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Research Article

Integrated Architecture Model of Tourism Information Service in Smart Scenic Spots Based on Hybrid Cloud

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Tourism industry can promote the prosperity of the local economy. In addition, the booming tourism business in recent years has also led to the development of related industries and services. According to high-tech technologies such as cloud computing, hybrid cloud, and panoramic image, we will plan to design a comprehensive and integrated architecture model of scenic spots that integrates all tourism information and various services, strive to create smart scenic spots, bring the best play experience to tourists, and strive to attract more attention and attention. The results show that (1) the overall average satisfactory approval of UI test is as high as 93%, which can meet the requirements. (2) After the improved panoramic image mosaic method, the correct rate is as high as 93.90%, the effect is 4.90% better than that before the improvement, and the algorithm is more efficient. (3) The scenic spot configuration management effect is excellent, and various situations in the scenic spot are effectively monitored. (4) The average response time per request of the original system is about 161 ms. Compared with the original system, the response time of the new system is reduced by about 57%, and the access success rate is 100%. The system in the experiment runs well and satisfies the integration of tourism information resources and services in scenic spots.

1. Introduction

The world is in dynamic development and change, and life is full of high-tech products and services. Visiting scenic spots has become increasingly popular as the main way for people to relax after being baptized by work and study. The full number of tourists at home and abroad makes the service of scenic spots, which is already insufficient in manpower and material resources, worse, and the related equipment of many scenic spots is old and backward, which simply cannot meet the demand. To solve the problem, we should start from the implementation, not simply change the existing tourism information service system, but turn it into a whole, and integrate good services into an integrated architecture model to "send" tourists, no matter who can enjoy high-quality services. Literature [1] distinguishes between reasonable attention and overreaction areas and determines the whole space of cloud computing security problems. Literature [2] uses CloudSim simulation toolkit to evaluate the modeling, simulation, and resource allocation algorithms of the cloud computing environment. Literature [3] solves the problem of authorization data derivation and repeatedly checks security authorization in hybrid cloud architecture. Literature [4] exerts the potential of a hybrid cloud platform and provides fault awareness resources. Literature [5] identifies the severe challenges faced by customer organizations in hybrid cloud computing through the exploration of system literature. Literature [6] considers that there are multiple cloud service providers to collaboratively store and maintain customer data and involves building a collaborative integrity verification mechanism in a hybrid cloud. Literature [7] uses MapReduce computing framework in a hybrid cloud environment and proposes OTA strategy to significantly improve the effectiveness of speculative execution. Literature [8] discusses and summarizes the development status of smart scenic spots in

China and points out the problems and develops countermeasures. Literature [9] discusses the integration of digital measurable images and electronic maps and constructs a visual data platform for observing scenic spots and a real 3D visual management mode. In reference [10], the method of three-dimensional measurement and reconstruction of panoramic three-dimensional perception is used by using the optical characteristics of quadric hyperboloid mirror. Reference [11] proposes a multi-functional fusion VR panoramic image shadow elimination algorithm, which uses HSV color features and LBP/LSFP texture functions to obtain image detection results. Literature [12] considers 360 degree panoramic images in the graphic design of virtual museums and solves graphic design problems. Literature [13] upgrades the information service system of the bus terminal, integrates the information of various modes of transportation and realizes the information sharing model. Literature [14] provides spatial analysis image analysis of wilderness livestock grazing and forest service management space. Literature [15] designed and implemented automatic and one-stop application service for graphic and text data display and provided the framework of a one-stop application service system for seismic network. In the literature mentioned in the introduction, the existing work is explained. Different studies focus on the optimization and allocation of tourism resources, and without considering the shortcomings of different methods, there are problems of efficiency. This paper puts forward a comprehensive research scheme of multiple strategies, which makes use of the advantages of different stages and algorithms to correctly configure them and to realize the overall goal optimization. The key problem of this paper is how to realize the integrated application of various optimization methods to achieve the overall optimization of the whole system.

2. Theoretical Basis

2.1. Cloud Computing. Cloud computing [16] supports massive distributed computing and stores data [17] on the cloud. It reduces the rigid requirements for equipment and software, improves the utilization rate of resources, and can better adapt to various scenarios. In addition, the use of cloud computing costs less capital, which is one of the main reasons why cloud computing is popular. As a mature and widely used emerging information technology in recent years, cloud computing has emerged in related fields of all walks of life and has become the technical support and theoretical basis of various projects (such as system services). It is deeply loved by technicians with various advantages and is a well-deserved "darling." Figures 1 and 2 show the paradigm [18] and basic characteristic diagram [19] of cloud computing:

2.2. Hybrid Cloud. Because of its characteristics and various needs of various industries, cloud computing has derived many technologies related to cloud computing over time, such as edge computing, computer network cloud computing, and hybrid cloud. This paper chooses hybrid cloud [20] technology for architecture pattern design. Cloud computing can be roughly divided into public cloud [21] and private cloud [22]. Hybrid cloud is IT architecture in between. The cloud computing development process of hybrid cloud is shown in Figure 3:

Hybrid cloud is based on Internet architecture and is divided into four layers: application layer, capability layer, adaptation layer, and physical layer. The specific architecture design is shown in Figure 4:

In the architecture design in Figure 4, a hierarchical structure pattern is adopted. The purpose of stratification is to realize the application of different layers and subdivide complex problems into different problems to solve, which is easy to realize the integration of tourism information proposed in this paper. In this paper, the collection layer of user information is processed to ensure the security of user information and achieve specific operational results.

2.3. Panoramic Image. In this study, we use 360-degree panoramic images to describe and restore the famous scenic spots in the scenic spot, so that tourists can feel the charm of the scenic spot on the Internet and tourists can deeply understand the situation of the scenic spot and increase the publicity of the scenic spot. The 360-degree panoramic image [23] can give people a pseudo-3D [24] visual effect. It has the function of switching between day and night scenes at the same time.

2.3.1. Cube Panorama [25]

(1) Plane projection

$$\begin{cases} e = a - y, \\ c = \sqrt{r^2 + e^2}, \\ \psi = \dfrac{\pi}{2} - a\tan\dfrac{e}{r}. \end{cases} \tag{1}$$

(2) Front plane projection

$$\begin{cases} e = a - y, \\ c = \sqrt{r^2 + e^2}, \\ \psi = a\tan\dfrac{e}{r}, \\ \theta = \dfrac{\pi}{2} - a\ \tan\dfrac{a - x}{c}. \end{cases} \tag{2}$$

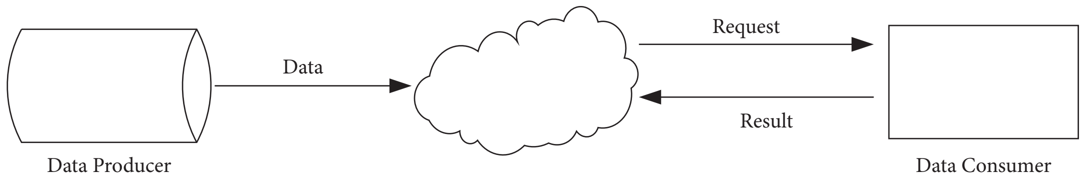

Figure 1: Cloud computing paradigm.

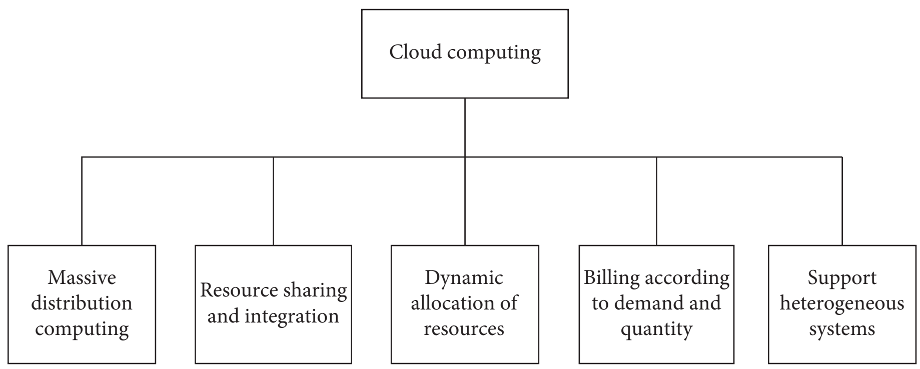

Figure 2: Basic characteristics of cloud computing.

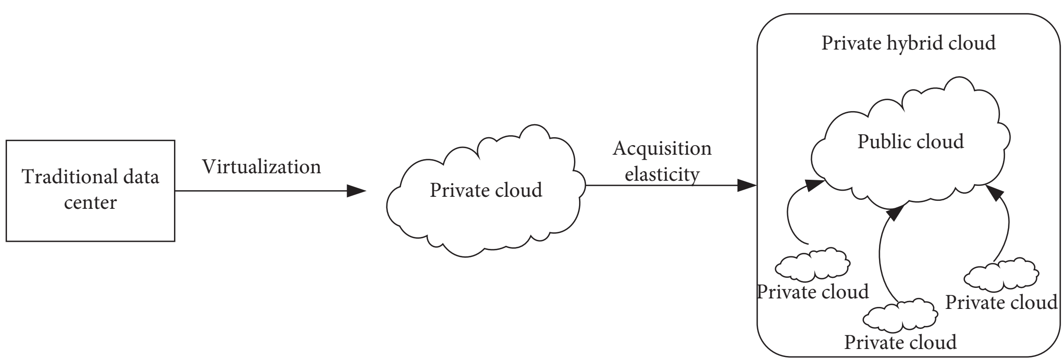

Figure 3: Hybrid cloud development process.

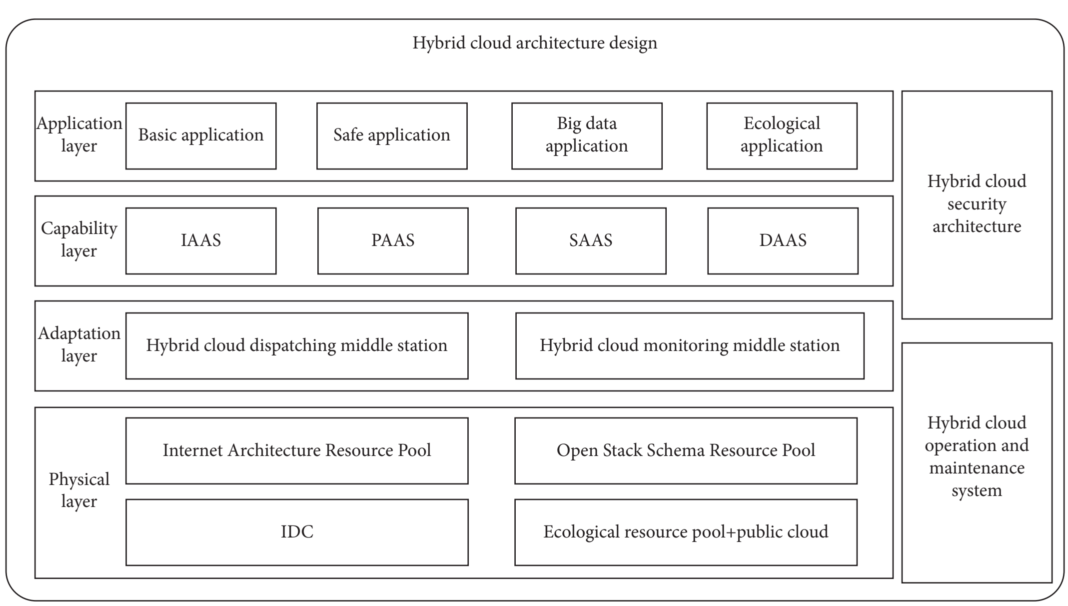

Figure 4: Architecture design.

(3) Rear plane projection

$$\begin{cases} e = a - y, \\ c = \sqrt{r^2 + e^2}, \\ \psi = \dfrac{\pi}{2} - a \tan \dfrac{e}{r}, \\ \psi = \psi + \pi, \\ \theta = \dfrac{\pi}{2} - a \tan \dfrac{a - x}{c}. \end{cases} \quad (3)$$

(4) Left plane projection

$$\begin{cases} e = a - y, \\ c = \sqrt{r^2 + e^2}, \\ \psi = \dfrac{\pi}{2} - a \tan \dfrac{e}{r}, \\ \psi = \psi + \dfrac{3\pi}{2}. \end{cases} \quad (4)$$

(5) Upper top projection

(x, y) in the first quadrant:

$$\theta = \frac{3\pi}{2} + a \tan \frac{y - a}{x - a}. \quad (5)$$

(x, y) in the second quadrant:

$$\theta = a \tan \frac{a - x}{y - a}. \quad (6)$$

(x, y) in the third quadrant:

$$\theta = \frac{\pi}{2} + a \tan \frac{a - y}{a - x}. \quad (7)$$

(x, y) in the fourth quadrant:

$$\theta = \pi + a \tan \frac{x - a}{a - y}. \quad (8)$$

Fixed formula:

$$\psi = a \tan \left(\frac{\sqrt{(x - a)^2 + (y - a)^2}}{a} \right). \quad (9)$$

(6) Lower bottom projection

(x, y) in the first quadrant:

$$\theta = \frac{\pi}{w} + a \tan \frac{x - a}{y - a}. \quad (10)$$

(x, y) in the second quadrant:

$$\theta = \pi + a \tan \frac{a - x}{y - a}. \quad (11)$$

(x, y) in the third quadrant:

$$\theta = \frac{3}{2}\pi + a \tan \frac{a - y}{a - x}. \quad (12)$$

(x, y) in the fourth quadrant:

$$\theta = a \tan \frac{x - a}{a - y}. \quad (13)$$

Fixed formula:

$$\psi = a \tan \left(\frac{\sqrt{(x - a)^2 + (y - a)^2}}{a} \right). \quad (14)$$

2.3.2. Sift Algorithm. Scale space definition of 2D image:

$$L(x, y, \sigma) = G(x, y, \sigma) * I(x, y). \quad (15)$$

Definition of two-dimensional Gaussian function:

$$G(x_i, y_i, \sigma) = \frac{1}{2\pi\sigma^2} \exp\left(\frac{(x - x_i)^2 + (y - y_i)^2}{2\sigma^2} \right). \quad (16)$$

LoG scale space:

$$L(x, y, \sigma) = \nabla^2 G(x, y, \sigma) * I(x, y). \quad (17)$$

Normal distribution in N-dimensional space:

$$G(r) = \frac{1}{\sqrt{(2\pi\sigma^2)}^N} e^{-r^2/2\sigma^2}. \quad (18)$$

Gaussian value calculation:

$$G(x, y) = \frac{1}{2\pi\sigma^2} e^{-(x - m/2)^2 + (y - n/2)^2 / 2\sigma^2}. \quad (19)$$

Gaussian difference space:

$$\begin{aligned} D(x, y, \sigma) &= [G(x, y, k\sigma) - G(x, y, \sigma)] * I(x, y) \\ &= L(x, y, k\sigma) - L(x, y, \sigma), \end{aligned} \quad (20)$$

where * denotes convolution operation and (X, Y) represents pixel position information. $L(x, y, \sigma)$ is defined as the convolution operation between the original image $I(x, y)$ and a two-dimensional Gaussian function $G(x, y, \sigma)$ with variable scale.

2.3.3. FAST Algorithm. The relevant formulas for extracting feature points are as follows:

$$N = \sum_{x \in circle(p)} C_i, C_i = \begin{cases} 1 \left| I_i - I_p \right| > t, \\ 0 \left| I_i - I_p \right| < t. \end{cases} \quad (21)$$

2.3.4. Self-Correction of Brightness Differences. Because of some complex factors, the original images we collected are easily interfered with light, angle, position, and other factors, resulting in different degrees of image brightness difference, so we should focus on adjusting and processing the brightness of these images in advance. The relevant formula is as follows:

$$\overline{I} = \frac{\overline{I}_1 + \overline{I}_2}{2},$$
$$\begin{cases} \overset{*}{I}_1 = I_1 - (\overline{I}_1 - \overline{I}), \\ \overset{*}{I}_2 = I_2 - (\overline{I}_2 - \overline{I}). \end{cases} \tag{22}$$

2.3.5. Image Fusion. Image fusion solves obvious gaps.

$$f_w(x, y) = \begin{cases} f_{11}(x, y)(x, y) \in f_{11}, \\ d \times f_{11}(x, y) + (1 - d) \times f_{22}(x, y)(x, y) \in (f_1 \cap f_2), \\ f_{22}(x, y)(x, y) \in f_{22}. \end{cases} \tag{23}$$

2.4. Dijkstra Algorithm. Tourist scenic spots have complex routes and criss-crossing roads, so the Dijkstra algorithm can be used to solve the shortest path problem in order to plan the optimal path. The relevant formulas are as follows:

$$Z = \sum_i \sum_j w_{ij} x_{ij},$$
$$Z = \sum_i \sum_j \left(w1_{ij} \times y_1 + w2_{ij} \times y_2 + w3_{ij} \times y_3 + \cdots\cdots + wn_{ij} \times y_n \right) x_{ij}. \tag{24}$$

Aiming at the optimization problem under different paths, the shortest distance under different paths is taken for summation.

2.5. Collaborative Filtering Recommendation. Collaborative filtering recommendation is used to calculate the similarity of user preferences.

$$W_{ab} = \frac{\left| U_{(a)}{}^{I} U_{(b)} \right|}{\left| U_{(a)}{}^{U} U_{(b)} \right|},$$
$$P_{(a,m)} = \sum_{v \in S(a,K) \mathrm{IN}(m)} w_{av} r_{vm}. \tag{25}$$

3. Requirements and Analysis of Architecture Patterns

Before the formal construction simulation, we should analyze the real needs of this architecture model from all aspects and angles, what functions scenic spot managers and tourists need and what problems exist in the existing scenic spot information services to be solved. These are the issues that need to be discussed emphatically in this part.

3.1. Analysis of the Present Situation of Tourism Information Service Platform. The platform functions of each APP and website are different, which makes it difficult for tourists to experience comprehensive tourism information services. In most cases, tourists must download the corresponding client or website to register in order to obtain information, which causes inconvenience and trouble to some groups (especially the elderly). Popular travel platforms are shown in Table 1.

From the table, we can find that the functions of some platforms overlap, and each platform has a focus direction, while the other functions are imperfect and missing. These platforms have no complete functions. If tourists want to experience complete tourism services, they must download or log in to multiple platforms, which is very inconvenient.

3.2. Integrated Architecture Design of Information Services

3.2.1. Hybrid Cloud Deployment Strategy. Figure 5 shows the flow chart of hybrid cloud:

3.2.2. Overall Architecture Design. The platform architecture usually adopts the B/S architecture mode. The function is relatively simple, and the sharing ability is relatively weak, as shown in Figure 6.

The improved hybrid cloud architecture is shown in Figure 7:

The hierarchical structure proposed in Figure 6 handles different information and communicates between different layers. In the framework shown in Figure 7, some layers of modules are integrated to improve the ability of modules to process information. The purpose of this realization is to improve the efficiency of information processing and achieve the best efficiency with the least cost.

3.3. Design Objectives and Feasibility. The design goal of this paper is to create a smart scenic spot suitable for the modern construction process, match people's modern life, and update and iterate the related systems of tourism information service. We should use hybrid cloud and other network information technologies to carry out comprehensive IoT work so that tourists can enjoy intelligent services and design and customize excellent travel experiences according to tourists' needs and hobbies.

3.3.1. Economic Feasibility. Tourism is developing well, with great passenger flow and increasing demand. Because of the single function and backward construction of the original information service system, a lot of manpower and material resources are wasted. The time cost and economic cost increase, and the system maintenance is difficult. In the early stage of the construction of the new information service system, there will be more capital investment in infrastructure equipment, platform architecture construction, operation and management costs, maintenance costs, etc., but it can fully meet the increasing demand of tourists and will not cause other losses. Profits can also offset capital consumption in the early stage. This study is economically feasible.

Table 1: Analysis of the current situation of tourism platforms.

Category	Function	Platform name
Raiders	Introduction of scenic spots, routes, shopping, air tickets, and leisure projects	Miaotu, Bread-Free Travel, Cicada Tour Raiders
Traffic category	Air tickets, tickets, train tickets, car rental, and other modes of transportation booking	Ctrip, 12306
Tickets	All kinds of tickets and package reservations for scenic spots	Flying pig, where to go, the same journey
Accommodation category	Hotel reservation and other services	Airbnb, Huazhu, Yilong
Tourism products	Shopping in shopping malls, specialty gifts, package services from travel agencies	Tuniu, Mother Donkey
Travels	Publish travel records, photos, strategies, and other recording tools	Bread is free to travel, on the road, to arrive
Tool class	Translation, bookkeeping, weather inquiry, exchange rate conversion, map navigation, and other practical functions	Gaode map, Baidu map, ink weather, Youdao translation

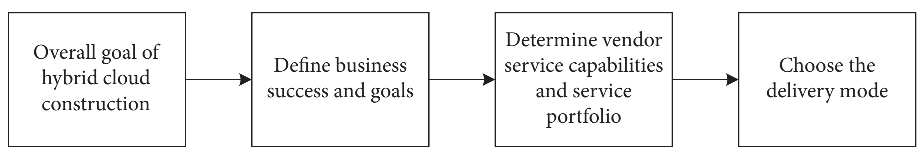

Figure 5: Deployment policy flow chart.

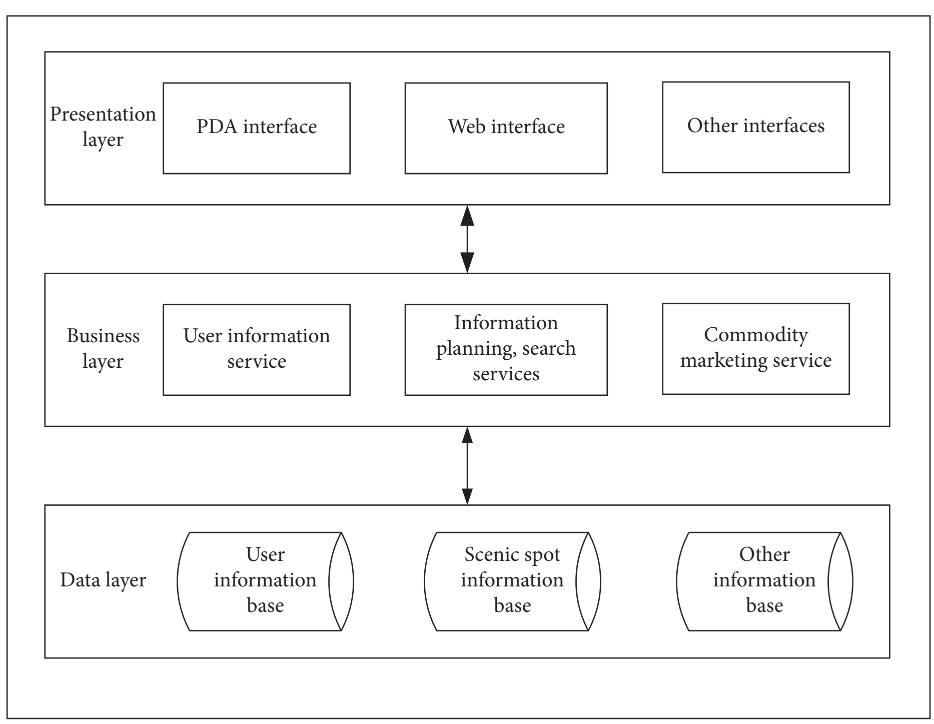

Figure 6: Old platform architecture.

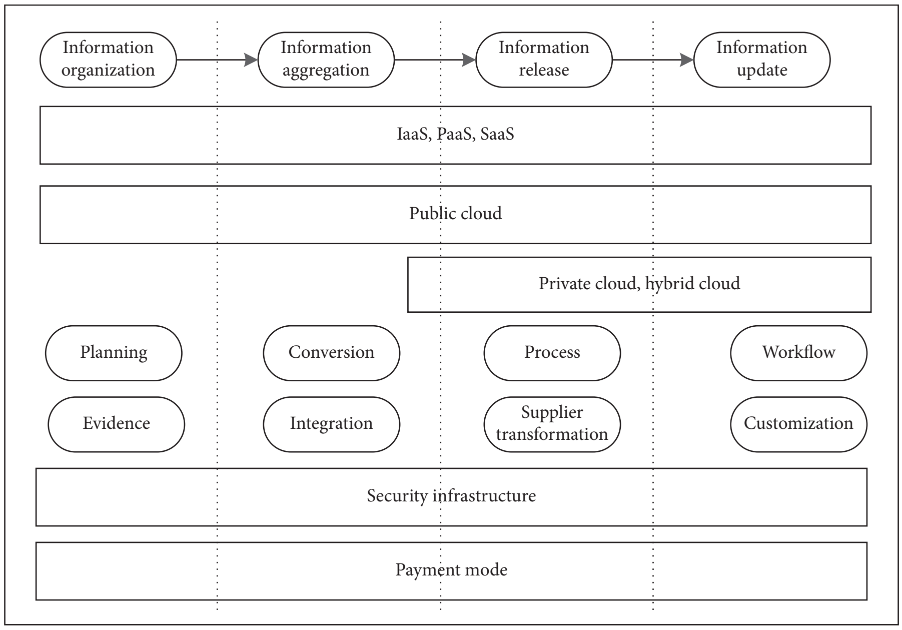

Figure 7: Hybrid cloud platform architecture.

3.3.2. Technical Feasibility. Internet technology is changing with the international trend and is very mature. This study is technically feasible and reliable.

3.3.3. Feasibility of Social Environment. Daily exhaustion of work and study life constantly torments people, so it is very important to relax. Traveling makes people get out of the narrow space. More and more abundant material life provides opportunities for the development of tourism, and the popularity of terminal products such as electronic equipment makes online access to comprehensive information services a common service mode.

3.4. Functional Overall Requirements Analysis

3.4.1. Scenic Area Management Module. Scenic area managers need to fully control the scenic area, so they need a management module for daily command and dispatch. The management module architecture of the scenic spot is shown in Figure 8.

3.4.2. Visitor Service Module. Tourist service module is the core focus of architecture pattern design. The service module studied in this paper is relatively perfect compared with other platforms, as shown in Figure 9.

4. Simulation and Testing of Architecture Patterns

Considering the financial problems, time cost, and other factors, we choose to make a simple test version of the architecture model and carry out a relatively primary simulation and testing of the system. More detailed contents need to be improved and optimized after being put into use.

4.1. Development Platform and Environment. The scenic spot management module mainly takes C language as the development environment, and MYSQL manages the database. The main platform of the tourist service module is based on WeChat, WeChat official account, and WeChat applet and developed in C language.

4.1.1. Development Environment. In this paper, the integrated architecture model is developed under the operating system environment of Windows 10, using the C programming language. The development platform is Visual Studio 2018, the processor is AMD Athlon (tm) II P360 Dual-Core Processor 2.30 GHz, the running memory is 8G, and the simulation platform is MATLAB. WeChat development tool is used for front-end design.

4.1.2. Development Framework. Using Open Layers, WebSocket client technology, and using MVC pattern for software design.

4.1.3. WeChat Platform. Everyone's mobile phone is equipped with WeChat, which integrates chat, payment, information, and life. WeChat supports multiple programming languages. Therefore, it is very convenient and efficient to choose this platform to realize functions, which effectively solves the trouble that other platforms have to download multiple apps to have multiple services and reduces the burden on tourists. In addition, visitors only need to bind WeChat to record all information and ensure the security of their own information.

4.2. System Interface. Designers should understand users' expectations and behavior characteristics when using the system, analyze people's comfort zone when using it, and

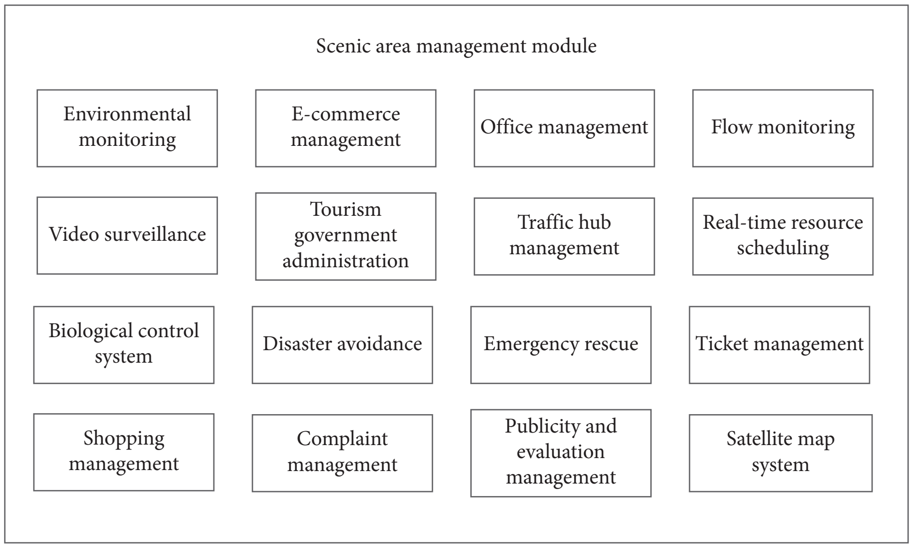

Figure 8: Functions of the scenic spot management module.

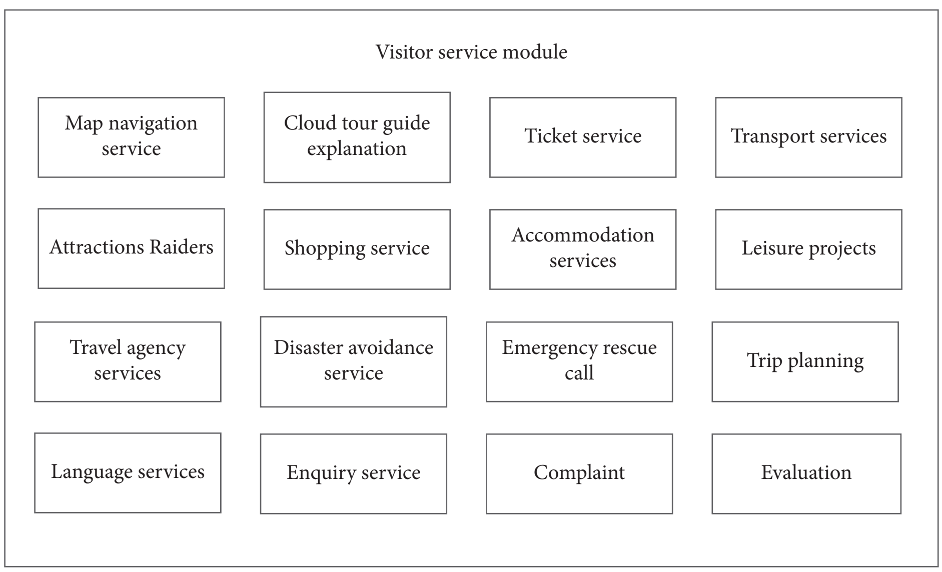

Figure 9: Functions of the tourist service module.

enhance human-computer interaction. It usually has a simple interface, clear colors, easy operation, superior sensitivity, and anti-mis-operation function, which makes people feel effective, relaxed, and pleasant. The design style is minimalist.

(1) The scenic spot management interface is shown in Figure 10

(2) The specific interactive interface of tourist service is shown in Figure 11

4.3. UI Testing. Test the rationality of the operating interface of this platform, using Google Chrome browser for detection, and detection results are passed. Therefore, we invited 10 volunteers to test and count the satisfaction recognition. The specific test statistics are shown in Figure 12:

As shown by the result in the figure, although all the UI tests of the test items have passed, because the users have different use effects and great autonomy, except for the three basic contents of garbled code, hyperlink, and clarity, the rest of the contents make users dissatisfied to varying degrees, and the final overall average satisfaction recognition is 93%. Comparing the satisfaction recognition degree, we find that except for the font size and color style, the rest basically meet the requirements of users, as shown in Figure 13.

Ensure that the user interface will provide users with corresponding access or browsing functions through the functions of test objects; ensure that the user interface meets the standards of the company or industry. The user interface (UI) test is used to verify the user's interaction with the software.

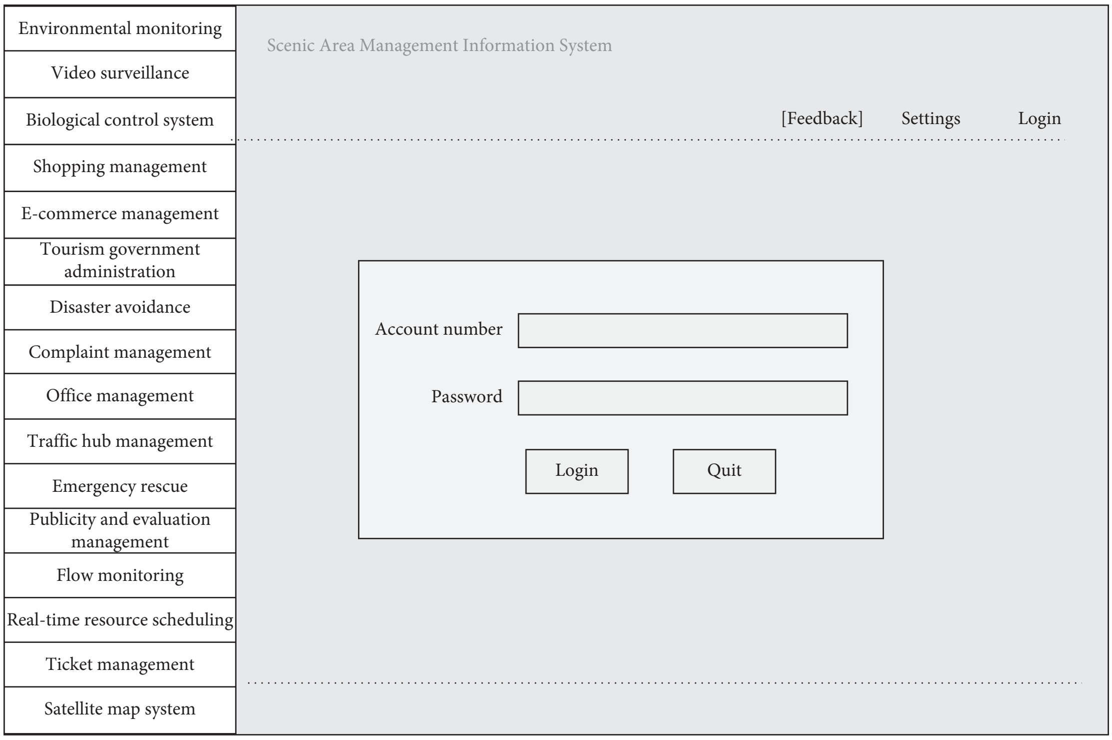

FIGURE 10: Scenic area management interface.

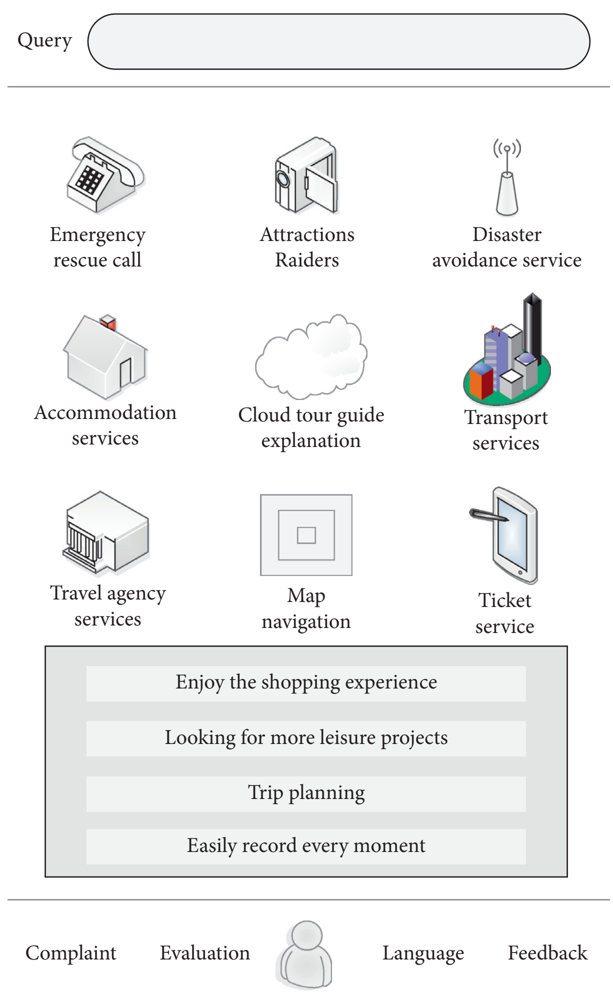

FIGURE 11: Visitor service interface.

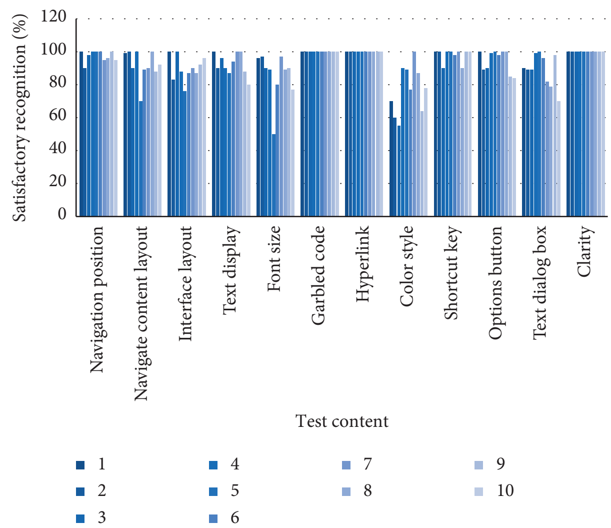

Figure 12: UI test results.

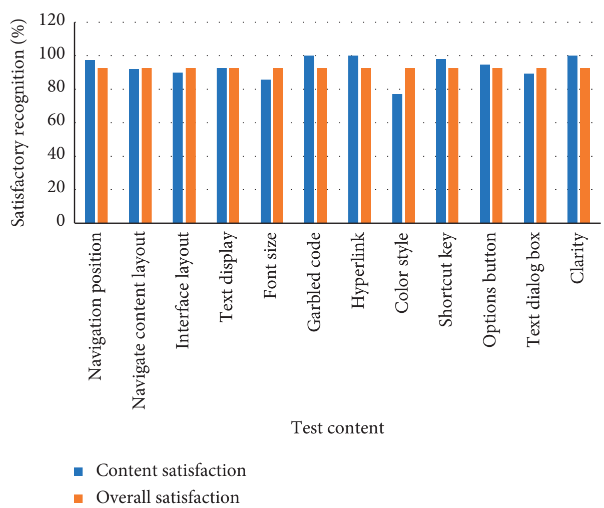

Figure 13: UI average satisfaction acceptance.

Table 2: Comparison of spliced data.

Splicing method	Feature point N1	Feature point N2	Matching point	Matching time (s)	Correct rate (%)
Primitive	155	129	52	2.75	89
Improvement	184	130	32	1.35	93.90

Usually in UI testing, through the experience of different users, the user satisfaction reached more than 90%, indicating that the UI interface is the user can meet the requirements. In the article, the user satisfaction reached 93%, and the problems found were still further improved.

UI average satisfaction is based on a user experience questionnaire survey, which is generally the result of customer experience and scoring of basic users. This paper uses the method of user experience questionnaire to achieve, and the results are general statistics of all members of the proportion of the score to obtain.

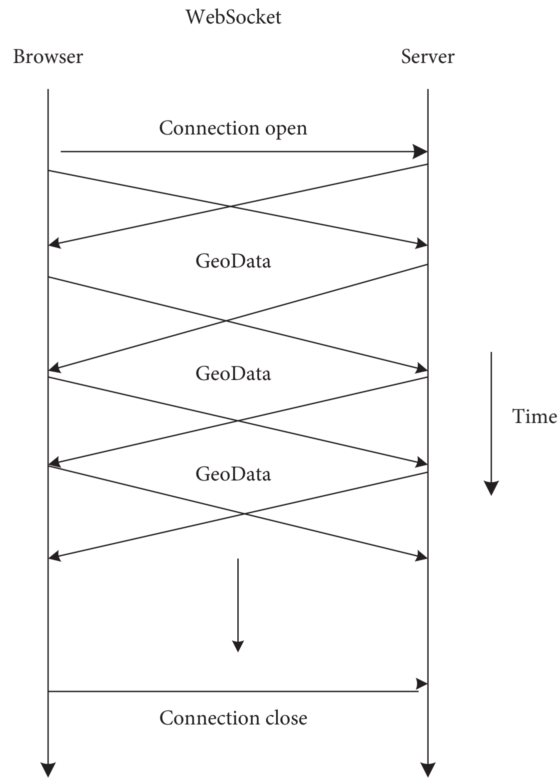

Figure 14: WebSocket communication process.

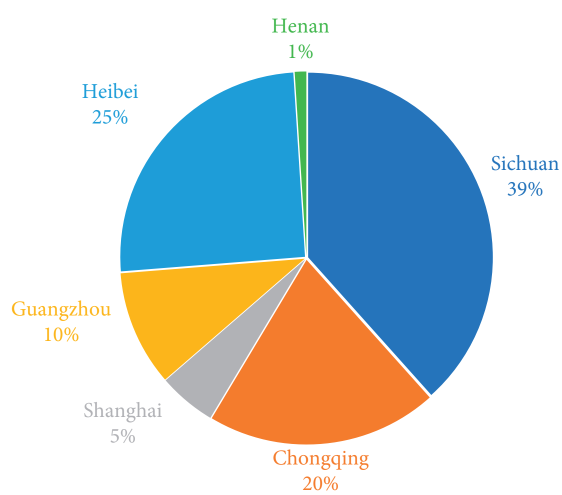

Figure 15: Traffic statistics of parking lots in scenic spots.

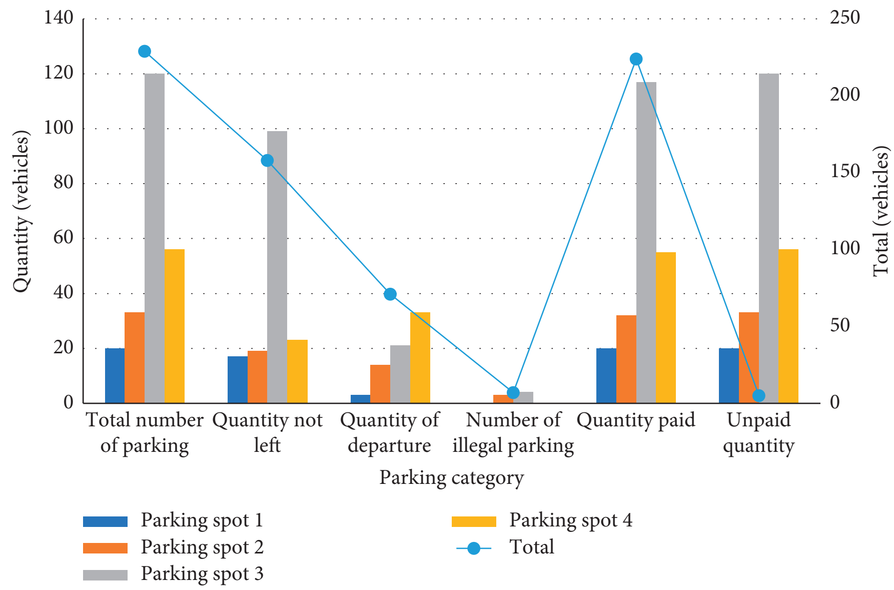

FIGURE 16: Parking details of scenic spots.

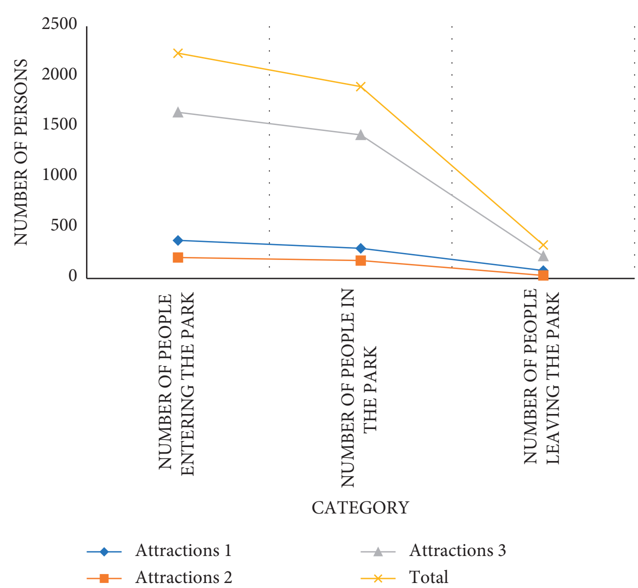

FIGURE 17: Statistics of passenger flow in scenic spots.

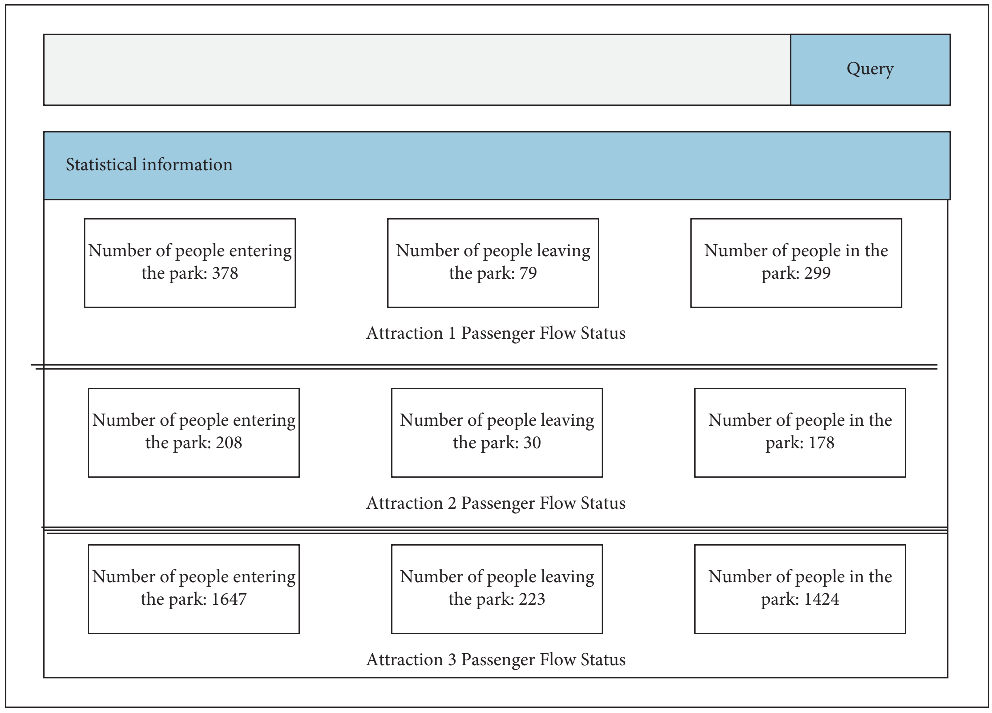

Figure 18: Scenic area passenger flow interface.

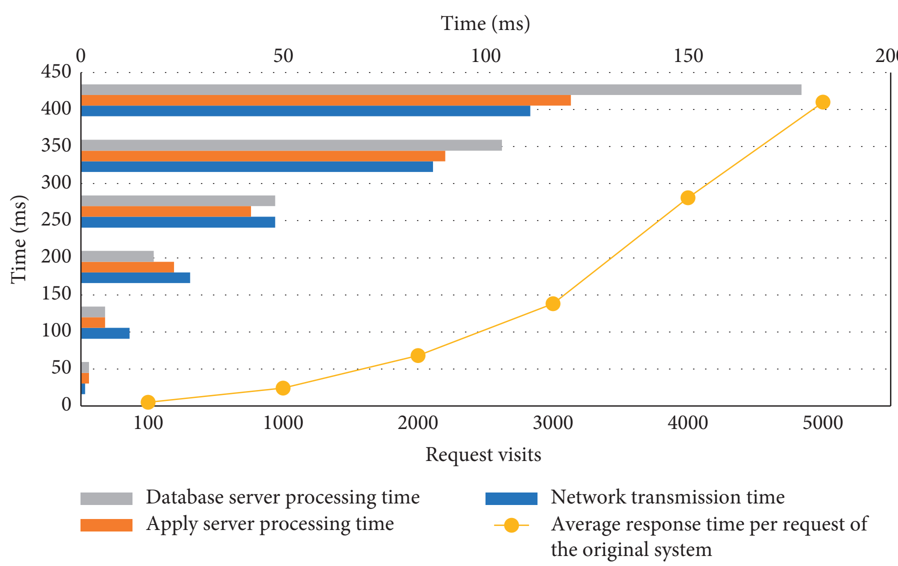

Figure 19: Response time distribution of the original system.

4.4. Running Performance Comparison

4.4.1. Panoramic Image Arrangement Algorithm. By comparing the original method with the improved method, the result shows that the accuracy of the improved method is as high as 93.90%, the effect is 4.90% better than that before the improvement, and the algorithm is more efficient in Table 2.

4.4.2. Real-Time Scenic Spot Configuration Management

(1) The communication process of status transfer in scenic spot resource allocation is shown in Figure 14

(2) Take the configuration status of parking lots in scenic spots as an example as shown in Figures 15 and 16

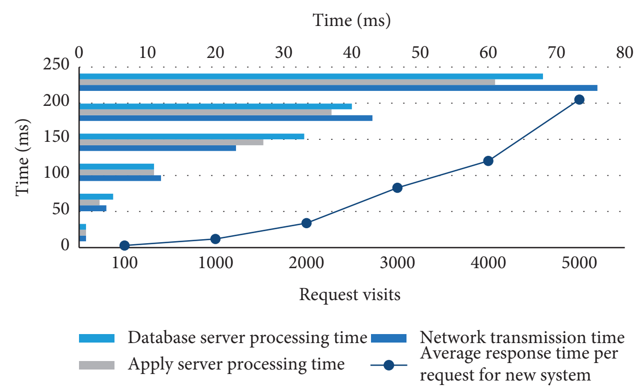

Figure 20: Response time distribution of the new system.

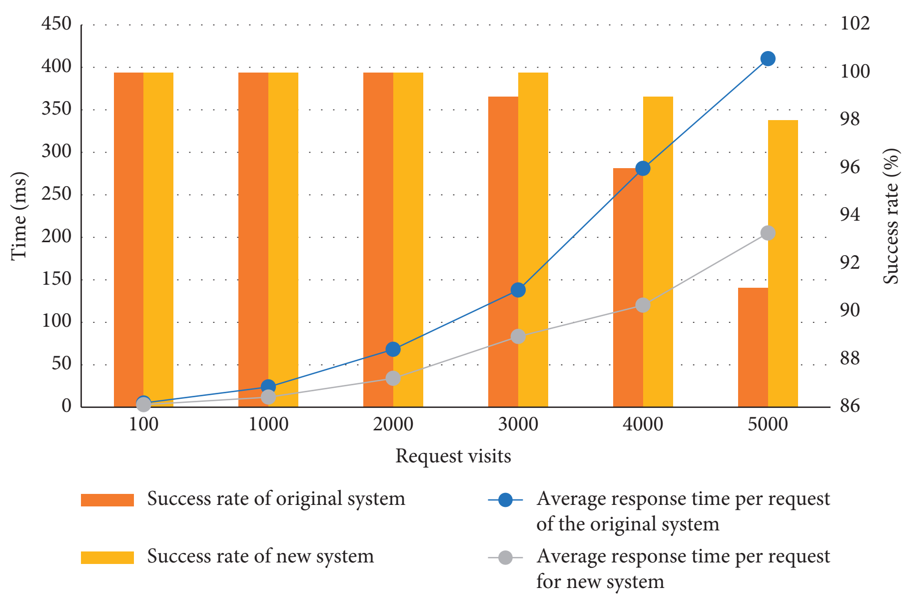

Figure 21: Comparison between old and new systems.

(3) Take passenger flow as an example as shown in Figures 17 and 18

4.4.3. System Access Response Time. ART and TPS indexes are used to evaluate the load performance of the model:

$$\begin{aligned}\text{network transmission time} &= N_1 + N_2 + N_3 + N_4,\\ \text{server Processing time} &= A_1 + A_3,\\ \text{database server processing time} &= A_2,\\ \text{response time} &= N_1 + N_2 + N_3 + N_4 + A_1 + A_3 + A_2.\end{aligned} \tag{26}$$

Grouped according to the number of visits to concurrent requests, it is divided into six groups: 100, 1000, 2000, 3000, 4000, and 5000. Comparing the response time distribution between the original system and the new system, we can find that the average response time of each request of the original system is about 161 ms, and the average response time of each request of the new system is about 91 ms, which is about 57% less than the original response time, and the access success rate is 100%. The specific situation is shown in Figures 19–21.

5. Conclusion

To sum up, the research results show that (1) the overall average satisfaction of UI testing is 93%, which basically meets the requirements of users, and the font size, color style, and content vary from person to person. (2) Comparing the original mosaic method with the improved mosaic method, the result shows that the accuracy of the improved method is as high as 93.90%, the effect is 4.90% better than that before the improvement, and the new improved algorithm is more efficient. (3) The scenic spot configuration management effect is excellent, which can effectively monitor various situations in the scenic spot. (4) The average response time of each request of the original system is about 161 ms, and the average response time of each request of the new system is about 91 ms, which is about 57% less than the original one, and the access success rate is 100%. The results are good, but the simulation process and conclusions still need to be revised and refined in view of the simple version we used in functional testing and analysis.

Data Availability

The experimental data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no conflicts of interest regarding this work.

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