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Image Monitoring and Management of Hot Tourism Destination Based on Data Mining Technology in Big Data Environment

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ABSTRACT

With the development of society, tourism has become a pillar industry in the national economy of many countries and regions. Tourism is booming, and its role in economic growth and employment promotion is increasingly valued by the state. The demand for tourism consumption has further increased. With the rapid development of information and communication technologies such as cloud computing, Internet, Internet of Things and mobile intelligent terminals, intelligent tourism has emerged. Tourism destination image refers to the synthesis of people's perception, impression and viewpoint of tourism destination, as well as the synthesis of the cognition and idea of the society, politics, economy, life, culture, tourism development and other aspects of the destination. In order to solve the problems encountered in the development of tourism, it is necessary to accurately extract the image monitoring information of tourism destinations, generate the corresponding tourism routes by using all the candidate destination sets, generate all the destinations formed by the destination sets, and return the recommendation results to the tourists.

1. Introduction

At present, the tourism industry is booming, and its role in economic growth and employment promotion is increasingly valued by the state. With the development of computer data mining technology, it can solve many problems in the development of tourism [1]. When people decide to travel, they will be faced with a series of decisions such as choosing a tourism destination, travel time and method, the most important of which is to choose a tourism destination. At present, some tourism enterprises mainly adopt theme tourism route design, supermarket tourism route design, operational research method tourism route design and market-oriented tourism route design when planning tourism routes [2]. These tourist route designs have not fully utilized the advantages of modern information technology. With the development of database technology, especially the extensive application of data mining in various industries, it is possible to mine suitable tourist routes [3]. There are many factors forming the image of tourism destination, and its image composition is also complicated. The era of big data has triggered a comprehensive change in the development of tourism. Informationization and wisdom have led to a faster spread of public opinion, which is directly related to the survival of tourism destinations [4]. With the strong support of the National Tourism Administration, information technology has become an important productive force in tourism development and an important supporting force to ensure the sustainable development of tourist attractions [5].

It is very necessary to use big data technology to deeply analyze tourists' perception of tourism destination image, tourism motivation and tourism demand from the perspective of tourists. The specific application of data mining technology mainly involves three key technologies, namely, data mining algorithm application technology, original data processing technology, and pattern library establishment and representation technology [6]. In the image monitoring system of hot tourist destination, the real-time and accuracy of recommendation are contradictory. The formation of tourism destination image can be roughly divided into political and economic conditions, natural environment of tourism destination, cultural tourism resources, infrastructure, tourism development and other aspects [7]. Although there has been a great deal of research on tourism recommendation service, it provides tourists with convenient and efficient tourism recommendation service. However, the existing researches on tourism recommendation services have not included any time limit. Using mature data mining technology to provide tourists with accurate and intelligent tourism information recommendation services has greatly accelerated the application of data mining technology in the field of tourism

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recommendation [8]. In today's situation where tourism is in the buyer's market, there are many alternative tourist destinations to choose from. People will compare the images of the relevant tourist destinations and finally choose the tourist destination that can meet their tourist needs and psychological expectations [9].

Creating a good brand image of a tourist destination is crucial to the development of tourism industry in a tourist destination. This brand image can help the tourist destination to show the local characteristic tourism resources and services to consumers in the most intuitive way and promote the development of local tourism [10-11]. Tourists demand more and more information on tourism destinations, but local tourism information is fragmented, lack of data integration and sharing, lack of accurate services, and scattered information access channels, which make it difficult to easily meet the needs of the majority of self-help tourists [12-13]. In order to more effectively meet the tourists' corresponding needs and reasonably allocate the limited public service resources, the local government needs to clarify the characteristics of tourists' demand for local tourism information and consulting services, so as to provide corresponding tourism public service information in a targeted manner [14]. From the perspective of China's national conditions and long-term development of national life, the global tourism dominated by tourist destination cities and radiated by core scenic spots is becoming a new trend after vacation tourism and sightseeing tourism [15]. With the rapid development of tourism, the image construction of tourism destination occupies an important position in the tourism industry, and the research on the image construction of tourism destination has attracted more and more attention of tourism researchers [16]. Data mining is the core of applying big data to intelligent tourism. Based on the big data environment, this paper uses data mining technology to analyze the image monitoring and management of hot tourism destinations.

2. Tourism Destination Decision in the Age of Big Data Intelligence

In the image monitoring system of hot tourist destinations, each link must retrieve the required data from the corresponding database. For example, a schema database, a user registration database, a destination information database, etc. The development of China's tourism industry will show the trend of industrial modernization, and the role of science and technology in promoting the development of tourism industry is increasing [17]. Tourism is an information-intensive, comprehensive and highly information-dependent industry, which naturally meets with big data. The database management system in the offline module is mainly responsible for operating, maintaining and managing the data in the database. One of the characteristics of tourism is geographical location correlation, that is, every destination and route can be accurately found on the map [18].

Big data mining plays a vital role, pointing out that in the process of smart tourism, data collection, storage and management are all services for data mining, and what smart tourism ultimately needs is to use the useful information obtained from mining. With the explosion and development of the Internet, the information resources on the Internet have gone from scarcity to the other extreme. In the face of massive information and search results, users are often unable to make choices. The database is responsible for recording basic personnel information and track information obtained through Beidou tour guide cards. The Beidou data acquisition architecture is shown in Figure 1.

The hot spot tourism destination image monitoring system based on data mining technology can generate a destination route database according to a given destination range, including a destination information table and a route category table. You can also generate user information tables, user transaction tables, and user selection trend tables according to user characteristics. The data mining algorithm may only mine some data in the database [19]. To this end, we need to extract useful data and repair the incompleteness and inconsistency of real world data. With the

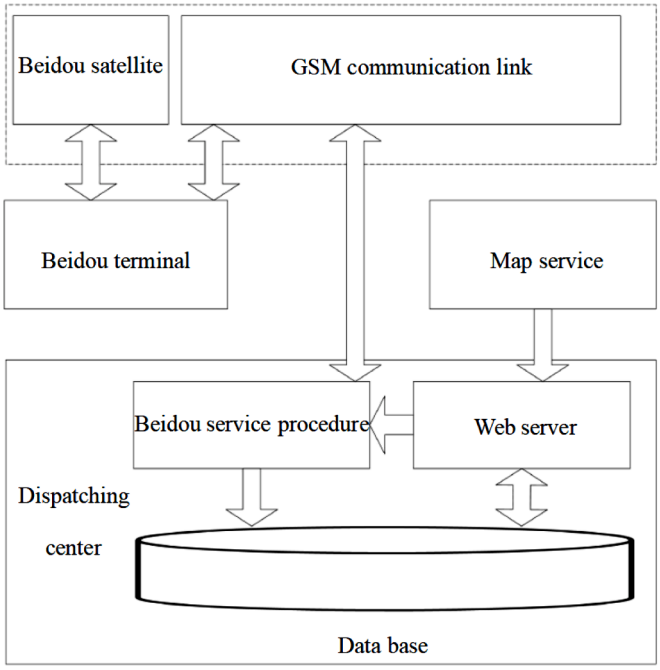

Figure 1. Beidou data acquisition architecture

development of Internet technology and the popularization of mobile devices, a large amount of visual data, such as tourist images, are generated on the Internet every day. Compared with traditional scenes, tourism scenes still have conventional challenges, such as viewing angle, lighting, appearance and occlusion of tourists [20]. In the process of data mining, data preprocessing is an indispensable stage. The initial data are mostly noisy and incomplete. There are many kinds of data formats, so it is necessary to extract useful data in practical system applications and convert the initial data into formats that can be recognized by data mining algorithms in recommendation systems.

Travel itinerary planning service uses travel itinerary planning algorithm to reasonably plan travel itinerary for tourists. In order to meet the needs of personalization, it is very important to apply data mining technology to the process of personalized service recommendation system, but this process involves three key technologies: the processing of original data, the establishment and representation of pattern library, and the application of data mining algorithms. Compared with behavior recognition, static image behavior recognition has its own characteristics. For example, static images lack motion information, which leads to many methods based on spatio-temporal features not being applied to image-based behavior recognition. Due to the challenges of complex background and self-occlusion, it is difficult to segment the behavior region of interest from the image, which is also a problem caused by lack of motion information [21].

Judging from the development of intelligence, China's information construction still needs to be strengthened. Although the communication network has been basically guaranteed, most scenic spots still cannot realize comprehensive, thorough and timely perception of scenic spots. The data communication link consists of GPRS communication module, telecom operator base station and data processing center. Location data and other related data generated by electronic tour guide card positioning are first transmitted to the telecommunication service operator through GPRS channel, and then the operator transmits the data to the data processing center through Socket technology, and vice versa. The principle of data communication link is shown in Figure 2.

The online module of the hot tourism destination image monitoring system based on data mining technology can provide online browsing and recommendation services for users. The advantages and disadvantages of this part of the design directly affect the level of the whole

Figure 2. Data communication link principle

tourism route recommendation system and its popularization and application effect. In the era of big data, the ubiquitous data collection technology makes our personal information leave traces in the associated data centers [22]. When the amount of data is very large, it is necessary to maintain a transaction identification set for each frequent item using the vertical format data storage method. And a large amount of memory is required. In general, the mining data of association rules are data characterized by destination item codes and transaction codes. Data conversion is required during data preprocessing. When tourists choose tourist attractions, scenic spots and destination cities, they often refer to network information, and their travel decisions are often influenced by the experience of network evaluation.

2.1. FPGA

The hardware designs are typically written in a hardware description language (HDL) such as Verilog or VHDL as such an FPGA-based design. This abstract design needs to go through a series of steps to adapt to the available logic of the FPGA. The first step is logic synthesis. This high-level logic structure and action code is translated into a logic gate. In the second step, technical mapping, the gates are separated into groups of matching logic resources (i.e., netlist generation) on the FPGA. The next two steps are determined by routing the specific logical blocks and interconnect resources of the logical group are the placement and routing that carry the user's signals. The final step is to create a "configuration bit stream" and generate the bit stream. The configuration bit stream is a binary file that properly configures the logical blocks and routing resources of all FPGA programmable bit positions. Typically, the configuration bit stream is stored in an external non-volatile memory, such as EEPROM. As shown in Figure 3, the host processor or host controller is used to download the configuration bit stream to the programmable bit location of the FPGA and put the FPGA into the appropriate hardware circuitry to perform a particular calculation. Used to program (configure) or a set of calculations. The configuration bit stream needs to be downloaded every time the system is powered up, and all the time the user wants to change the circuit while the system is running.

According to the interface supported by the device, there are also two possible ways to download the bit stream. In serial programming mode, the FPGA is configured by loading 1 bit per configuration clock cycle. In parallel programming mode, the FPGA is configured by loading 8x, 16x, and 32 levels of bits per configuration clock cycle. It's 8X-32X times faster than serial mode and reprogramming where speed is important and common, useful for some applications.

3. Application of Data in Brand Image Management of Tourist Destination

3.1. The Design of Tourist Destination Brand Image

The brand image of the tourist destination can help the tourist destination show itself to consumers in an image and intuitive way. This kind of display should highlight the unique and most distinctive side of the tourist destination. What kind of tour route can tourists travel through to complete all destinations on the tour route within the planned consumption time limit, and this route is the route with the highest tourism value under the tourist travel time limit. No matter whether consumers have been to a tourist destination or not, they can have a strong image perception of the tourist destination through the brand image of the tourist destination, and then have a deep impression on the tourist destination, which mainly benefits from the positioning and design of the brand image of the tourist destination [23] and the FPGA data transfer waveform is shown in figure 4.

In many cases, users do not know what valuable information knowledge the data has. For a data mining system, it should be able to search and discover knowledge of multiple patterns at the same time to meet users' expectations and actual needs and the diagram is shown in figure 5.

Tourism companies or local tourism departments complete the transmission of information through these methods, so that more potential customers are mined. Collaborative filtering technology provides personalized recommendation technology according to user preferences, and calculates the similarity between users and products according to past consumption and search records of users or products.

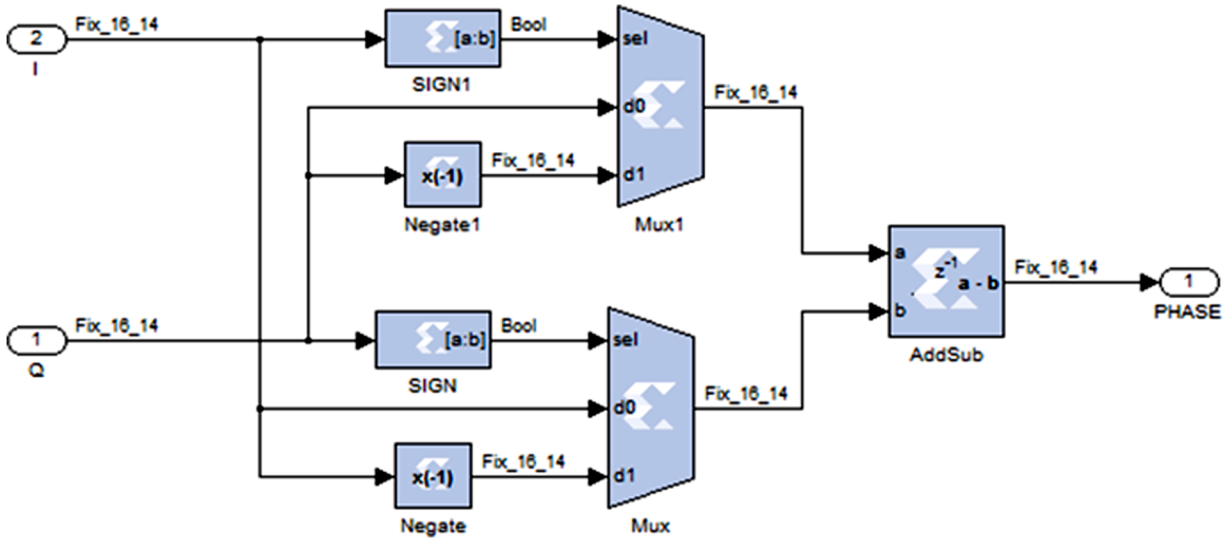

Figure 3. FPGA Data mining Circuit

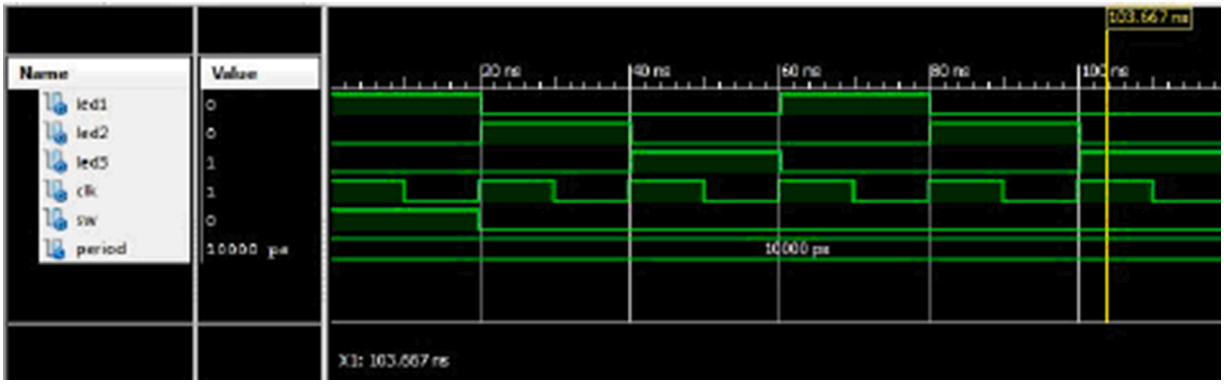

Figure 4. FPGA based data transformation waveform

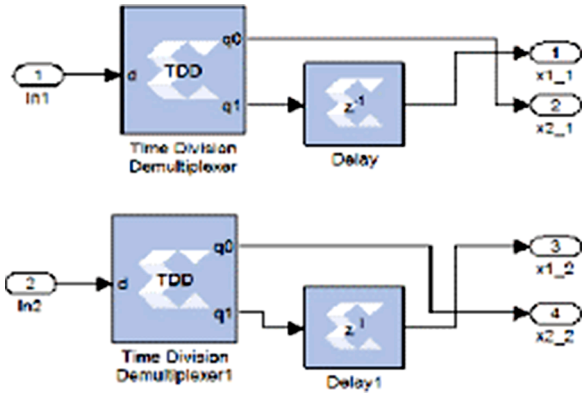

Figure 5. FPGA based Image analysis

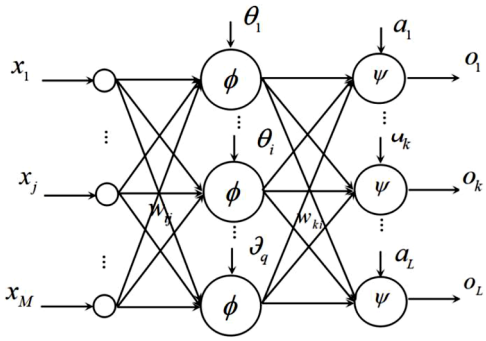

Figure 7. Spanning tree process

And establish an interest model, then use users or products to predict users' interest in products and make recommendations. The traffic solution based on cloud internet architecture is shown in Figure 6.

The specific process can be shown in Figure 7. First, the minimum spanning tree is obtained, and then the cycle is controlled according to the conditions to cut off the edge with the largest weight. If two clusters need to be obtained, only one of the longest sides needs to be cut.

The application of mobile network and intelligent terminal in intelligent tourism is mainly completed through various applications. Tourism is a kind of experience on the road. The traditional way of surfing the Internet cannot solve the tourists' need to find information and participate in interaction in real time during the tourism process.

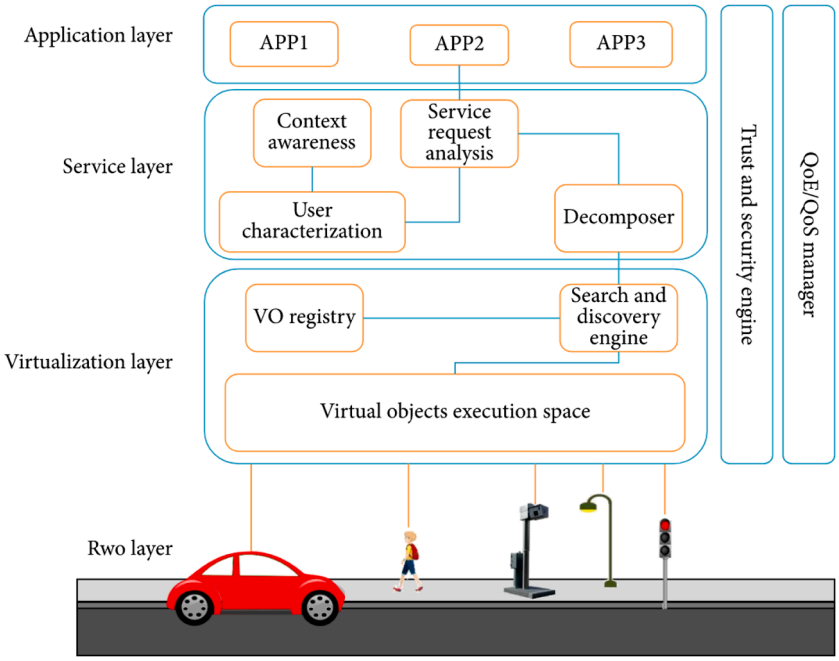

Figure 6. Traffic solution based on cloud Internet Architecture

Due to the variety of tourism products, complex structure and various forms, information and data will often change dynamically. This problem needs to be solved by establishing models of tourists and tourism product information. The positioning mode of the mobile communication network is shown in Figure 8.

The user's preference for the destination is analyzed by using the geographic topic model, and the tourism destination is recommended according to the tourism characteristics. According to this model, users' preferences for various destination characteristics can be obtained, and their preferences for other destinations can be predicted. Similarly, a numerical value can be used to express users' preferences for destinations. For each user P, its satisfaction with each destination is calculated as formula:

$$P = P(Y = 1) = F(\beta_i X_i) \tag{1}$$

The core of the recommendation system is a recommendation algorithm. The simplest recommendation algorithm, such as a demographic-based recommendation algorithm, classifies users based on the most basic information such as age and gender. We define k as the sensitivity of the unit and i as the network output of the hidden layer, that is, the network output before the non-linear transformation. Get the hidden layer to output layer weight update rule:

$$U_{ij} = \frac{H_{ij}}{\sqrt{\sum_{t=1}^{k} H_{it}^2}}, i = 1, \ldots n, j = 1, \ldots, k \tag{2}$$

In addition to the accuracy of each tourism scene category, we also showed the classification performance of each tourism scene scenic area. The table shows the accuracy of the multi-stage transfer learning model. We can find that multi-stage transfer learning performs best in most types. The results of the single-level transfer learning model are shown in Table 1.

In order to understand the personal considerations of tourists, their attitude towards self-help tours, the problems encountered and the solutions adopted, etc. Before doing the demand analysis, I made a questionnaire in the survey network. According to the questionnaire of 100 people randomly collected from the website, the data on the causes of distress during the trip were obtained as one of the references for demand analysis. The data are shown in Table 2.

According to the classification model of scenic spots and hotels and the preference settings in tourist models, the system can more accurately recommend scenic spots and hotel information that tourists are interested in, and meet the needs of personalized information acquisition. From the experiment, it can be seen that the optimization effect of lower bound inspection is the best. Combining the two optimization strategies, it can be seen from Figure 9 that the algorithm using the two optimization strategies performs best in time.

Data mining is the process of extracting hidden, unknown, but potentially useful information and knowledge from a large number of incomplete, noisy, fuzzy and random data [24]. In addition to considering the satisfaction of smart households, the two important factors of play time and travel expenses should also be taken into account to give users more choices. The positioning of the brand image of the tourist destination must have obvious differences with other tourist destinations, thus leaving a unique impression on consumers, which is also the key point of the successful positioning of the brand image of the tourist destination. The electronic tour guide card has the functions of short message broadcasting, voice time telling, etc. Multielectricians will find users with similar consumption preferences through data mining algorithms and algorithms based on collaborative filtering. And in turn

Table 1
Classification accuracy of different levels

Number of levels	1	2	3
Number of classes	2	8	28
Accuracy rate	96.21	95.78	98.57

Table 2
Causes of distress during schedule

Reason	Meal arrangement	Accommodation arrangements	Traffic safety	Open time
Number	14	61	54	20
Proportion	14%	61%	54%	20%

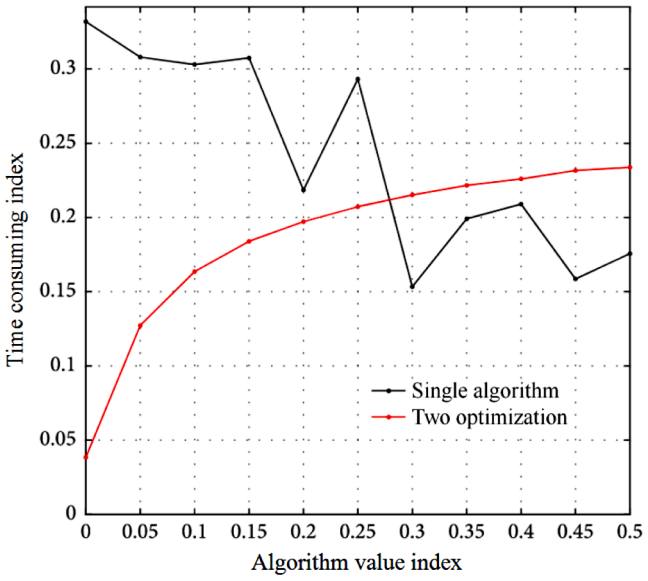

Figure 9. Comparison of algorithm performance time

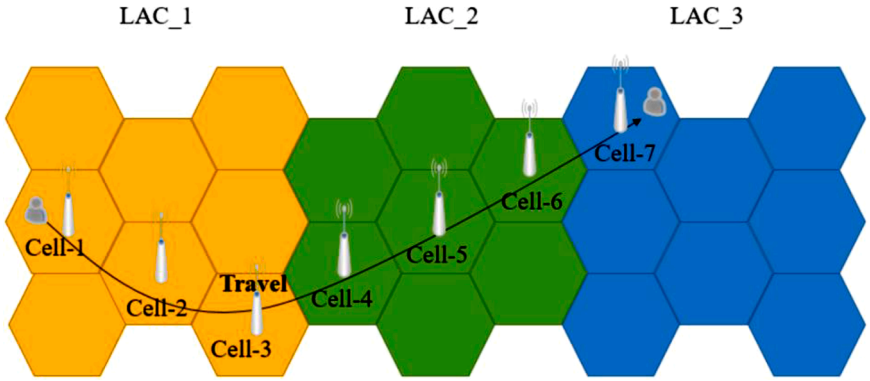

Figure 8. Positioning mode of mobile communication network

predict the commodities that users may be interested in, thus facilitating the completion of the transaction and improving the sales performance. In order to design the brand image of the tourist destination, the image of the tourist destination must first be positioned. The brand image positioning of the tourist destination can show the unique advantages of the tourist destination in terms of natural resources and cultural resources, and open a window for tourists to know about the destination, which is the identification of the tourist destination different from other tourist destinations.

3.2. Dissemination of Tourism Destination Brand Image

Classification schema maps data items in a data set to a given class. It reflects the characteristic knowledge of the common nature of the same kind of things and the difference between different things. The process of browsing the destination is dynamic, the interest of the user is dynamic, and the page may be modified frequently. The pattern generated by the pattern analyzer faces an update problem, otherwise the pattern in the pattern library is not an effective pattern. Therefore, the pattern analyzer not only analyzes the generated patterns, but also updates the patterns to ensure the effectiveness of the patterns. Users can put forward time, cost, satisfaction and other restrictions when making routes. When some routes with different time and cost but the same satisfaction are found out, it is necessary to further find the optimal solution under the influence of the two factors of time and cost.

Tourism destination recommendation based on association rules is to use frequent closed set mining algorithm, first count the number of occurrences of each destination in tourism records, and use FP-Tree data structure to mine frequent closed set. Conditional frequent pattern tree mines the conditional frequent pattern tree of each item according to the header through FP-tree, also known as conditional database, and finally obtains frequent patterns according to this conditional FP-tree. As shown in Figure 10.

If it is located in the scenic spot, mark that the scenic spot has been visited by tourists, and then return directly to the scenic spot where the tourists are located. Without optimization strategy, its complexity is:

$$w_{ij}(k+1) = w_{ij}(k) + \eta\delta_i \mathrm{x_j} \tag{3}$$

Each pixel of the first response graph of each layer is summed after convolution of the convolution kernel and each response graph of the previous layer. As shown by the formula:

$$f(t) = \sum_{j=1}^{N}\sum_{k\in Z} d_k^j \phi_{jk}(t) + \sum_{k\in Z} c_k^N \phi_{Nk}(t) \tag{4}$$

In a virtual scene, three-dimensional models need to be loaded and displayed in real time, so a balance must be maintained between the efficiency of three-dimensional rendering and the authenticity of the three-dimensional models. We can restrict neurons from being inactive most of the time. Defined as the activation value of a hidden cell, we formally define the following restrictions:

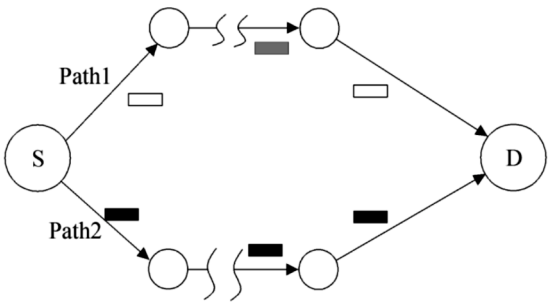

Figure 10. FP-tree

$$Q_i = C_q A_i \sqrt{\frac{2\Delta P_i}{\rho}} \tag{5}$$

To provide data information, better control and management with data connection pool, data control system, etc. are necessary to realize this function. In addition to the accuracy of each tourism scene category, it also shows the classification performance of each tourism scene scenic area. The table shows the accuracy of the multi-stage transfer learning model. We can find that multi-stage transfer learning performs best in most types. The results of the single-level transfer learning model are shown in Table 3.

According to the preferences of users, relevant models can be established. Generally, users can obtain explicit information of users by directly issuing questionnaires to users, according to the answers they fill in in the questionnaires or some information such as users' previous evaluations of products. Through non-linear conversion, the following results are obtained:

$$I(X;Y) = \sum_{y\in Y}\sum_{x\in X} p(x,y)\log\left(\frac{p(x,y)}{p_1(x)p_2(y)}\right) \tag{6}$$

At a certain order, it is possible that all candidate sets do not meet the conditions, and there is no need to move to the next order. The complexity without optimization strategy is:

$$n = \sum_{i-1}^{R} P_l W_{l,j} + b \tag{7}$$

Scenic area managers can set up designated areas on the map. The complexity without optimization strategy is:

$$y_i = f\left(\sum_j w_{ij}x_j - \theta_i\right) \tag{8}$$

Next, the image blocks of all the images are grouped into a data set. Before entering the unsupervised learning method, the data set needs to be pre-processed, that is, decorrelation. Formally:

$$O_t = f\left(\sum_i T_{li} - \theta_l\right) \tag{9}$$

After completing the design of the brand image of the tourist destination, the product can be put on the internet to allow consumers to vote and choose, so that consumers have the opportunity to directly participate in the design of the brand image of the tourist destination. The recommendation module of the online module of the hot spot tourism destination image monitoring system can directly provide services for users accessing the system, which can record the tourism sites visited by the users and generate relevant data, reflecting the advantages of intelligence [25]. In order to deal with these complicated data, some new and better analysis and modeling methods are needed. In real life, sequential pattern mining is widely used in various sequential data sets. For example, gene microarray data in bioinformatics can be used to discover which gene combination patterns frequently occur in certain types of patients.

3.3. The Maintenance of Tourist Destination Brand Image

Like all other products, the brand image of a tourist destination has its own life cycle. Therefore, in order to ensure the popularity and reputation of the brand, the local government should regularly maintain

Table 3
Classification accuracy of different levels

Number of levels	2	4	8
Number of classes	5	16	47
Accuracy rate	94.12	94.87	96.91

the brand image of the tourist destination and extend the life cycle of the brand image of the tourist destination. How to choose the destination and play sequence according to the restriction given by the user is a line search problem. The travel planning algorithm proposed by predecessors for travel routes usually only considers the degree of hot spots in the destination, and a few studies focus on limited planning time [26]. The Internet is the main channel for tourists to obtain tourism-related information. Moreover, compared with magazines, TV, propaganda atlas and other channels, the network is a more active information acquisition channel, which can more truly reflect tourists' attention to tourism destinations.

The online module of the travel route recommendation system can provide users with online browsing recommendation services. The design of this part has a direct impact on the level of the whole tourism route recommendation system and the promotion effect. The optimization complexity is as follows:

$$E(x,y,z)=\frac{xL_{LED}A_{LED}}{[(x-x_0)^2+(y-y_0)^2+(z-z_0)^2]^{3/2}} \tag{10}$$

Different fine tuning strategies correspond to different classification accuracy, and the accuracy data is shown in Figure 11.

In order to protect and manage the core resources of the brand image, the local core competitiveness should not be weakened by changing the core resources of the brand image at will. Local tourism public services can use big data mining and analysis technology to correlate different information such as keyword data searched by tourists, browsing page data, browsing time data and so on, so as to discover information expression modes preferred by tourists for different tourism-related information. Today's fierce competition in the tourism market requires the local government to continuously pay attention to the new needs of consumers, continuously introduce new tourism products and adopt new brand image communication methods according to the changing tourism market environment, and maintain consumers' loyalty to the brand image of the place [27]. Local tourism public services can be related to tourist search data, click data, web browsing and other data, and analyze the most preferred and trusted tourism information acquisition network channels of potential tourists, thus improving the efficiency and quality of tourism information dissemination.

4. Conclusions

The image monitoring system of hot tourism destination based on data mining technology can provide personalized, diversified and multi-destination tourism route reference for users and design a reasonable tourism route to meet the needs of users. Big data can avoid the errors of traditional sampling survey and truly reflect the demand for tourist information and consulting services and its changing trend, thus helping local governments to provide dynamic and appropriate tourism information and consulting public services. The hot tourist destination image monitoring system based on data mining technology mainly includes offline module and online module. The two parts cooperate with each other, through certain operation rules and processes, to generate targeted travel route recommendations for users. The hot tourism destination image monitoring system proposed in this paper is still a certain distance from the actual application. In the era of big data, through the analysis of massive data generated from different channels, tourism destinations can apply the analysis results to the process of tourism destination brand image design, brand image communication, brand image protection, brand image evaluation, etc. With the continuous maturity of data mining technology, the Internet has increasingly become the main channel for people to obtain information in their lives. Using mature data mining technology to develop and design a set of tourism recommendation system that can provide tourists with intelligent and accurate tourism information has become the urgent expectation of tourists.

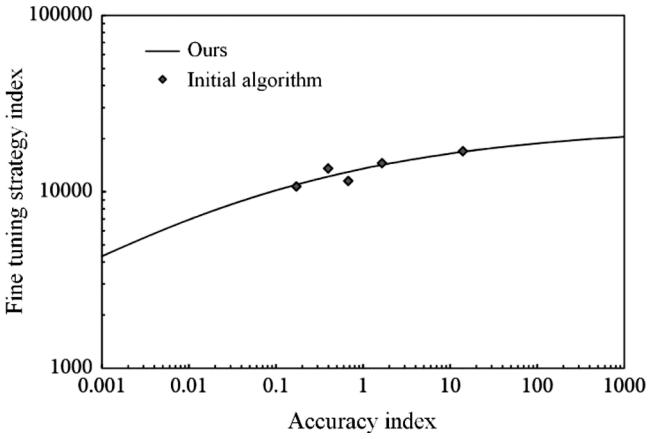

Figure 11. Accuracy index data

Declaration of Competing Interest

We declare that we have no conflict of interests.

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