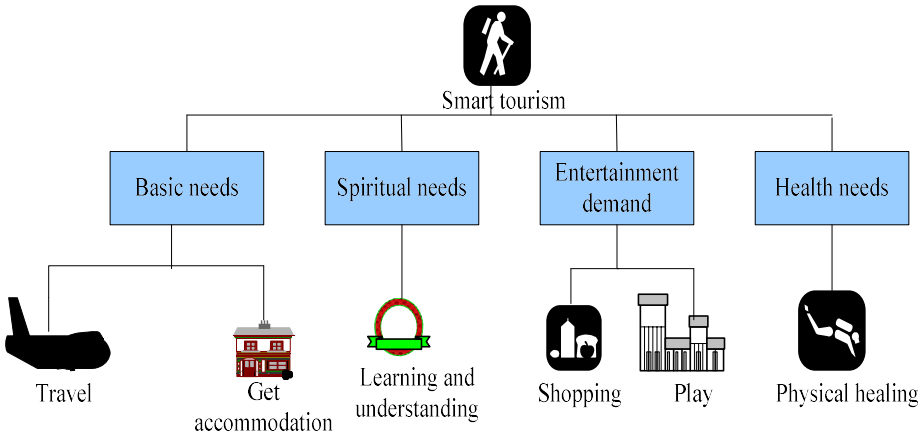


Figure 1: Elements of smart tourism

Smart tourism is a new tourism form with tourism industry as the main body. It can not only meet people's entertainment and health needs, but also meet their spiritual and knowledge needs [9]. With the gradual development of smart tourism, it mainly presents the following characteristics. The first is intelligence. The main users of smart tourism are smart enterprises, governments, scenic spots and tourists. The second is real-time. Tourists can interact with each other by using smart clients, so that tourism subjects can obtain and transmit relevant tourism information in a timely manner. The third is humanization. Smart tourism can provide personalized services for each passenger, thus promoting the improvement of tourism quality [10]. The characteristics of smart tourism are shown in Figure 2:

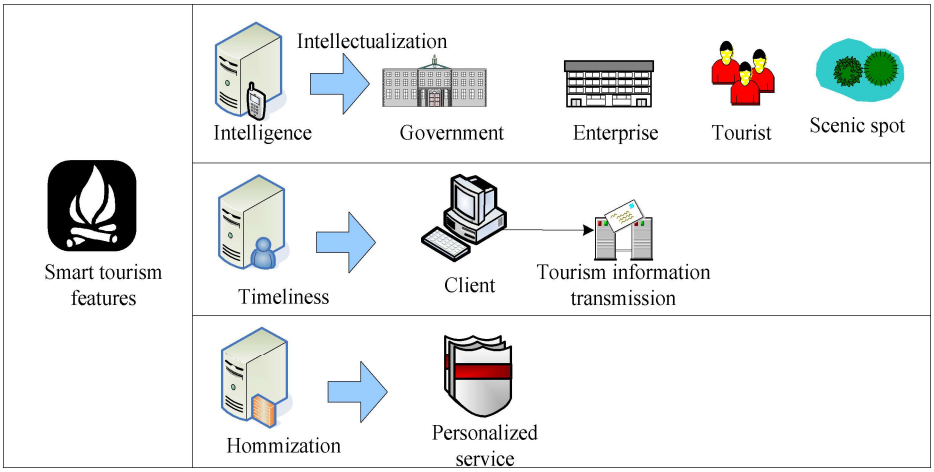


Figure 2: Features of smart tourism

Smart tourism services cover the whole space resources, the supply of elements in the whole industry, the value creation of the whole process services and the multidimensional and multi-level experience. The interaction among various stakeholders constitutes an intricate network connection. Smart tourism service is a typical ecological service. The formation process of smart tourism services is shown in Figure 3:

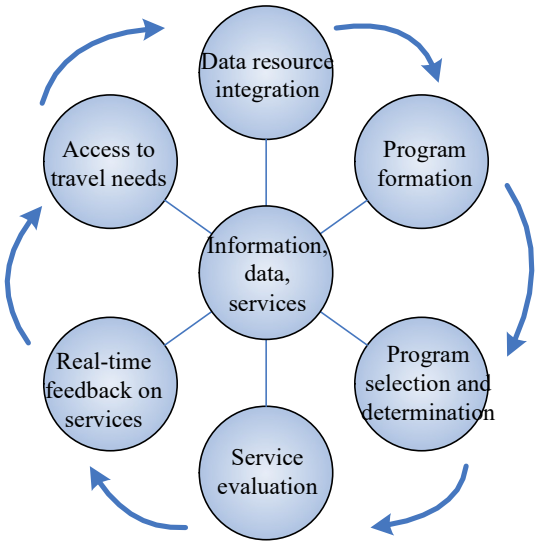


Figure 3: The formation process of smart tourism services

II. A. 2) Problems in Smart Tourism

At present, smart tourism is in its infancy, and there are still major problems. First of all, the cost of information construction is high, and the difficulty of information exchange is high. Secondly, the overall enthusiasm of tourism enterprises is low. At present, only large tourism enterprises and emerging tourism formats have certain economic strength, strong management ability and high requirements for information technology. Other small enterprises have weak demand for smart tourism development due to insufficient funds. Then, the management subject is difficult to unify. This has led to a multi-pronged approach to smart tourism, which ultimately leads to low construction efficiency and makes it difficult to effectively implement smart tourism. Finally, it lacks corresponding technical support. The development of relevant supporting technologies for smart tourism is not mature enough, and the problem of network security is difficult to be well solved. These have also become the primary constraints to the growth of smart tourism [11].

II. B.Smart Tourism BD Mining Model

II. B. 1) Application of BD Mining in Smart Tourism

The core of smart tourism is wisdom, and wisdom is the wisdom of the travel destination, the wisdom of the tourism administration, and the intelligence of the tourism marts [12]. Therefore, BD mining technology is also widely used in these three fields.

First of all, BD mining technology can be applied to the scenic spot recommendation system for intelligent tourism purposes. The demand for tourism is increasing, and the requirements for service quality and scenic spots are also higher and higher. At present, there are a large number of similar tourist attractions in the tourism market. How to recommend the correct tourist attractions for tourists to improve tourists' satisfaction with smart tourism services is extremely important [13].

Secondly, BD mining technology can be effectively applied to the intelligent management of urban tourism [14]. With the rapid development of the tourism industry, many travel agencies and tourism companies have emerged in the tourism industry. However, due to the lack of advanced management experience and management mechanism, the internal management of tourism enterprises is chaotic, which has a certain impact on the tourist experience. BD technology optimizes the internal business process of tourism enterprises, and then analyzes and digs user-related information based on the collection and integration of user data, so as to provide relevant tourism enterprises and platforms with tourism products based on user characteristics and preferences, and improve user purchasing power.

Finally, BD mining technology can also be applied to the development of smart tourism market. Traditional travel agencies adopt the B2C (Business-to-Consumer) model, that is, enterprises conduct direct business transactions with consumers and use the Internet for online sales. This model mainly relies on advertising promotion. Applying BD technology in the smart tourism market can realize the O2O (Online to Offline) model, that is, online marketing drives offline sales. This model transforms Internet users into offline users by using preferential promotion, online service reservation and personalized services to transmit offline information to Internet users, so as to meet their personalized needs.

II. B. 2) Necessity of Building Smart Tourism BD Mining Model

It can be seen from the above results that the usage of BD mining technology can collect the behavior of the tourism industry and tourists in real time and dynamically, and conduct comprehensive analysis on it, so as to formulate a personalized demand that meets the needs of tourists, and design a tourism plan that meets the actual situation of tourists [15]. From the collection of tourism information, the analysis of tourists' needs, data collation, data analysis, in-depth learning, and finally to the formulation of a reasonable tourism plan, people need to use BD and other technologies. Smart tourism with information services as its core should also realize the sharing of tourism resources and social resources. Smart tourism based on BD also includes tourism BD. By using BD technology, people can better understand tourism demand, tourism behavior and tourist satisfaction, thus improving the sales model of the tourism market, which shows that the promotion role of BD for smart tourism development cannot be ignored. Thus, in order to better realize the BD mining of smart tourism, it is necessary to build a BD mining model of smart tourism. On the basis of previous scholars' research and in combination with the current development of smart tourism, this paper proposes a construction method of smart tourism BD mining model based on edge effect.

II. C.Edge Effect

II. C. 1) Overview of Edge Effect

Edge effect refers to the ecological characteristics of the edge part of the patch, which is different from the central area of the block, under the influence of the external environment. Smart tourism is a complex ecosystem composed of society, culture and nature. Its boundary space and ecological environment share the same concepts and attributes. Therefore, this paper discusses the meaning of edge effect in smart tourism space based on the theory of edge effect in ecology. It specifically refers to the situation that the overlapping regions with different ecological environments in the tourism space are different from the original surrounding and central regions due to the impact of different culture, ecology, environment, demand and other factors. The tourism space under the interaction of multiple factors should be the most dynamic area. The three stages of edge effect development in smart tourism space are shown in Figure 4:

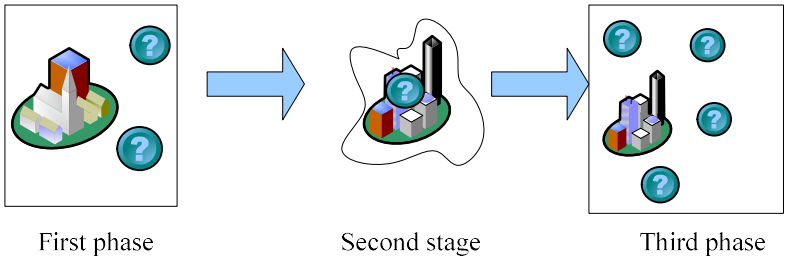


Figure 4: Three stages of edge effect development in smart tourism space

The performance of edge effect in smart tourism planning is mainly to stimulate more positive edge effects, that is, to improve the ecological and environmental effects of tourist attractions. The application of edge effect is generally divided into three steps.

II. C. 2) BD Mining Model Based on Edge Effect

The growth of the tourism industry has entered a new stage of development, and the development of the tourism industry is increasingly changing to the direction of refinement. With the help of BD and information technology, it can greatly provide convenient services for tourists' clothing, food, housing and transportation. At present, the existing tourism BD platform is of poor maturity and weak supervision, and less attention is paid to its positive edge effect. There is still a long gap for the realization of smart tourism. Building a tourism BD mining model based on the edge effect is an inevitable choice to meet the personalized tourism needs of tourists and promote the development of smart tourism. Based on this, this paper constructs a BD model of smart tourism by combining the edge effect theory.

To build a smart tourism BD mining model, first of all, people need to process the relevant data. Tourists and scenic spots are an entity of the data model, represented as *A* and *B* respectively. Tourist attractions cover a wide range. It can connect the scenic spots and the database, so that it can represent the geographical coordinates of the scenic spots.

Assuming that scenic spot B_m belongs to scenic spot *B*, the scenic spot can be marked with tuples:

$$\gamma_{B_m} = (x_1, \cdots, x_J; y_1, \cdots y_I) \tag{1}$$

Relevant materials of tourist attractions, including text materials, video materials and other multimedia materials, can be associated with scenic spots. At the tourist level, it is necessary to deal with the static information and dynamic information of tourists. The former is mainly stored in the user's personal information, while the dynamic information is recorded in the user's data log.

Assuming that a set of tourists is replaced by *A*, the user data log can be marked as:

$$\mathrm{q} = (\mathrm{z}, \mathrm{b}, \mathrm{a}, \overline{\mathrm{a}}_1, \cdots \overline{\mathrm{a}}_J) \tag{2}$$

Among them, z is the time;

$\overline{\mathrm{a}}_J$ is the user's description of an object's behavior attribute.

Then, it excavates tourism information. The mining of tourism information can be divided into two parts. The first part is the integration of frequent projects. By analyzing the basic information and attributes of tourists through BD, people can understand the main preferences and tourist concerns of tourists. The detailed information about the tourist attractions can be seen in Table 1:

Table 1: Basic information of tourist attractions

Serial number	Name	Information	Attribute
1	Accommodation	Price, address and model	Basic needs
2	Travel	Price, meal type and location	Basic needs
3	Meals	Quantity and vehicle type	Basic needs
4	Admission ticket	Price and number of people	Entertainment demand

The second part is to classify the basic data of multiple tourism platforms to obtain a set of local frequent projects. The database *P* is divided into unrelated data blocks and then sent to *n* nodes, so it can be calculated using the following formula:

$$W = \frac{h}{\sum_J f \cdot |n * i|} \tag{3}$$

Among them, W is the data output result;
$\sum_J f$ is the data format factor;
$n * i$ is to divide each data block;
h is a frequent itemset.

Through the above processing, a set of candidate frequent projects with global characteristics is obtained, and BD analysis technology is used to grasp its analysis objectives. In this process, tourism information is extracted to obtain low-density information value.

In the generation stage, the tourism information should be scanned first, and then the support frequency of the candidate data should be calculated according to the statistical principle, and then compared with the known minimum support frequency. In the qualified project collection, the corresponding file is entered and the corresponding results are obtained. The text can be divided according to the following formula:

$$Q = \frac{1 \Rightarrow i}{I \cdot |c_1, c_2|} \tag{4}$$

Among them, Q is the output result of tourism information;
c_1, c_2 are tourism information.

Finally, a smart tourism BD mining model is built, which is based on tourism information mining, and effectively solves the uncertainty problems in tourism. By using BD analysis technology, people can obtain the historical browsing records of tourists, understand their evaluation of tourism and their retrieval records, and make corresponding predictions on tourism information. In addition, the model can realize the automatic search of tourist attractions, excavate the potential characteristics of tourist attractions, connect tourists' preferences with scenic spots, and provide tourists with tourist routes according to tourists' preferences. The specific process of tourism route recommendation is shown in Figure 5:

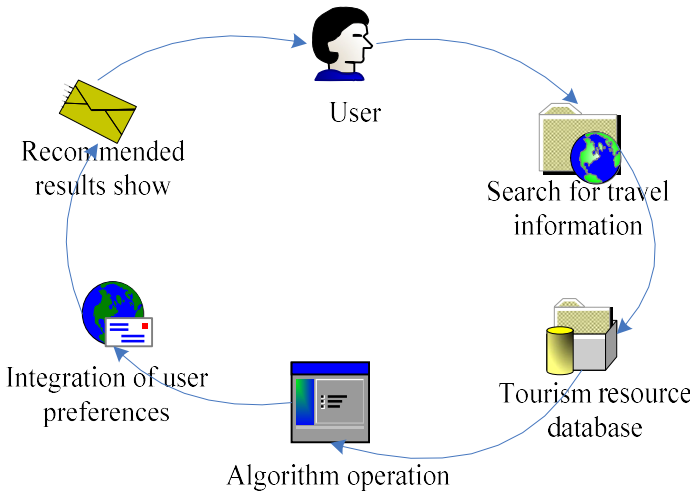


Figure 5: Tourist route recommendation process

After the user's recommendation is realized, the recommended route can be calculated, and the formula is as follows:

$$C(a, m) = \sum_m n \cdot qa \tag{5}$$

Among them, (a, m) is user a's interest in item m;
$\sum_m n$ is the relationship between user interest and implicit class;
qa is the relationship between the q-th implicit class and user a.

Through the above calculation, users can send and recommend the content of interest to tourists in real time. After the initial search is completed, the search results need to be optimized to ensure that the information sent to tourists is optimized and accurate. On this basis, according to the information generated by the recommendation results, the interest of tourists is analyzed, so as to provide tourists with a tour route full of underwear.

Then, according to the recommendation and output results, the product and weight are adjusted, and the results are corrected. The calculation formula is:

$$A = \frac{|p|}{k \cdot s} \tag{6}$$

Among them, k is the degree of interest of users;
s is the weight of route recommendation;
$|p|$ is the optimized factor.

Through BD technology, various data are stored in the database. A smart tourism BD mining model including tourism indicators, time information, visitor access information and positive edge effects of positive boundary effects is established. The model contains key data information of tourism. If the tourism data can be extracted, loaded and transformed, it can provide better services for tourism subjects. On the one hand, it can provide personalized tourism services for tourists; on the other hand, it can also facilitate people to achieve information retrieval and data sharing.

II. C. 3) Specific Construction of the Model

To comply with the actual application needs of current smart tourism and support BD mining analysis, this paper constructed a smart tourism BD mining model based on edge effects for different levels of mining analysis models such as conventional statistics, advanced analysis, and deep mining. Among them, the basic model based on data mining can be obtained by defining parameters, defining plans, defining processes, and defining schemes. The specific structure of the smart BD mining model is shown in Figure 6:

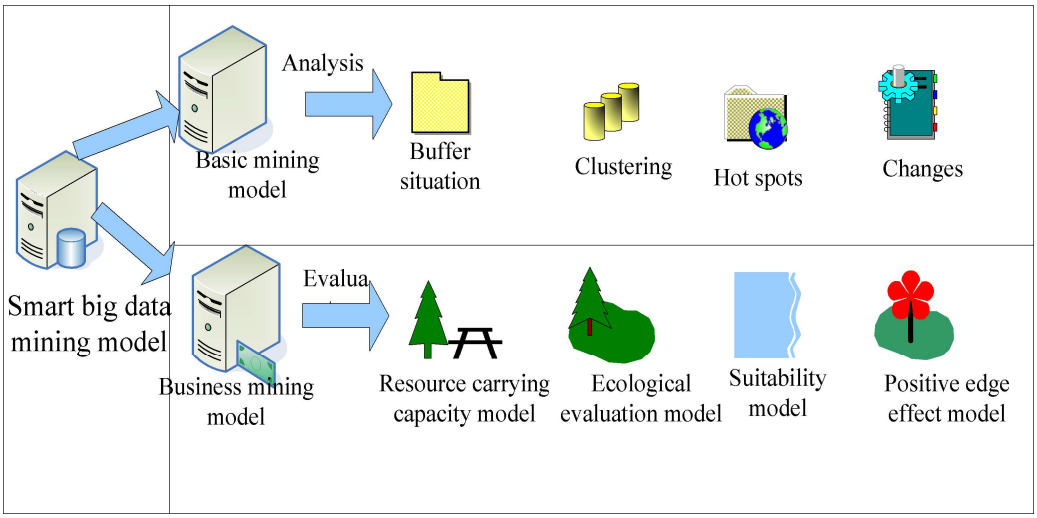


Figure 6: Composition structure of smart BD mining model

The analysis model in the smart tourism BD mining model contains the description of the model and the entity of the model. They all exist in the form of documents or programs. Therefore, the BD mining analysis model mainly includes the model dictionary library and the model document library.

The model dictionary library mainly refers to the description of the name, number, document, etc. of the model based on the BD mining model. The organization of the dictionary library usually includes files, menus, databases, etc. The index in the dictionary library and the classification model document are the basis of the model, while the source code file and core code document in the model document are the most important documents. Therefore, there are many types of template documents in the model library, and the number of corresponding model documents would not be less.

The basic model of BD mining based on the model dictionary database and model file database is used to register and control plug-ins through the standardization of plug-in interfaces. The executable program, com component (Component Object Model), dynamic library API (Application Programming Interface) and network service in the plug-in are its main forms. The rapid use and construction technology of plug-ins can quickly build a set of basic tools for BD mining and analysis.

III. Empirical Evaluation of Smart Tourism BD Mining Model

Through exploring the current situation of edge effect and smart tourism, this paper proposed a new idea of building a BD mining model for smart tourism. To verify the feasibility of this idea, this paper also needs to conduct empirical analysis.

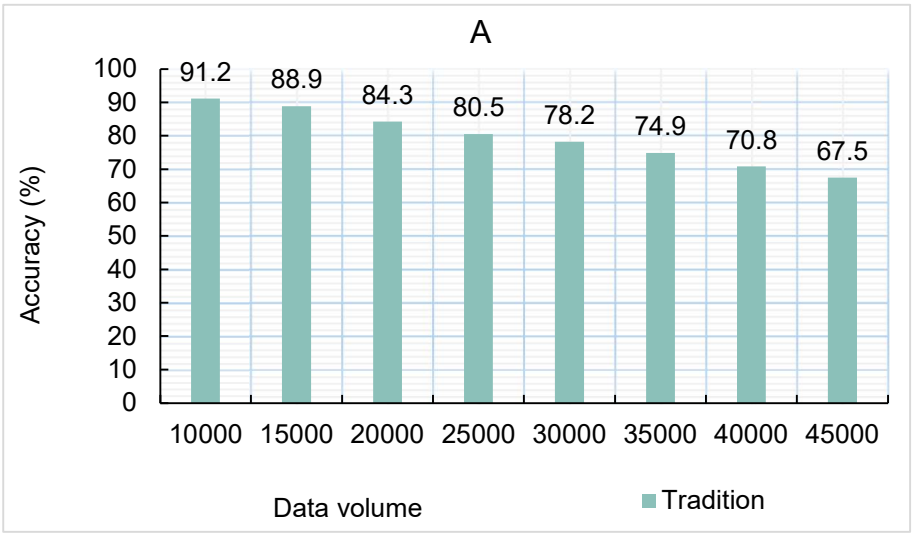
III. A. Evaluation Methods of Smart Tourism BD Mining Model

In order to better verify the practical role of edge effect in the smart tourism BD mining model, this paper compared this model with the traditional model, and compared the accuracy of the two models for tourism information mining, the coverage of tourism information, and the differences in tourism economic benefits, so as to draw relevant conclusions.

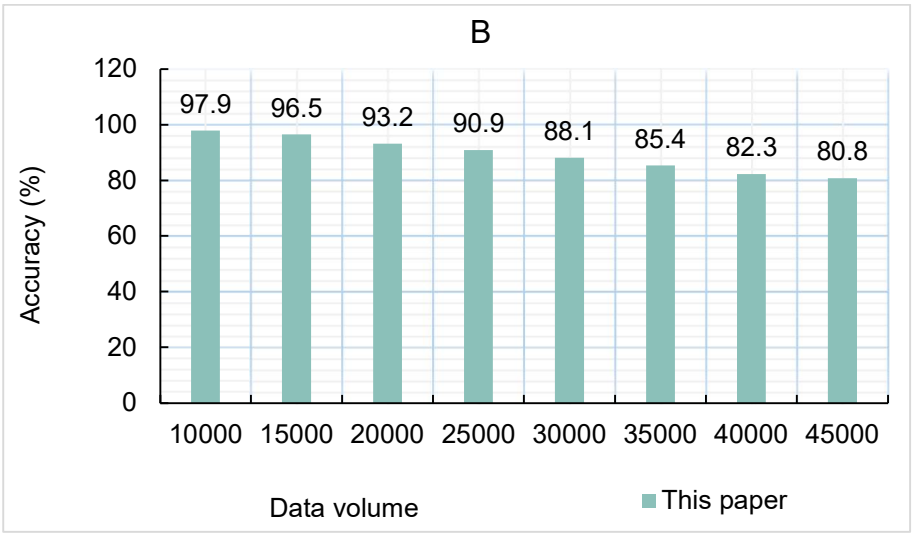
III. B. Experimental Results of Smart Tourism BD Mining Model

III. B. 1) Accuracy Evaluation of Tourism Information Mining

The accuracy of information mining is the most direct manifestation of the accuracy of BD mining models, and also an important factor affecting the performance and use of models. This paper selected different amounts of data from the database and tested the accuracy of the two models for these data mining. The specific test results are shown in Figure 7:



(A): Accuracy of traditional tourism information mining model



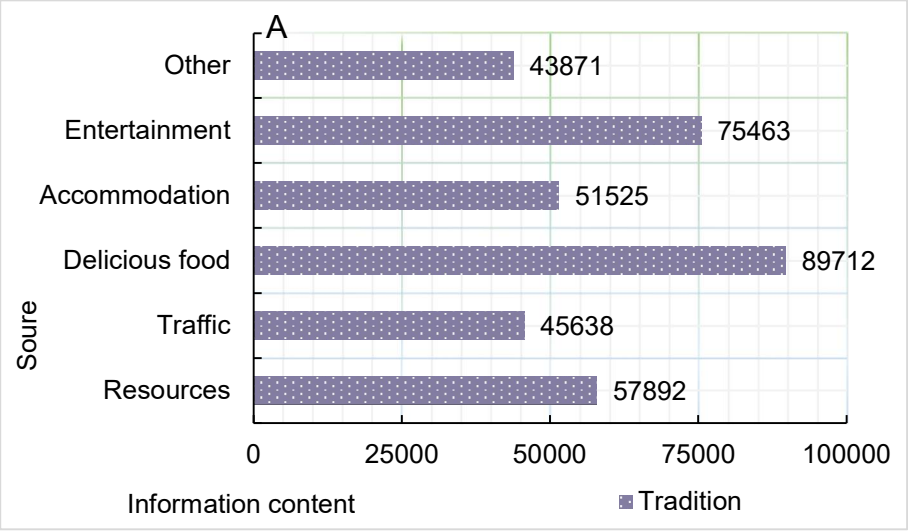
(B): The accuracy of tourism information mining in this model

Figure 7: Comparison of the accuracy of tourism information mining between the two models

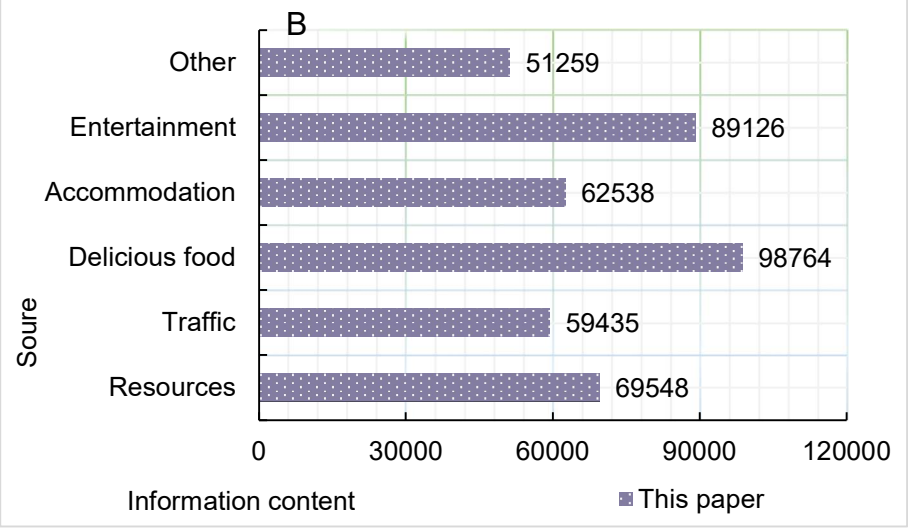
It can be seen from Figure 7 (A) and Figure 7 (B) that the accuracy of tourism information mining in the traditional model was 91.2% when the data volume was 10000, 80.5% when the data volume was 25000, and 67.5% when the data volume was 45000. When the data volume of this model was 10000, the accuracy of tourism information mining was 97.9%, which was 6.7% higher than the traditional model. When the amount of data was 25000, the accuracy of tourism information mining in this model was 90.9%, and its accuracy was improved by 10.4%. When the amount of data was 45000, the accuracy of tourism information mining in this model was 80.8%, which was 13.3% higher than the traditional model. It can be seen that the model in this paper was more accurate than the traditional model for tourism information mining, which indicated that the model in this paper had better accuracy and was more conducive to smart tourism BD mining.

III. B. 2) Evaluation of the Coverage of Tourism Information

After comparing the accuracy of the model for tourism information mining, it is also necessary to test the coverage of its tourism information. The coverage of tourism information can fully reflect the ability of the BD mining model to mine information and collect information, which is of great significance for tourists to master tourism information and develop targeted services. The specific amount of information about the two models is shown in Figure 8:



(A): Tourism information coverage of traditional model



(B): Tourism information coverage of this model

Figure 8: Comparison of tourism information coverage between the two models

According to Figure 8 (A) and Figure 8 (B), in the traditional model, the coverage of resource information was 57892; traffic information was 45638; food information was 89712; accommodation information was 51525; entertainment information was 75463; other information was 43871. In this model, the coverage of resource information was 69548; traffic information was 59435; food information was 98764; accommodation information was 62538; entertainment information was 89129; other information was 51259. Compared with the traditional model, the resource information coverage of this model has increased by 11656; the traffic information coverage has increased by 13797; the food information coverage has increased by 9052; the accommodation information coverage has increased by 11013; the entertainment information coverage has increased by 13663; the other information coverage has increased by 7388. It can be seen that the model in this paper covers more information, and its ability to mine, collect and sort out information is stronger, which is more helpful for the tourism platform to customize better services for tourists based on the information collected, thus improving tourists' satisfaction and experience.

In addition, this paper also sorted out the main sources of tourism information in this model. The specific information about the main sources of tourism information in this model is shown in Table 2:

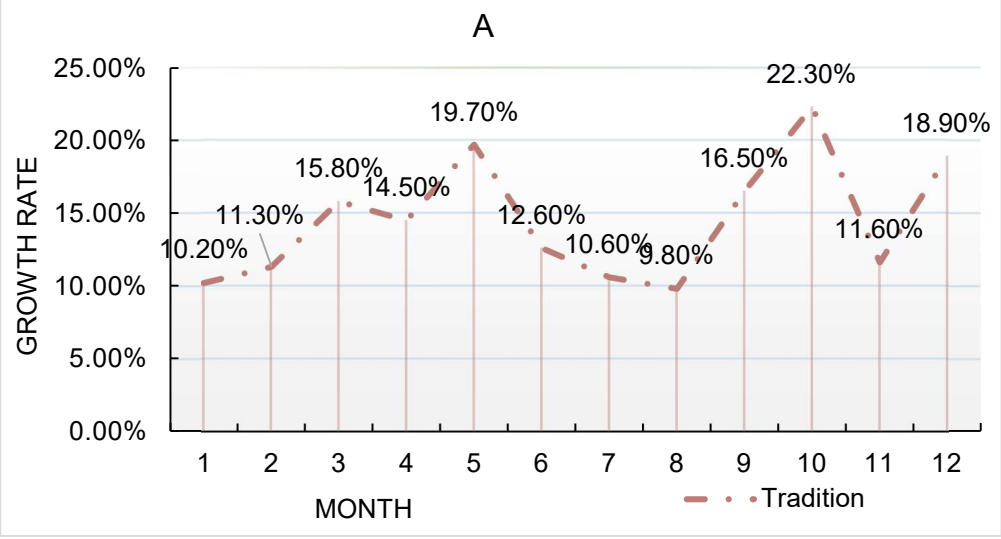
Table 2: Main sources of tourism information in this model

Serial number	Source channel	Proportion(%)
1	Internet companies	24.8%
2	Communication operator	20.2%
3	Government sector	15.8%
4	Cultural and tourism enterprises	29.3%
5	Other ways	9.9%

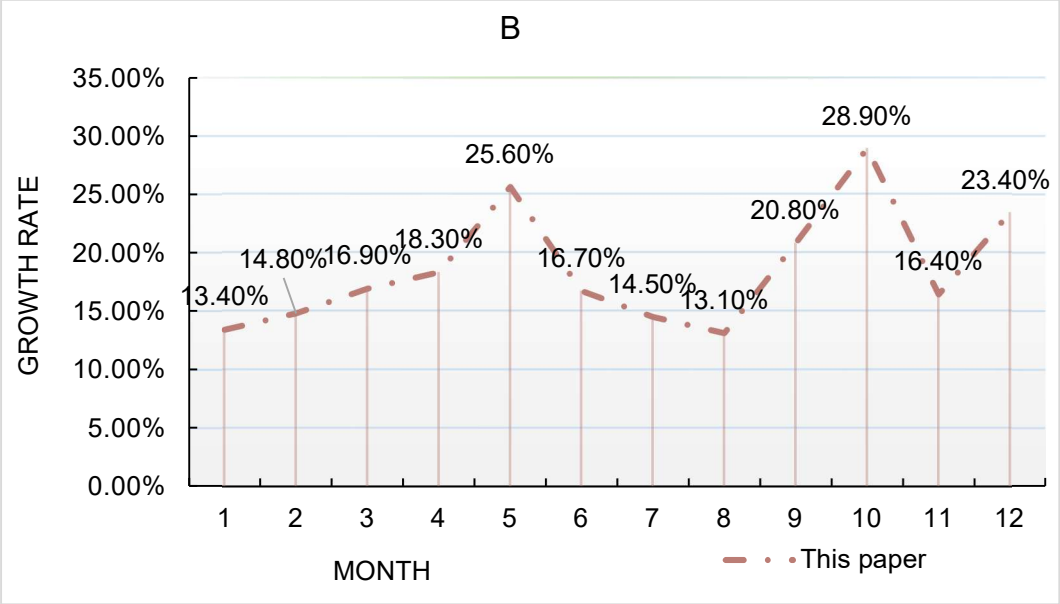
It can be seen from Table 2 that the source channels of tourism information in this model are relatively rich, and the most important ones are the data of cultural and tourism enterprises themselves and the Internet data. This indicates that in order to better realize smart tourism, the tourism platform must integrate the Internet data and cultural and tourism enterprise data, and provide different tourism services for tourists according to different tourism information.

III. B. 3) Evaluation of Tourism Economic Benefits

The improvement of tourism economic benefits is the ultimate goal of smart tourism, and also the most important way to verify the BD mining model for promoting the development of tourism economy. This paper applied the two models to a smart tourism platform, and predicted the changes in the monthly tourism economic benefits of the tourism platform in 2022 after using the two different models. The specific results of the two models for the economic benefit growth of smart tourism are shown in Figure 9:



(A): Growth and change of economic benefits of smart tourism based on traditional model



(B): The growth and change of economic benefits of smart tourism in this model

Figure 9: Comparison between the two models for the growth of economic benefits of smart tourism

It can be seen from Figure 9 (A) and Figure 9 (B) that the economic benefits of the traditional model had a relatively high growth rate in May, October and December. The growth rates of economic benefits in these three months were 19.7%, 22.3% and 18.9% respectively. In other periods, the economic benefits of tourism in this model were basically within 17%. The economic benefit growth of this model in May, October and December was 25.6%, 28.9% and 23.4% respectively. Compared with the traditional model, the economic benefit of this model in May was 5.9% higher; the economic benefit in October was 6.6% higher; the economic benefit in December was 4.5% higher. It can be seen that the model in this paper is more helpful to promote the increase of economic benefits of the tourism platform. At the same time, the platform pays attention to the theory of marginal effects, which helps the platform to better carry out ecotourism planning and achieve the improvement of tourism ecological benefits, and plays an important role in the natural protection and sustainable development of scenic spots.

To sum up, this paper conducted empirical research on the smart tourism BD mining model under the ecological effect, and found that the method in this paper is feasible, which helps to improve the accuracy of the model for tourism information mining. Compared with the traditional model, the accuracy of the model in this paper has improved 13.3% when the data volume was 45000, and the model in this paper had stronger ability for information mining. In addition, the application of this paper's model to the smart tourism platform can effectively enhance the tourism platform's economic benefits while promoting its ecological effects. This showed that the model in this paper had better performance and higher practical value.

IV. Conclusions

With the rapid development of current science and technology and the progress of the IoT, massive BD has brought different impacts on people's daily life, and also brought different changes to the tourism industry. The theme of this paper is the construction of smart tourism BD mining model under the ecological effect. First, it briefly summarized the research background of this article, then summarized and analyzed the advantages and disadvantages of previous scholars' research, and then proposed to apply the edge effect to the construction of smart tourism BD mining model in combination with relevant theoretical research. In order to verify this assumption, this paper also carried out experimental research. The research showed that the idea of building smart tourism BD mining model proposed in this paper has high application value. It can improve the accuracy of the data mining model and make the obtained tourism information more usable. At the same time, its tourism information covers more, which can provide better services for users and improve user satisfaction. In addition, it can promote the economic benefits of tourism and realize the ecological benefits of scenic spots.

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