

Pain Points in Tourism and its 5G-based Intelligent Solution

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Abstract. Although the construction of smart tourism has aroused a boom, it is still in the early stage of development, and many traditional problems in the tourism industry have not been well solved, as well as some new problems have emerged. The development of 5G provides the basis to realize the ubiquitous high-speed interconnection between people and things as well as between machines and machines, which bring about the opportunities to solve these problems. This paper reviews the development of smart tourism, analyses the pain points existing in current systems. From the perspective of cybernetics, a 5G based intelligent tourism system providing intelligent service centered on "tourist experience" under the consideration of sustainable development of tourism industry is put forward.

1. Introduction

In recent years, 5G technology has developed rapidly and will be put into commercial application. 5G is not only a means of high-speed interconnected data transmission, but also a catalyst which will produce a chain reaction. Business and service models in 5G era will undergo tremendous changes. New applications and technologies will emerge suddenly and grow explosively. Before 5G, mobile communication network did not have enough bandwidth to support large-scale interconnection, large-scale and high-density deployment of sensors could not be achieved, the transmission of high-resolution images, videos and voice was difficult, the data sources that big data and cloud computing could collect and process were greatly limited, the ability of real-time transmission and processing was insufficient, and it was difficult to implement real-time control of intelligent devices. With the development of 5G, these problems will be solved or improved, people's lifestyle, social management mode and production and circulation mode may change qualitatively.

Tourism has the characteristics of comprehensiveness, linkage and openness, not only including sightseeing, food, housing, transportation, shopping and entertainment, but also closely related to industries such as manufacturing, agriculture, transportation, culture, etc. It can constantly absorb and contain elements of other industries, form interdependent relations and drive each other forward. Because Information and communication technology (ICT) has penetrated into all levels of life and production in modern society, the impact of the explosive growth of new technologies in 5G era can be more intensively reflected and directly felt by people in the tourism industry.

This paper aims at establishing a new intelligent tourism system to solve the pain points existing in the tourism industry. This paper firstly reviews the development of smart tourism, then analyses the pain points existing in the tourism industry. A new intelligent tourism system based on 5G is put forward, which is centred on "human experience" and under the consideration of ecological protection. At last some key technical problems to be solved in realizing the system are analysed.

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2. Development of Smart Tourism

IBM first launched the Smart Earth Business Plan in 2008. IBM believes that "smart city" in the 21st century can make full use of information technology and communication technology to sense, analyse and integrate the key information of the core system of urban operation, and make intelligent correspondence to various needs, including people's livelihood, environmental protection, public safety, urban services, business activities, so as to create a better life for mankind[1]. "Smart tourism" is developed on the basis of smart city[2].

The application of information technology in tourism research and practice in Europe and the United States has been carried out earlier than in China. They focus on the deep participation of tourists, the deep relationship between tourists and tourist destinations, and the role of tourism in the overall development of economy and society from the perspective of sustainable development[3]. Focusing on the application of smart phones in tourism, scholars have done a lot of research in three main fields[4]: The first was initiated within the research area of human-computer interaction and focuses largely on the design aspects of mobile tour guides[5, 6], mobile recommendation systems[7], navigation systems[8], location-based services[9], and theme park crowd management systems[10]. The second examines the adoption of mobile information services in travel[11]. The third seeks to describe the impact of mobile technology on the tourist experience[12].

On the Construction of Smart Tourism, as early as 2001, the European Union launched the project of "Creating User-friendly Personalized Mobile Tourism Services"[13]. Under the "Smart Country 2015" development strategy launched in 2006, Singapore has implemented the "Smart Tourism Plan"[14]. Seoul, Korea, has developed the "I Tour Seoul" Palm Mobile Tourism Information Service Platform. In June 2012, Brussels, Belgium, launched a smartphone-based "Identify the City" project, which uses short-range wireless communication chips to make digital signs throughout Brussels streets and alleys. In 2009, British and German companies cooperated to develop an intelligent tour guide software, which is based on Augmented Reality technology. The software allows tourists to experience the forgotten historical time through sound, light and image. In addition, it can provide interactive route planning tools and tailor-made travel plans exclusively for tourists.

Smart tourism is regarded as one of the core strategies of tourism development in China. In May 2011, the National Intelligent Tourism Service Center officially settled in Zhenjiang and began to promote the construction of Smart Tourism projects. The State Tourism Administration has announced two batches of 33 pilot cities for smart tourism. The era of comprehensive smart tourism is coming.

"A Mobile Tour to Yunnan" is a representative smart tourism project. Based on Internet of Things, Cloud Computing, Big Data, Artificial Intelligence, Face Recognition, Small Procedures, Tencent Cloud, Wechat Payment and other core technologies, APP provide tourists with the whole process services before, during and after the tour. Tourists can use APP to book tickets and hotels, understand destination information, view scenic spots, and plan tour routes.

Since February 2015, Hangzhou has launch the construction of a tourism big data center. In the early days of the Golden Week of National Day 2018, Hangzhou monitored the flow of 12 popular scenic spots, which were more concentrated by tourists. Through the release of App and Wechat Public Number in Hangzhou, tourists could inquire the flow information and historical data of key areas in real time and make a reasonable play route[15].

Guilin launched the "One Key Tour to Guilin" project. The "i Tour Guilin" Smart Tourism Service Platform, developed in cooperation with Tencent, takes public numbers and small programs as carriers. Tourists can purchase tickets online, brush their faces and sweep code into the park, check in hotels intelligently, order meals by themselves, book parking spaces online, pay parking fees, and connect cars, find toilets, check weather and other functions

through a mobile phone. The tourism supervision platform realizes the government's all-weather, all-round and whole-process supervision of the tourism market.

Recently, the concept of "Smart Tourism 2.0" or "Smart Scenic Area 2.0" has also appeared in the tourism market. For example, the core of "One Map Touring Wuzhen" launched by Gaode Map is to pay more attention to tourists' overall tourism experience, expand the service radius from the scenic area to the scenic area + outside the scenic area, let the "travel" and "tourism" organically combine, break through the simple "tour" in the depth of service, cover the tourists' eating, living, traveling, Entertainment and shopping, and meet the tourists' full cycle and all-round demand. This kind of product has abundant functions, but its essence and main connotation are not different from the above-mentioned smart tourism projects.

3. Pain Points Analysis

After initially experiencing the new service of smart tourism, tourists are eager for the emergence of tourism services that run through the whole life cycle of tourism, that is, the stage of making travel plans, the stage of implementing travel and the stage after the end of travel, with more transparent information, more reasonable price, more intimate service, more complete content and more convenient use. Although the construction of smart tourism in China has aroused a boom, it is still in the early stage of development, many traditional problems in the tourism industry have not been well solved, and some new problems have emerged. At present, the main pain points in the tourism industry are as follows:

3.1. Travel planning

Accessing information through PC client or mobile app of Smart Tourism platform, making travel plans by oneself is faced with incomplete and incoherent information, which requires a lot of time and mental labour. Although the data provided by various information platforms have reached unprecedented richness and detail, these information are often one-sided, scattered and single-dimensional, such as advertising, evaluation and strategy of other tourists and quotations provided by OTA, etc., but it is difficult for tourists to distinguish the accuracy of these information, they often find that the actual situation does not correspond to the prior information when they arrive. Because they are not familiar with tourist destinations and do not have the ability to process and analyse data, it is difficult for tourists to organize relevant information in an orderly manner and to make accurate judgments according to the inherent logical relationship. Due to the lack of professional knowledge, it is difficult for tourists to make a reasonable route planning based on this information, which includes all the elements of "eating, living, traveling, shopping and entertainment" as professional as the mature routes of travel agencies.

3.2. Travel implementation

Although tourists can get a lot of information through mobile phones and the Internet, they can also complain through App or public numbers provided by Smart Tourism platforms, but it is still difficult for tourists to avoid falling into various traps, such as unprofessional explanation, disguised shopping, insufficient travel time, unsatisfactory food and shelter, secondary consumption and so on.

In the implementation of self-service tourism, tourists need more services provided by smart tourism, but they also face more problems. For example, although a detailed plan has been made, it is only after arriving at the scenic spot that one knows that the scenic spot is not open or full, misestimates of the distance between the accommodation or catering place and the scenic spot lead to the lack of connection of travel time, and has to miss some planned scenic spots, upset the plan due to delays or traffic disruptions caused by weather or natural disasters, mobile navigation software only considers road conditions and does not consider tourism elements, resulting in poor travel experience, hard to understand scenic spots with rich cultural connotations and appreciate their wonderful points, and so on.

3.3. After the trip

Many people maintain and enhance their sense of experience by summarizing travel experience, collating travel materials and writing travel notes. But in reality, facing a large number of paper media materials, photos and videos on G, it is difficult to arrange them in time, and it is even more difficult to reconstruct their mental journey according to their relationship in time, space and logic. As time goes by, all kinds of touches and feelings in traveling gradually weaken, and even memories are slowly disappearing after a period of time.

3.4. Integrity crisis

Honesty and credit is a chronic disease in the tourism industry for a long time. It is also the root of many superficial phenomena that lead to the deterioration of tourism experience. The problem of dishonesty is bi-directional. On the one hand, there are some problems in the operation of travel-related enterprises, such as non-fulfilment of promises, poor service quality, price fraud and so on. On the other hand, tourists also have dishonest behaviours such as non-compliance with contracts, disobedience to order, and exploiting loopholes to get small profits. Many intelligent tourism projects provide convenient means of complaints and rights protection, which is conducive to curbing dishonesty, but it is still difficult to solve the problem fundamentally without establishing a complete mechanism. On the other hand, smart tourism service based on cloud computing and big data not only facilitates tourists, but also brings new problems of privacy violation and abuse of big data. The emergence of new problems such as "killing ripeness" of big data has caused the credit crisis of network platform services and hindered the further development of smart tourism.

3.5. Tourism Safety and Environmental Crisis

With the rapid development of tourism, tourism safety and environmental crisis are becoming increasingly prominent. The large tourist population and relatively concentrated travel time are one of the characteristics of Chinese tourism. In a relatively short period of time, the influx of large numbers of people has brought tremendous security pressure to scenic spots. Especially, many areas with abundant tourism resources are located in remote areas, complicated geographical and climatic environment, relatively backward economy, as well as imperfect transportation and safety facilities. They are not only prone to tourism safety accidents, but also difficult to deal with and rescue accidents. On the other hand, the large number of tourists and development of tourism projects also has a tremendous impact on the environment, including not only the natural ecological environment, but also the human ecological environment. Unorderly development and uncontrolled tourist flow will not only destroy the natural environment, but also have a negative impact on monuments, cultural relics and the lives of local residents. Improving the level of tourism management, that is, to promote economic development, and to ensure tourism safety and environmental protection, is an urgent problem to be solved in the development of tourism.

4. Intelligent Tourism Solutions Based on 5G

Intelligent tourism is a complex service, management and marketing system established by integrating the latest information technology to meet the individual needs of tourists and improve their sense of self-experience. Its essence is "people-oriented", comprehensive use of a variety of information technology to provide tourists with a better tourism experience. The tourist experience is generally understood as an integration of activities, interpretations, and sensations within space and time[16]. The concept encompass both the consumption of displayed objects and the subjective interpretation of meanings and motivations of the tourist [17]. It is argued that the general functions of ICT tools play important and differing roles in shaping the tourist experience within all three stages of a trip (see Figure 1)[18]. In particular, the smartphone enables interactions between the tourist and both the physical and virtual world

regardless of location. The adoption and use of mobile technologies are the potential catalyst for a new generation of modern tourists—the so-called “creative tourist class”[19]

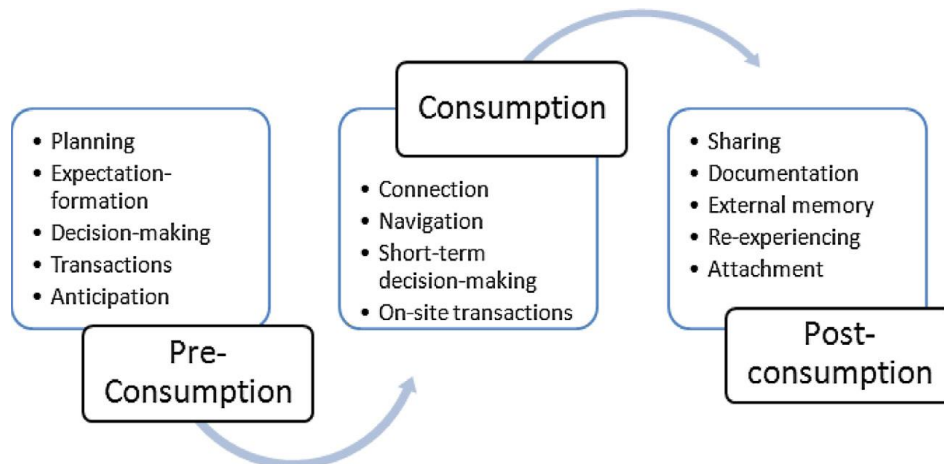


Figure 1. Three stages of tourist experience and the transformation by ICT
(adapted from Gretzel et al. [18])

From this point of view, to solve the existing pain points, it is not enough to provide information services alone. Smart tourism system also needs to have the ability of coordination and control, so that the tourism ecosphere composed of tourists, government, enterprises and the environment can be balanced dynamically.

4.1. Deficiency in ability of current smart tourism system

At present, most of smart tourism systems are constructed on the basis of cloud computing, Internet of Things, mobile terminal communication, artificial intelligence[3] and big data[20]. Supported by the powerful data storage and processing capabilities of cloud platform, and with the help of the 4G network dominated by LTE, tourists can obtain tourism information through various media and enjoy extensive tourism information service, which is one of the core connotations of the concept of smart tourism[3].

However, due to the limitation of connection density and bandwidth, the 4G network is not enough to support a large number of sensors and Internet of Things devices, and the breadth, depth, accuracy and real-time of situation awareness are insufficient. The real-time transmission capability of high resolution images and videos is unsatisfactory. VR equipment is inseparable from wired transmission, so that its application is greatly limited. In areas where crowds are particularly concentrated, it is even difficult for tourists to connect to mobile communication networks or to receive data. This leads to the poor completeness, accuracy and real-time ability of information obtained by tourists from the smart tourism system. Tourists still need to spend a lot of physical and mental energy in activities unrelated to tourism experience. As a result, tourists often feel more tired than enjoyable, contrary to the original intention of leisure and relaxation. In addition, due to the lack of ability in situational awareness, the crowd behaviour of tourists shows great blindness and randomness, and often results in high concentration of tourists in some regions, with poor touring experience, high security risk, causing irreversible damage to the environment because of exceeding the carrying capacity.

4.2. Intelligent Tourism System Based on 5G

From the perspective of cybernetics, this ecosphere can be regarded as a complex large-scale system consisting of the above four control objects. In order to achieve an ideal stable state of the system, we need not only a sensor providing information, but also a controller and

an actuator. In this sense, this paper tends to use "Intelligent" rather than "Smart" to express the concept of new system.

The Intelligent tourism system is composed of data center, cloud service platform, large amount of sensors and intelligent devices. The system uses a large number of sensors to collect data, and uses data center to store, process and analyse data. It provides services, outputs information and controls intelligent devices through cloud service platform. The intelligent devices execute instructions and provide services for users. Among them, the data center and cloud service platform are roughly equivalent to the controller, the intelligent device is equivalent to the actuator, and the sensors and the interconnected network constitute the feedback channel of the of the control system. The structure of the intelligent tourism system and the interaction among the four main bodies of the tourism ecosphere are shown in Figure 2.

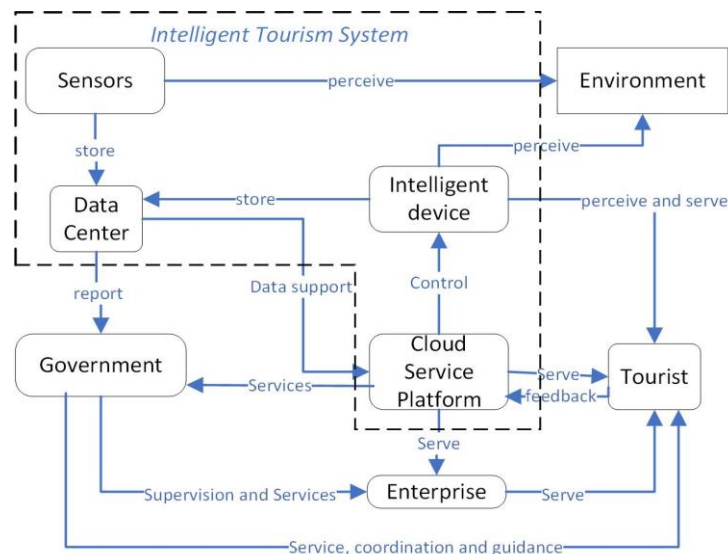


Figure 2. Intelligent Tourism System and the interaction among the bodies of tourism ecosphere

Sensors in the system include mobile phones, the Internet, satellites, cameras, wireless sensor networks and sensors on various Internet of Things devices and intelligent devices. The mobile phone is one of the most important sensors. The identity, whereabouts, visited webpages, published comments, videos and photos of tourists are important data sources. In addition, billions of Internet of Things devices and ubiquitous sensors will provide deep-seated and omni-directional perceptual data for intelligent tourism.

Intelligent devices include cloud robots, unmanned vehicles, VR/AR/MR devices, wearable devices, Internet of Things devices, etc. On the one hand, intelligent devices directly provide services to tourists, such as guidance, consultation, positioning, identity authentication, distribution, commuting, alert, rescue, commentate, game & entertainment, VR experience, etc. On the other hand, they use their own sensors to monitor tourists and the environment, collecting data and sending them to the data center.

Data centers use big data technology to discover hidden rules from a large amount of data collected by sensors and predict future trends, such as tourists' preferences, the distribution of tourists crowd, the interaction between tourists and the environment, and network public opinion etc.

With the support of data center, cloud service platform provides various services for tourists, enterprises and governments in the form of cloud service. These services can be customized according to demand, including statistical analysis of tourism market, monitoring of

tourism public opinion, environmental monitoring, safety monitoring, monitoring of tourists crowd, issuing information, navigation and guide services, shopping guide services, feedback complaints and suggestions, intelligent devices control, VR/AR/MR services, tourist source analysis, precision marketing, etc.

In tourism ecosystem, the intelligent tourism system has established multiple loops among the main bodies. The most important are enterprise-intelligent tourism system-tourists loop, government-intelligent tourism system-tourists loop and government-intelligent tourism system-enterprises loop.

In enterprise-intelligent tourism system-tourists loop, enterprises obtain precise marketing, customer source analysis, tourist analysis and other services from cloud service platform. The characteristics, feelings and preferences of tourists are feedbacked to enterprises, which helps put forward new products, improve their service quality. Enterprises can also make full use of new technologies such as robots, unmanned vehicles, the Internet of Things and VR/AR/MR to design new tourism products and service modes at a low cost, so as to attract more tourists, reducing operating cost and obtain better economic benefits.

In government-intelligent tourism system-tourists loop, the cloud service platform provides the government with information on the distribution of tourists, complaints and suggestions, public opinion situation and environmental conditions in the form of cloud service. The government can also obtain the statistical analysis report of the tourism market from the data center and synthesize all kinds of information for decision-making as well as take administrative measures, that is, to coordinate and guide tourists in various ways, so as to achieve the global optimization of tourists distribution and protect the environment, ensures good experience and the safety of tourists.

In government-intelligent tourism system-enterprises loop, the government obtains feedback from tourists and the market through the cloud service platform and supervises the enterprises to ensure the integrity of the enterprises. At the same time, the government can formulate policies to create a good market environment and provide conditions for the growth of enterprises so as to achieve sustainable development.

The realization of such a system depends on the advanced performance of 5G. 5G is not only a way of data transmission, but also an important technical pillar for new applications such as automatic driving, AR, VR, cloud robots and so on. It is the catalyst for the formation of a new system of intelligent tourism. 5G can provide up to 10 Gbps data rate, 10 to 100 times faster than LTE and Advanced LTE network, and can provide transmission delay as low as 1 millisecond. High transmission rate is helpful to improve the access ability of massive data. 5G can provide 100 times the number of 4G device connections in each unit area, 99.999% availability, 100% coverage and 90% network energy savings[21], so as to support a large number of Internet of Things devices and sensors. By providing end-to-end network slicing capabilities, flexibly and dynamically allocating and releasing the required network resources for different needs in the whole network, and flexibly responding to different application scenarios, including mobile broadband (eMBB), large-scale Internet of Things (mMTC) and low-latency, high-reliability Internet of Things (uRLLC), which require different bandwidth and delay. As shown in Figure 3, 5G implements data transmission, information distribution and instruction delivery in different application scenarios between cloud data center, cloud service platform, tourists and environment. mobile phones, wearable devices, VR devices and environmental sensors, various kinds of interconnected devices, as well as vehicles and robots.

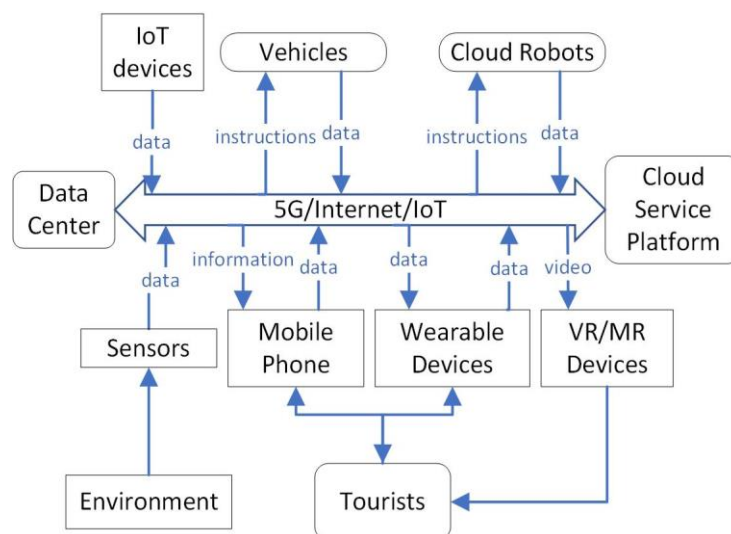


Figure 3. Information and data flow of intelligent tourism system

5. Conclusion

In 5G-based intelligent tourism system, intelligent machines will further replace human work. The system will not only provide information services for tourists, but also help people to organize, analyse and make decisions on the information they get. It will replace people to complete sales, tour guides, transportation, management and security, and provide new tourism projects for tourists through virtual reality (VR)/mixed reality (MR). These new functions will further reduce the mental, physical and economic burden of tourists, so that tourists can enjoy tourism more fully and have a more perfect tourism experience. In the future, the core connotation of Intelligent Tourism includes not only information service, but also entity and all-round intelligent service, which further reduces the negative factors in tourism experience and more accurately meets the personalized physical and mental needs of tourists. In this process, a large number of new applications will continue to emerge, bringing a lot of opportunities, but at the same time, it also poses more challenges to the research of technology, such as big data processing, artificial intelligence, unmanned driving, block chain-based security and trust mechanism, VR/AR/MR technology and intelligence equipment, there are still a lot of technical problems to be solved and broken through.

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