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REVIEW ARTICLE

Application of new technologies on tourism development in the context of big data

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ABSTRACT

In order to cope with the pressure and challenges brought by the growing number of tourists in China, the development of big data and related electronic information technology provides new opportunities for the operation and management of scenic spots. On the premise of analyzing the relevant background of big data, the advantages of the application of big data in the management of tourist attractions, tourism marketing, tourism operation status and the shaping of tourist reputation are proposed, which provides technical support, data support and intellectual support for the realization of efficient operation, management, analysis, prediction and evaluation of scenic spots. Combining with the application status of big data in the tourism industry, firstly, the paper proposes to establish a data storage and management system based on cloud computing technology, which provides high-performance services for the storage and management of tourism big data. Secondly, it promotes the application of Internet of Things technology in tourism and realizes the intelligent management of tourist attractions. The third is the establishment of the travel information center service platform, for the calculation and processing of data, massive high data access and query to provide a guarantee. The fourth is the establishment of a protection system for tourism data security through active defense, physical isolation and other technical means to provide multi-level and all-round protection for tourism data security.

Keywords: tourism industry; big data; cloud computing; the Internet of things; information security

1.Introduction

In recent years, with the continuous development and progress of China's social economy, the growing number of tourist groups has brought pressure and challenges to the operation and management of scenic spots, while the development of big data and related electronic information technology has provided new opportunities for the operation and management of scenic spots.

2. The background of big data generation and its application in tourism

Big data comes from the name of the futurists Toffler's "third wave". The McKinsey Company in June 2011 issued an earliest report on the big data, in which the influence of big data, key technology and application fields are analyzed detailed. Its core concept is big data, like currency and gold, is a new economic asset. In general, big data refers to the data set that cannot be sensed, acquired, managed, processed and served by traditional Information technology (Information Technology, IT) and soft-

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ware and hardware tools within a tolerable time[1]. Compared with traditional data analysis mode, tourism big data analysis has the following "4V" characteristics. One is Variety. The content and sources of tourism data are very rich, and tourism data cover various types of data forms in the Internet era. The second is Velocity. It mainly indicated in the data processing speed, which greatly saves the cycle cost of data analysis, to provide a basis for scientific and reasonable decision-making. The third is high Value. The cost of data storage is low and the method of data acquisition is convenient and efficient. The fourth is the Volume. The primary feature of big data is the huge amount of data storage. Big data analysis stores real-time data of the tourism industry in fixed big data databases, some of which reach gigabytes (GB), terabytes (TB) or even parabytes (PB).

According to the Internet Data Center (IDC) report, the global Data volume roughly doubles every two years, and it is estimated that in 2020, the world will have a total of 35 ZB of Data volume, and the data volume will increase by nearly 44 times compared with 2010[2]. The arrival of the era of big data is changing people's mode of production and way of thinking. In August 2015, The State Council issued *the Outline of Action for Promoting the Development of Big Data*, which is the first authoritative and systematic document for promoting the development of big data officially issued by China. The document stressed that the big data format can stimulate business model innovation and is an important soft power to enhance the core competitiveness of enterprises. In 2016, the Ministry of Industry and Information Technology formulated *the Big Data Industry Development Plan (2016-2020)*, giving specific instructions for the industrialization of big data. The document calls for using China's existing experience in big data development to accelerate the construction of big data centers and public service platforms. We will increase research and development in key technologies and promote collaborative innovation systems and mechanisms. We will increase policy support to promote high-quality and high-standard construction of big data in China. It is predicted that the revenue of China's big data-related industries and service industry will exceed 1 trillion yuan in 2020, with a compound annual growth rate of 30%. The combination of big data and tourism industry will provide technical support and service framework for the high-quality development of tourism industry. Big data can not only store massive tourism data, but also integrate the data, help people analyze tourism demand and market development trend, and provide a basis for scientific decision-making. Big data can also drive the development of tourism-related industries and provide services for the tourism industry to explore new markets and businesses.

3. Advantages of big data application in tourism industry

1) The application of big data in the tourism industry makes the management of scenic spots more intelligent, efficient and convenient. Tourism industry of big data analysis is to integrate massive structured data (numbers, symbols and other data), and unstructured data (text, images, voice, video and other data) by converting the complex data into interactive graphics to help users better understand and analyze data object, discover and have aninsight into its inherent law. Relying on the visualization platform of tourism big data, the management and decision-making officials can intuitively obtain valuable information through real-time monitoring, analysis and processing of the visualization data, to provide a basis for accurate decision-making, and realize the intelligent, efficient and convenient management of scenic spots. For example, through integration with the Internet, operators and other third-party big data, it can predict the flow of people and cars in the next few days. Through the intelligent scenic spot monitoring system, emergencies such as stampedes, crowding can be monitored and warned timely. Through monitoring system and data analysis, human and material resources can be allocated scientifically to strengthen the management of

market violations. Through the one-card system of scenic spots, the attributes and behavioral preferences of tourists can be analyzed, and the Internet big data can be integrated to accurately locate the tourist source and target consumers in the national market.

2) Big data improves the marketing efficiency of tourist destinations, aims at the source market and realizes precise marketing. Big data precision marketing, also known as data-driven marketing, refers to the analysis of a large amount of consumer data collected or existing by enterprises through big data analysis technology and mining technology with the goal of driving consumers to participate in efficient and one-to-one marketing. And according to the analysis results to optimize a new marketing method of enterprise marketing strategy[3]. With the continuous enrichment of data dimensions, the increasing number of application scenarios, especially the increasingly rich location data and Internet of Things data brought by mobile, data marketing is also rapidly evolving, and the era of intelligent marketing in China is coming. Firstly, the application of big data technology in the field of tourism marketing can not only analyze and forecast the tourism industry chain and marketing level, but also cover the precise mining and crowd matching of tourism demanders. Based on big data collection of behavioral data of tourism consumers at multiple points of contact, through integration and analysis of data, accurate user portraits and other means, it can accurately find the matched tourism groups. Secondly, in terms of identifying the tourist source market, with the arrival of the era of individual tourists, tourism needs are more personalized, tourism market segments are more diversified, and the way of tourism is changing from sightseeing to leisure vacation. Big data can help identify tourist needs and segment the tourism market. Generally speaking, big data identification of customer market is mainly reflected in four aspects: firstly, big data can improve the conversion rate of customer market; secondly, judge the key tourist market of scenic spots; thirdly, identify the reasons for the loss of customers; fourthly, excavate the market depression of scenic spot. Through the accumulation of cookies big data to analyze the recent performance of active data and label each active data with corresponding attribute successively. The user's interest can be determined by the user's stay time and relevant information, and the main city of potential users can be determined by the source of visitors. See **Figure 1** for the big data precision marketing model.

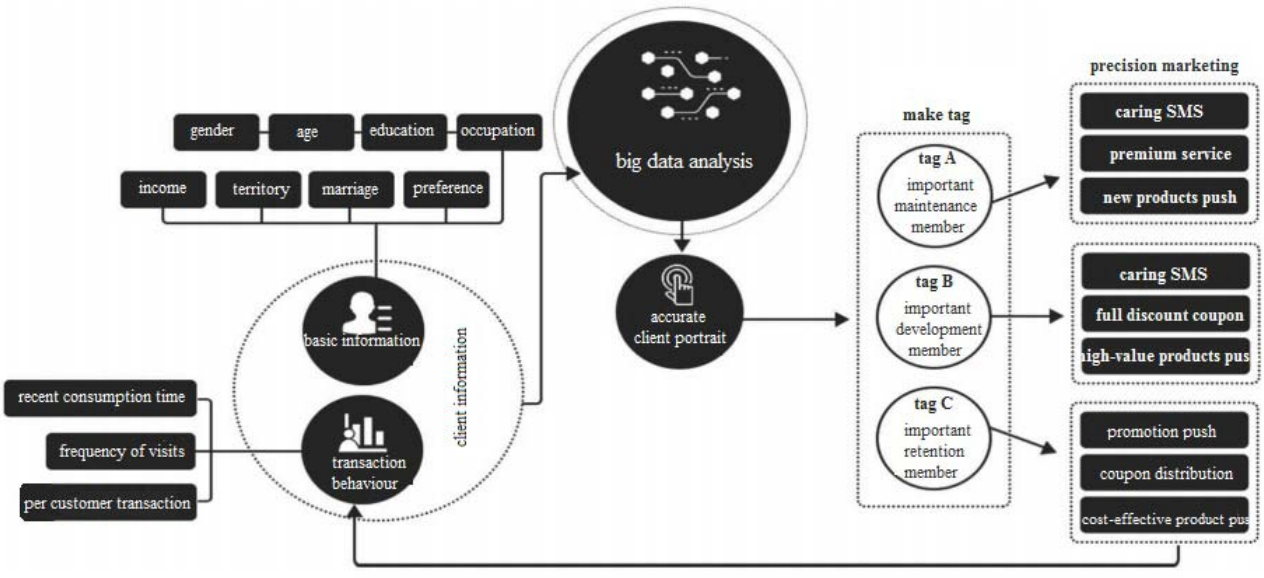

Figure 1. Schematic diagram of realizing precision marketing mode with big data.

3) Big data can help scenic spots analyze their operating conditions and predict their operating trends. Traditional data analysis can only understand the business situation of a certain business or a certain department of the scenic spot, and it is difficult to observe the management changes of the park from a global perspective. Whenever the scenic spot enters the peak admission period during holidays, you can see the relevant news of tourists queuing or staying in tourist attractions. These problems are difficult to control because the data of different formats are not integrated. If the data of ticket booking, traffic and park entry can be combined and compared, the specific time of peak period of park entry can be analyzed in advance, traffic restriction can be carried out in advance or control and management can be increased in important areas. By using the big data of scenic spots, through the analysis of tourists' basic attributes, booking behavior, travel trajectory, etc., tourist portraits are constructed to assist scenic spots to formulate accurate marketing strategies and strengthen the guidance of tourists' secondary consumption behavior, so as to predict the operation trend of scenic spots. The example is the application of big data visualization technology. Big data visualization technology is a technology to explain massive data visually through mathematical modeling and graphic animation display[4], including visual analysis of scenic spot detection data and thermal map of scenic area. The first is the scenic spot test data visualization analysis, through data processing unit to monitor the scenic passenger flow condition in real-time, and the collected data is processed through data center transformation to present a visual dynamic picture of passenger flow saturation in scenic spots, so as to provides the basis achieve the control of the traffic, the scenic spot operation assessment and for online analysis and evaluation. The second is the thermal map of scenic spots. Through the analysis and positioning function of GPS system, the collected data will be processed by visual data processing tools such as Google Chart, and the thermal map of scenic spots describing the density of tourist flow will be displayed on the screen, which can predict the dynamic change of tourist flow in scenic spots in a short term, so as to guarantee the safe operation of scenic spots.

4) Big data can detect the popularity of online reputation of scenic spots and provide a basis for building a good image of scenic spots. Online word-of-mouth refers to the positive or negative information about a merchant's products or services delivered by consumers to potential consumers through the Internet[5]. Through the study of online word-of-mouth, we can analyze the impression of tourists on scenic spots, understand the demand preference of tourists, and provide first-hand information for the optimization management of scenic spots, to provide a basis for the development of marketable products and improvement of service quality. There is a positive correlation between the image of tourist destination and the reputation of tourist attraction, that is, the tourist destination with good reputation comes with good image, and vice versa. An important indicator affecting the popularity of the scenic area is the number of comments. The more the number of comments, the more the tourists who visit the scenic areas, and the higher the popularity of the scenic area. If there are few comments on scenic spots, it indicates that the performance of scenic spots is flat in terms of online word of mouth and public opinion, and the scenic spots is less popular. **Table 1** is the ranking of the top 20 Scenic spots in China in *the Online Word of Mouth Public Opinion Report of 5A Scenic Spots in the first-half of 2019* jointly released by NetEase Tourism and Dadiyunyou. The report conducted big data analysis of public opinion on 258 5A-level scenic spots across the collected 926,130 public opinion comments objectively reflected the evaluation of tourist satisfaction at major scenic spots in the first half of 2019.

Table 1. Top 20 ranking table on the degree of satisfaction of national scenic spot

Ranking	Name of the scenic spot	2019 degree of satisfaction/%	Ranking change compared with 2018
1	the Palace Museum	95.85	19
2	Nanjing Zhongshan scenic area-Sun Yat-sen Mausoleum scenic area	95.24	3
3	Chengdu Mount Qingcheng-Dujiangyan scenic spot	94.84	25
4	Sanya Nanshan Cultural tourism Zone	94.63	3
5	Nanjing Confucius Temple-Qinhuai River scenic belt	94.29	29
6	Big and Small Fairyland Tourism District, Sanya	94.29	23
7	the Olympic Green, Beijing	94.03	48
8	Boundary Island tourism area	93.57	35
9	Zhoushan Mount Putuo Scenic area	93.51	2
10	Hangzhou West Lake Scenic Area	93.31	49
11	Lijiang Old Town Scenic spot	93.22	28
12	Tengchong Volcanic Park and Hot Sea Tourist Area, Baoshan city, Yunnan Province	93.18	69
13	Xishuangbanna Tropical Botanical Garden, Chinese Academy of Sciences	93.17	10
14	Weinan Huashan Scenic Spot. Shaanxi Province	92.95	- 4
15	Yichun Mingyue Mountain Tourist area	92.73	78
16	Jinhua Dongyang Hengdian World Studios scenic spot	92.56	25
17	Ningde City Fuding Mount Taimu tourism area	92.51	06
18	Wuxi Lingshan Scenic Spot	92.51	19
19	Mount Jiuhua Scenic Spot in Chizhou City	92.50	45
20	Chongqing Dazu Rock Carvings Scenic spot	92.42	19

4. New approaches to tourism development in the context of big data

4.1. Establishment of data Storage and Management System Based on Cloud Computing Technology

Cloud computing is a new type of super computing, which is data-centered and data-intensive. It has its own unique technology in data storage, data management, programming mode and other aspects[6]. The distributed architecture of cloud computing well solves the needs of big data acquisition and storage. Its low cost in hardware and software, management and operation makes it possible to process and utilize cloud computing in tourism big data due to the economy and practicality. In order to meet the demand of efficient storage and transmission of tourism big data, most IT manufacturers use Google File System (GFS) data storage technology or Big Table data management technology to process tourism big data.

GFS data storage technology

GFS is a scalable distributed file system for managing large distributed data-intensive computing[7]. What is new about GFS is that it takes cheap clusters of commercial computers to build distributed file systems, which have stood the test of practical application while reducing costs. The basic architecture and working principle of GFS are shown in **Figure 2**. A GFS consists of a master server and multiple chunk servers, so that a GFS

can provide document services for multiple client applications simultaneously. GFS regards server failure as a normal phenomenon and automatically tolerates faults through software, which greatly reduces the cost of the system while ensuring system reliability and availability.

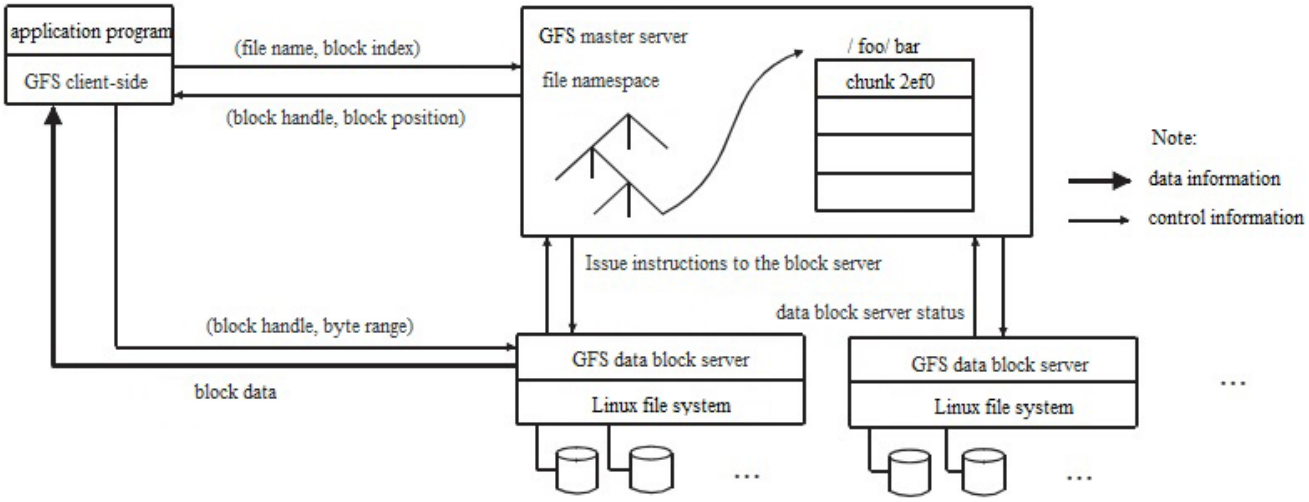

Figure 2. Schematic diagram of GFS basic architecture and working principle.

BigTable data management technology

In order to solve the problems of system scalability and data access performance of relational database system, Google developed BigTable database[8]. Compared with other data storage and management systems, BigTable has the following advantages: firstly, it has high applicability. The development of Bigtable technology is to meet the needs of a series of product applications, with high scalability and compatibility, to provide high-quality services for distributed storage and acquisition of tourism data. Secondly, the usability is strong. BigTable technology has superior performance in data storage and acquisition, and its system is available in any case, which provides a reliable guarantee for the uninterrupted computation and processing of tourism big data. Thirdly, it is simple and operable. The simplicity of the underlying system of BigTable reduces the probability of system errors and facilitates the development of upper-layer applications. **Figure 3** shows the address structure of the sub-table of BigTable distributed storage.

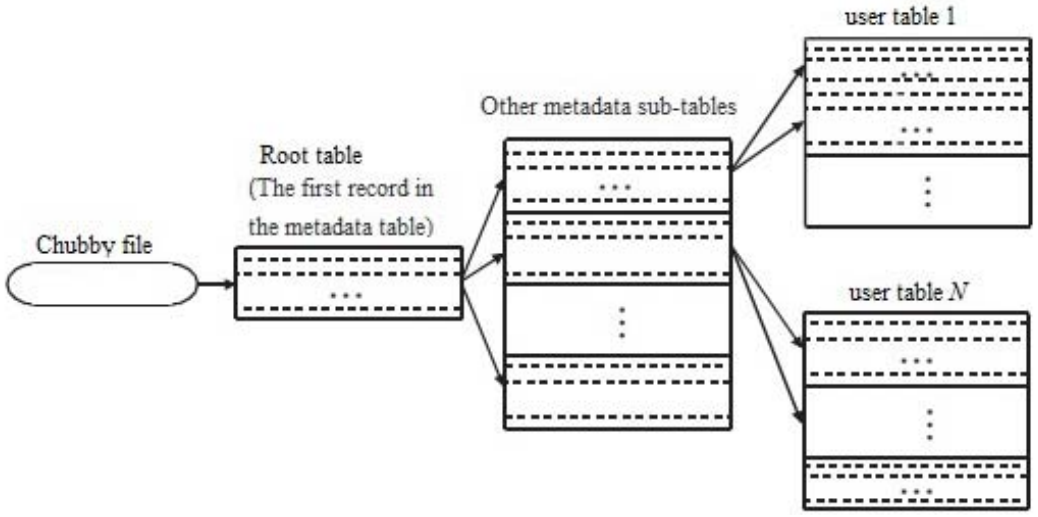

Figure 3. Address structure of the sub-table of BigTable distributed storage.

The Internet of Things is an integrated part of the future network. It is a global dynamic network facility with self-configuration capability based on standard and interconnected communication protocols[9]. The Internet of Things is called the third wave of the development of the world's information industry after computer and Internet through the integrated application of intelligent perception and identification technology, pervasive computing and ubiquitous network. The working principle of IoT technology is shown in **Figure 4**.

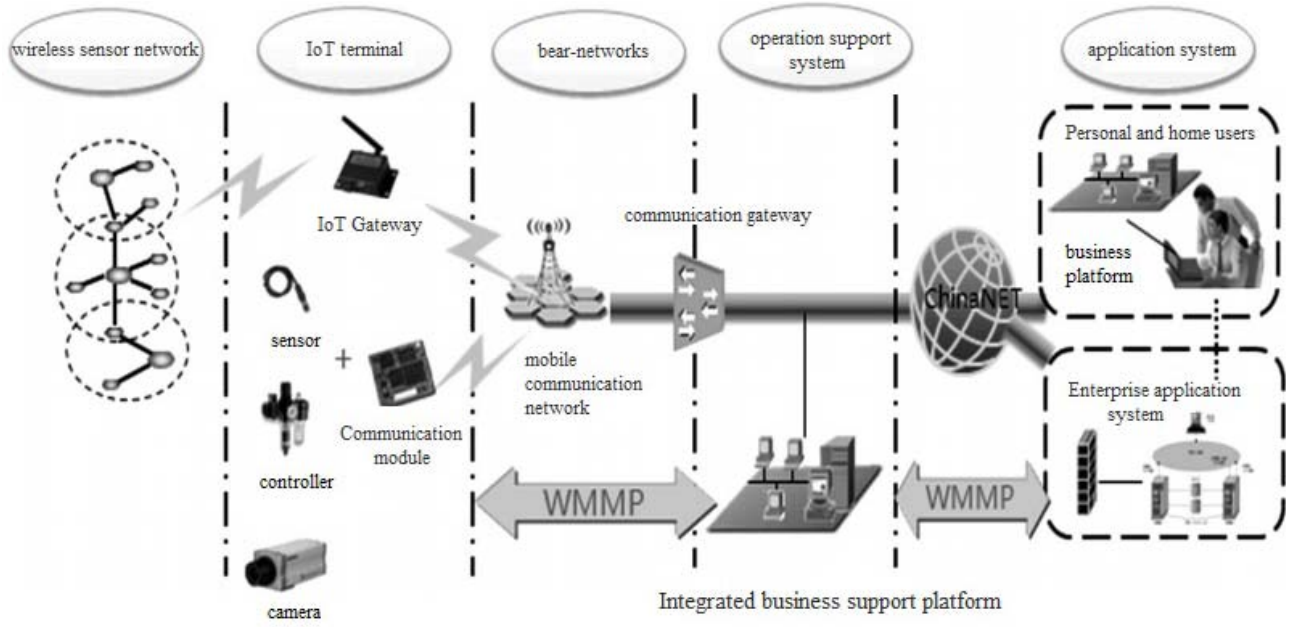

Figure 4. Schematic diagram on working principle of Internet of Things technology.

4.2. Further promote the application of Internet of Things technology in tourism

The application of Internet of Things technology in tourism is mainly reflected in the following two key technologies: First, infrared bidirectional sensor technology. Infrared bidirectional sensor technology is mainly applied to the two-way statistics of outflow and inflow of tourist flows in scenic spots. Its design is mainly composed of infrared sensor equipment, wireless transmission network, adjustment controller, power supply and antenna. Each group of infrared sensors has two pairs of infrared sensors. When tourists walk into the sensor detection area, the system will judge their entry and exit behavior by monitoring one of the two pairs of sensors covered by tourists. Multiple groups of infrared sensors can be installed in the scenic spot. By setting the geographical location of the sensor, the data of tourist inflow and outflow in a specific location can be transmitted to the data center management platform by wireless network, so that the monitoring and statistics of tourist flow in the whole scenic spot can be realized.

The second is Radio Frequency Identification (RFID) technology, also known as E-Tag technology, which uses radio frequency signals to automatically identify target objects and obtain relevant information[10]. RFID technology is widely used in tourism industry. For example, the application of RFID electronic ticket technology can not only realize the anti-counterfeiting of scenic spot tickets, but also easy to operate and manage, easy to sell tickets quickly. Tourists directly swipe their cards to check tickets, realize automatic ticket checking to solve the problem of ticket checking and queuing, and realize the digitalization, humanization and high efficiency of tourist services. Tourism RFID technology integrates the functions of tour guide, tour guide, positioning, traffic flow and

flow data collection as one, carries out real-time automatic collection and analysis of the data of the scenic spot, and realizes the wisdom of scenic spot management.

4.3. Establish the tourism big data center information service platform

The information service platform of ism big data center is based on tourism informatization and tourism data accumulation. Through intelligent technical means, it highly integrates tourism services, tourism management, tourism marketing and other data to realize the mutual perception of tourists and service elements of the scenic spot. Comprehensively using big data to search, analyze, integrate, and optimize the scenic spot management service platform. The information service platform is required to be able to cope with the challenges of massive and highly concurrent data access and massive heterogeneous data query in the design of computer information system service architecture, and the data center is required to have the characteristics of fast stability, flexible capacity expansion, security protection, energy conservation and environmental protection. The overall design of the tourism big data center information service platform is divided into basic hardware layer and server layer, application database layer, data center external interface layer, and provides a unified database access interface externally, to provide data support services for other application systems of the platform. See **Figure 5** for the infrastructure of tourism big data center information service platform.

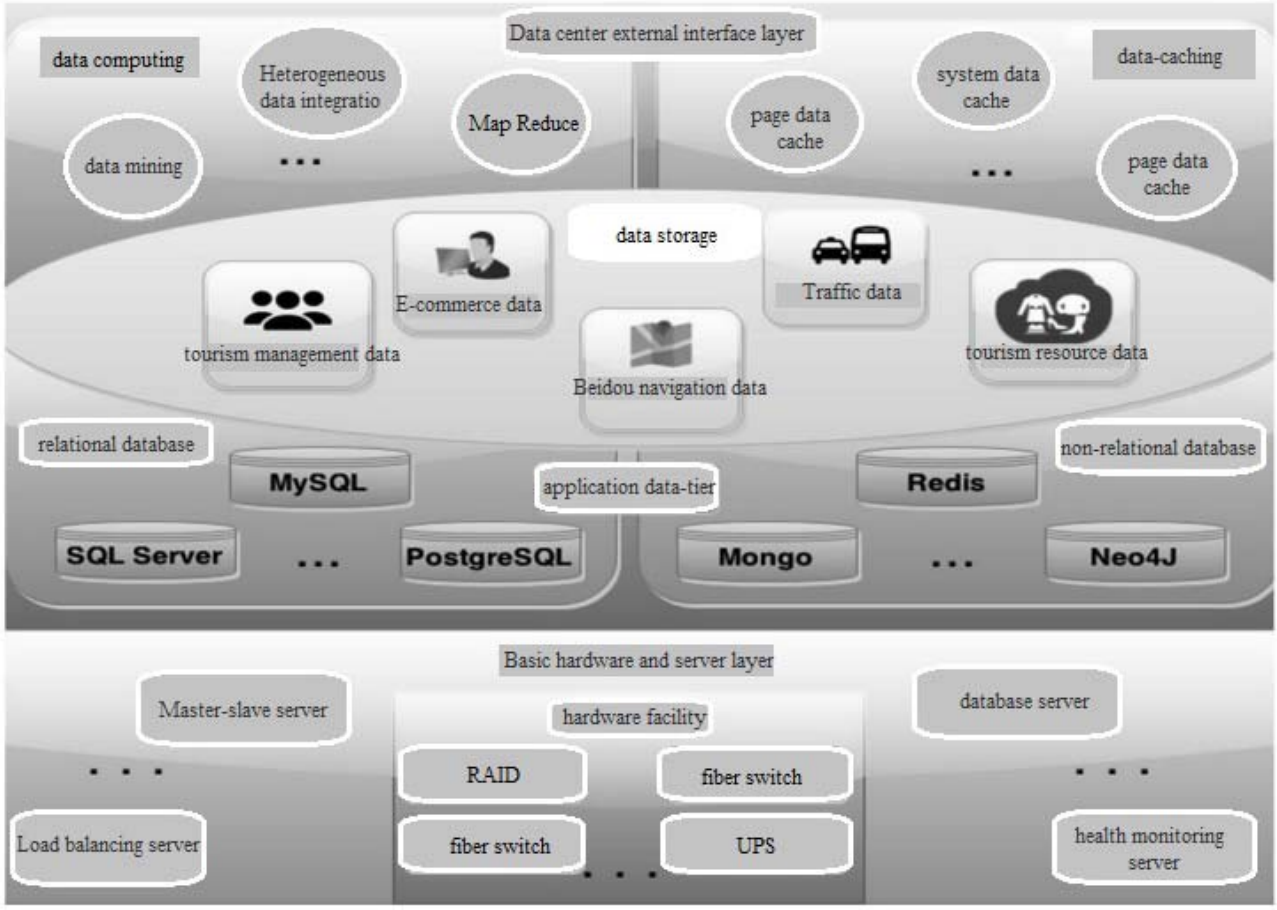

Figure 5. Schematic diagram on center informatization service platform of tourism big data.

Basic hardware layer and server layer

The basic hardware layer is the basic hardware facilities to ensure the normal operation of the data

center. It mainly includes Redundant Arrays of Independent Drives (RAID) devices and Uninterrupted Power Supply (UPS) devices. RAID devices can restore and access data even when a few hard disks are damaged. The UPS ensures that data is securely stored to hard disks in the event of a data center power failure. All these devices provide security basis for stable and rapid response of tourism big data center.

Apply the database layer

Due to the huge amount of data, numerous types of data and complex types and structures of the tourism big data information service platform, it is the prerequisite to ensure smooth operation of the platform to fully and effectively manage and utilize all kinds of information resources. Its main characteristics are: one is to realize data sharing. Data sharing includes the simultaneous access of all users to the data in the database, as well as the various ways that users can use the database through interfaces and provide data sharing. The second is to reduce data redundancy. Compared with file system, database realizes data sharing, thus avoiding users to create application files independently. It reduces a lot of repeated data, reduces data redundancy and maintains data consistency. The third is the independence of data. On the one hand, the independence of data includes that the logical structure of the database in the database and the application are independent of each other, on the other hand, the change of the physical structure of the data does not affect the logical structure of the data.

External interface layer of data center

The external interface layer of the data center is composed of two parts: data computation and data buffering. The data computation integrates various heterogeneous data sources to complete the unified work of complex data query and give the query results. The data cache stores part of the data in the memory and hard disks, ensuring fast data retrieval and preventing system performance deterioration due to cache clearing during a cold restart. In terms of physical location, the information service platform of tourism big data center is the terminal built in the data center. This terminal is not open to the external personnel of the system, but is the terminal used by decision makers and managers to make overall decisions in the data center. The information service platform of tourism big data center has the characteristics of simplified display, overall command and auxiliary decision-making, and plays a role in maintaining the stability of scenic spots, improving emergency response capacity and ensuring public security of scenic spots.

4.4. Establish technical services for tourism information security protection

The function of tourism information security protection support service is to ensure the communication security, application security and data security of the upper application of tourism by constructing a multi-functional, multi-level and all-round security defense system. Through the construction of intelligent information prevention system, the relevant departments can do a good job in the prevention of tourism safety emergencies to win precious time. The technical service structure of tourism information security protection is shown in **Figure 6**. Its defense features are mainly reflected in two aspects: active defense and physical isolation.

Active defense

In order to deal with the complex and changeable network attack, computer active defense is paid more and more attention by the industry. Active defense is to detect abnormal user behaviors through statistical analysis of historical user behavior data, calculation of user habits. Using neural network with learning and adaptive ability to realize intelligent intrusion detection; the intelligent active defense is completed at the optimal defense cost. For example, for the detection of abnormal user behavior, different processing is added according to the hazard level of the behavior; Automatic learning and updating recognition model, can be customized recognition model; Provides a variety of visual reports, records the attack behavior of attackers, and provides network forensics.

Physical isolation

In order to cope with external network attacks, physical isolation technology is attracting more and more attention in the industry. Physical isolation consists of three parts: one is the physical isolation of clients. This scheme is used to solve the information security problem of network client. The application of physical isolation card in the client of the network can make a workstation connected to both Intranet and extranet, and work in time-sharing on Intranet and extranet. At the same time, the physical isolation between Intranet and extranet can be absolutely guaranteed, to work easily and save resources. The second is the physical isolation at the hub level. A network line can be used in the client's internal and external double network wiring, through the remote switch to connect the internal and external double network, to achieve the purpose of a workstation to connect the internal and external two networks, and in the network wiring to avoid the client to use two network lines to connect the network. The third is physical isolation on the server side. It realizes the task of data filtering and transmission on the server side through complex software and hardware technologies. The key of its technology lies in that there is no physical data connection between internal and external networks at the same time, but the data can be processed and transmitted in a fast time-sharing manner.

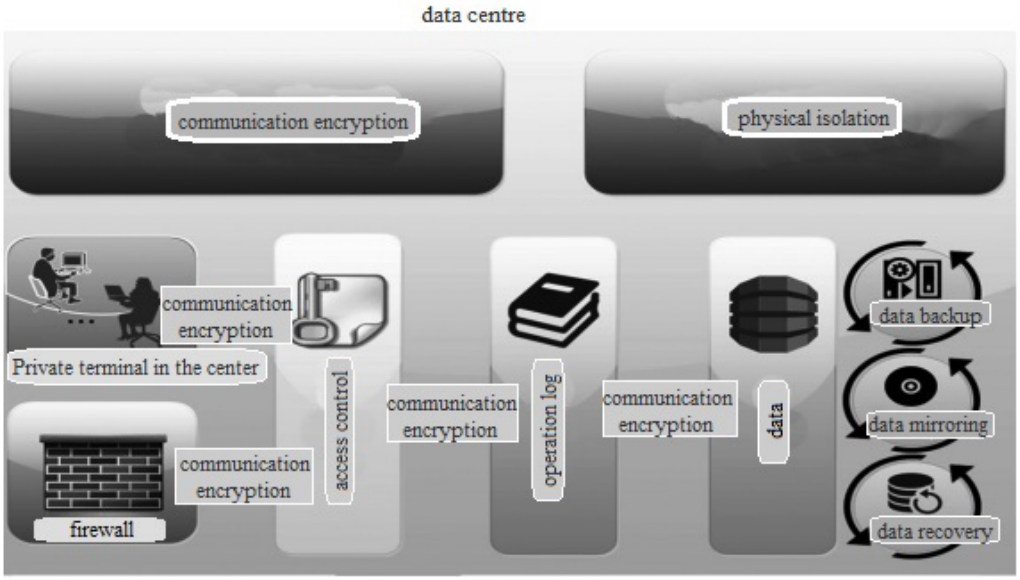

Figure 6. Schematic diagram of tourism information security protection technology service.

Conflict of interest

The author declares no conflict of interest.

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