Research on the Key Technology and System Architecture of Smart Research Travel in Novel Coronavirus Epidemic

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Abstract. In December 2019, China’s research travel market plummeted as a result of the novel coronavirus epidemic. In the context of a depressed research market in the Information Age, the concept of “Internet + research” emerged. First, according to symbiosis theory, the symbiotic units of smart research travel are determined. Then, based on a structural design of smart research travel data system, key technologies in big data, cloud computing, and Internet of Things are described in detail. Finally, based on the traditional browser/server architecture model of computers, a smart research travel system architecture suitable for the epidemic situation is constructed. The purpose of this study is to build a new ecology of research travel, optimize resource allocation, and promote the healthy, stable, and sustainable development of research travel in the country.

1. Introduction
China has seen economic development in the last decades, with an average GDP growth rate of around 8% [1]. Research travel inherits and develops the educational concept and humanistic spirit of China’s traditional study tour based on the idea of “reading thousands of books and traveling thousands of miles.” Research travel has become an important aspect of quality education to enhance the self-care ability, innovative spirit, and practical skills of primary and secondary school students. The first year of research travel in China was 2017. Since then, research travel policies have been introduced, and research travel has become a new industry hot spot. In the next three to five years, the research travel market (not including the research market for adults and the elderly) is expected to be valued at over 100 billion yuan [2].

In the context of the Information Age, the Internet has changed people’s work, life, and consumption modes, created an environment with highly convenient and comprehensive service experiences, and increased the individual characteristic of the demand for research travel. The development of smart research travel reflects certain needs, which are supported by network technology and pays attention to service upgrading to enhance the research experience, which is the main direction of the industry’s development. The intention is to collect a variety of research information through Internet of Things (IoT)-aware terminal facilities, as well as maximize the comprehensive use of resources for students, related enterprises, institutions, and management departments so that personalized applications and services can be provided in accordance with these needs.

2. Definition and Significance of Smart Research Travel
2.1. Definition of Smart Research Travel

The definition of research travel has not been unified, and the generally accepted view is that “research travel” broadly refers to special travel for the purpose of research and exploratory learning; tourists undertake this activity due to the need for cultural knowledge. In a narrow sense, research travel is considered to be an out-of-school educational activity organized in a planned manner by the education department and the school, and combining research learning and travel experience for a group in centralized accommodation [3]. The participating groups are mainly primary and secondary school students, and many scholars believe that research travel is a comprehensive practical course [4].

Smart research travel is the application of information technology (IT) based on IoT, cloud computing, and intelligent data mining in the tourism industry, as well as a new form of research travel that combines information and tourism resources. As a new generation of research operation mode, the development process of smart research always adheres to “people-oriented” ideological guidance based on the needs of students. The process also involves various resources related to smart research with a high degree of integration through IT to establish a sound smart research travel service system so that students can enjoy the service at their preferred time and place.

The realization of smart research travel is based on the realization of smart tourism. Tourism is an industry highly dependent on information and communication technology (ICT) [5]. The rise of intelligent technologies such as artificial intelligence, big data and the Internet of Everything is reshaping the tourism industry and driving the realization of smart tourism. Technological progress has brought service innovation [6]. By using smart systems such as recommendation system and decision support system and smart devices such as wearable devices, smart tourism can provide tourists with more information services and decision-making reference [7], and greatly improve their travel experience. Through the analysis of tourist behavior data of primary and middle school students, not only can forecast the demand of the tourists and provide precise recommendation for tourists, meet tourists diversified and multi-level demand, but also according to the data of real-time feedback, master the smart research travel teaching effect, for subsequent research travel upgrading to provide support and guidance, promote the sustainable development of research travel.

2.2. Significance of Smart Research Travel

In a sense, smart tourism has upgraded the traditional service industry to a modern service industry in which students can be located through Internet technology, and their needs are effectively perceived and monitored. Smart tourism also enables the study of market dynamics, and combines and shares the collected data, to maximize service benefits. In addition, traditional research can only meet the static needs of tourists, and smart research is a good way to push the relevant services for students through information integration to meet the dynamic or personalized needs of students. The research symbiotic unit can obtain a real-time full map of the research operation, which provides good data support for development decision-making in the later stages of the enterprise. The smart research travel based on students’ research needs has created a new ecology of research travel, and achieved service delivery anytime and anywhere. This field is also conducive to the optimal allocation of resources, which is an important direction for the healthy, stable, and sustainable development of smart research travel.

3. Symbiotic Unit of Smart Research Travel

The concept of symbiosis was first proposed by German biologist Deberg in 1879 [8]. Symbiosis refers to the specific phenomenon of forming a kind of mutualistic connection between certain units in a specific environment [9]. The symbiotic unit is the most basic element that constitutes the symbiont or produces the symbiotic relationship, and it is the basic unit of the material and energy exchange in the symbiotic system, which can provide the necessary material parts for the symbiotic development of the symbiont [10].

The symbiosis method has gradually penetrated the fields of psychology, demography, economics, sociology, and tourism [11], and many phenomena in the social, economic, and life sciences can be described by the symbiosis theory of ecology [10]. As a social phenomenon, research travel can be
expounded by the symbiosis theory [12]. The research travel industry is a comprehensive, and sensitive industry [13]. The active involvement of many related units brings opportunities for the transformation and upgrade of this industry [14]. Smart research travel is achieved through computer technology support, and the symbiotic units are diverse. In addition to the symbiotic units of primary and secondary schools, travel agencies, research institutions, media, research bases (such as scenic spots and museums), the computer industry based on smart technology is also involved, and the symbiotic units are gradually enriched in the smart research market.

4. Structural Design of Smart Research Travel Data System
The structure of the smart research travel data system is divided into a horizontal model view controller (MVC) frame and a vertical functional tier to jointly support mobile phone applications, webpages, and other front-end pages. The bottom tier of the MVC framework is typically a database consisting of many tables, and the top tier produces a series of actions at the bottom, depending on specific functionalities such as user login, overall service, management, and data push modules. The specific data system structure is designed as shown in figure 1.

![Figure 1. Structure of smart research travel data system.](image)

5. Interpretation of Key Technologies of Smart Research Travel
In the process of smart research travel construction, influenced by the diversified demand for smart services, a growing number of new network technologies have appeared in smart research travel, which supports the construction of the smart research travel system. According to the preceding system design, the overall architecture of key technology application is shown in figure 2.
Figure 2. The overall technical architecture of the key technology application of smart research travel.

5.1. Big Data Technology
Smart research content, smart management, and smart service are the main components of smart research travel. Regardless of which element needs to be implemented, big data technology is the core of smart research travel technology. Many types of big data are available for smart research travel; the number of students, structure of research content, length of research, and other factors are included in the category of big data analysis of smart research travel. Through real-time monitoring and
aggregation of these relevant data, the development of smart research travel in a region can be objectively reflected, including the scale of development of the research travel symbiotic unit, and the student’s research preferences. These factors can provide an important information reference for the optimization and adjustment of the development plan of smart research travel.

5.2. Cloud Computing Technology

Smart research travel is a research travel development model set around the needs of students, which fully embodies the students and research travel symbiotic unit in all aspects such as research travel services, facility construction, and development planning. The reason is that smart research travel relies on cloud computing technology to provide a large amount of information processing and aggregation functions. Furthermore, smart research travel provides an important information reference for the research travel unit to conduct comprehensive analysis of the current research travel market so that research travel symbiotic units can achieve the dynamic collection and analysis of the research base information under the actions of a powerful cloud service center, cloud data platform, and cloud computing system. Thus, the research travel symbiotic unit can be used as a basis to create tailored smart research travel services for students. In addition, for the smart research travel cloud data center, we can also summarize and store all types of information upstream and downstream of the smart research travel industry chain so that the symbiotic units and students can retrieve the necessary information.

5.3. IoT Technology

According to survey data, more than 70% of the world’s hotels, transportation, and tourism industry are connected to customers through IoT technology [15], which to a certain extent reflects that IoT technology is widely used in various areas of society. For example, in 2013, the Walt Disney Company in the United States released a “magic” wristband for tourists participating in park tours. The wearable smart device includes a chip that provides wireless signal transmission and reception capabilities. At the same time, the equipment is connected to the park network management platform system so that visitors can enjoy intelligent services in the park. At present, China’s smart research travel can use IoT technology to conduct self-help research services for students. By turning the information of the research base into videos, pictures, virtual reality experiences, and others, the technology enables the students to easily scan a quick response code and conduct self-study on the research base.

6. Construction of Smart Research Travel System Architecture

Most of the smart tourism platforms currently in operation are based on the browser/server architecture model [16]. In this study, further improvements on the basis of the model were made, so that its sharing ability is strengthened and can provide a comprehensive service for the entire research process. In addition, data are not easily lost in storage, and a safe and reliable storage environment can be provided for the platform [17].

In a highly open market economy, competition in the research travel industry is increasing, and so is the demand for innovation and reform of research travel units. The development of smart research travel has become the key to sustainable development. The essence of research travel is smart service, and a series of related activities should be student-centered and customized on demand to cultivate students’ trust and loyalty, and effectively stimulate their enthusiasm for research. Promoting the smart development of research travel necessitates continuous improvement of technical support to highlight the research travel base of smart services, management, and research so that students can enjoy convenient and intelligent research services. Therefore, combined with the aforementioned key technologies of smart research travel, applying the functional advantages and integrating the smart research travel construction objectives are also necessary to construct a smart research travel system architecture, as shown in figure 3.
Figure 3. Key technology and system architecture of smart research travel.

6.1. Data Tier
The system interacts with the database or other data storage methods mainly through the data tier. In the data tier, all types of data, including research bases, primary and secondary schools, other symbiotic units, and students are classified and stored, which not only ensures classification management but also avoids the problem of slow data reading caused by a large amount of data mixing. In addition to ensuring data security, the data tier of the smart research travel system stores the data in the cloud, and establishes the management mechanism of information sharing and exchange to facilitate the operation and processing of big data. This method enables accurate decision-making for the symbiotic unit, allowing the provision of highly accurate services for the students.

6.2. Platform Tier
The platform tier provides students with the operating environment and service data for the software application, and offers services by encapsulating the platform’s functionality and software. The service at the platform tier provides (1) a basic operating environment for the students’ software system; (2) system monitoring, operation management, and cache management functions; and (3) platform environment and operation management, which are more secure and practical than those in the traditional platform. At the same time, through the cloud platform, a standardized information interaction management mechanism was built and data security management was achieved. Based on the management model of data in the cloud, authority management on the data of each subsystem was performed.

6.3. Service Tier
Data addition, deletion, revision, checking, and other operations are mainly implemented through the service tier to call the data at the data tier, and the service tier is responsible for defining the business logic of the system. In the entire process, the service tier acts as middleware that connects the previous and the next tiers, and is mainly responsible for providing all the services to the students to ensure the stability of system operation. The service tier includes student mobile application services, research base mobile application services, student services, comprehensive scheduling of symbiotic units, research marketing, public services, and e-commerce. The service tier connects the subsystems through information sharing mode and presents them to the students through the student interface or application services. The service tier provides students with research evaluation, vertical search, topic referral, and resource sharing by establishing an effective mechanism for student management.

6.4. Application Tier
The application tier is mainly responsible for the system interface and interaction. The results of the students in the system data input and system execution are completed at this tier. This tier has a relatively clear interface, and is divided into two modules, namely, smart service and smart management, to provide a full range of business applications for students and research symbiotic units. The smart research services aim to provide research topic inquiries, research base inquiries, research content recommendations, research cloud station services, appointment interaction, and other services. The smart research management aims to provide research flow monitoring, symbiotic unit management platform, government research management, real-time resource scheduling, environmental monitoring management, research base office management, and other services for all research symbiotic units. Through the unified management provided by the service tier, the hierarchical management can be achieved to avoid disorganized platform services.

7. Conclusion
Smart research travel not only conforms to the current trend of development in the Internet Age but also effectively meets the research needs and behavior of students. As a new form of “Internet + research,” the smart research shows the inherent needs of the innovation and development of traditional research travel. As a new form of industry, smart research travel involves a wide range of fields, which not only necessitate the joint participation of government, tourism enterprises,
educational institutions, and other symbiotic units but also involves IoT and cloud computing, big data analysis, artificial intelligence, and other advanced technologies. Thus, the construction of the system framework for the development of smart research travel needs a lengthy and difficult adjustment and optimization process. Exploration based on practice is necessary to effectively promote the development of “Internet + research” so that smart research travel can become an important component of quality education in schools.

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