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Retraction

Retracted: Augmented Reality Interactive Guide System and Method for Tourist Attractions Based on Geographic Location

Journal of Electrical and Computer Engineering

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Journal of Electricaland Computer Engineering has retracted the article titled "Augmented Reality Interactive Guide System and Method for Tourist Attractions Based on Geographic Location" [1] due to concerns that the peer review process has been compromised.

Following an investigation conducted by the Hindawi Research Integrity team [2], significant concerns were identified with the peer reviewers assigned to this article; the investigation has concluded that the peer review process was compromised. We therefore can no longer trust the peer review process, and the article is being retracted with the agreement of the editorial board.

References

[1] X. Zhuang, H. Jiao, and K. Lu, "Augmented Reality Interactive Guide System and Method for Tourist Attractions Based on Geographic Location," *Journal of Electrical and Computer Engineering*, vol. 2022, Article ID 7606289, 13 pages, 2022.

[2] L. Ferguson, "Advancing Research Integrity Collaboratively and with Vigour," 2022, https://www.hindawi.com/post/advancing-research-integrity-collaboratively-and-vigour/.

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Research Article

Augmented Reality Interactive Guide System and Method for Tourist Attractions Based on Geographic Location

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With the increasing improvement of people's living standards, more and more tourists choose to travel independently, which puts forward higher requirements for the existing tourist guide system of scenic spots. Augmented reality (AR) is a technology that integrates computer-generated virtual information into real scenes. It provides more interactive modes, allowing visitors to have a stronger sense of immersion in the real world. The interactive navigation system is an analysis and processing system that recommends algorithms for tourists through the back-end server by collecting the user's registration information data. It provides tourists with reasonable travel itineraries. This can not only allow users to avoid the peak flow of people and save tourists' time, but also reduce the hidden dangers of scenic spots and improve the turnover rate of passenger flow. This paper aims to study an interactive guide system combined with augmented reality technology to provide tourism services for tourists in tourist attractions based on geographic locations. This paper proposes an improved probabilistic algorithm model to accurately locate tourists. (Probabilistic algorithms are also called randomization algorithms. Probabilistic algorithms allow the random choice of the next computational step during execution. In many cases, when the algorithm is faced with a choice during the execution process, the random choice is time-saving compared to the optimal one. Therefore, the probabilistic algorithm can greatly reduce the complexity of the algorithm.) At the same time, the paper designs an AR scenic spot tour guide system. It tests the performance of the system. The results show that the initial response speed of the improved probability algorithm is 0.69 s, the average response time is 4 s when the number of concurrent users is finally increased to 600, and the growth rate is about 0.006 s. The improved algorithm can obviously enhance the response speed.

1. Introduction

GPS positioning technology is already a relatively mature means of spatial positioning. Because of its low equipment requirements and simple and quick positioning operation, it has been widely used in various fields such as military, navigation, transportation, and tourism. With the development of key technologies such as electronic maps, virtual reality, smart tourism, drones, and mobile Internet, people's daily travel and tourism are becoming more and more convenient. For tourist attractions, in order to meet the growing demand of users and create a personalized travel experience, some personalized travel applications based on the client are also necessary. Among these travel applications, the scenic navigation function is one of the most basic and frequently used functions. Therefore, improving the positioning accuracy of the client in the scenic spot and improving the navigation experience play an important role. In order to improve the accuracy of scenic spot navigation, the introduction of GPS map matching technology into scenic spot navigation plays a very important role.

There are three main types of tourism: (1) Paper guide map mode: the paper guide map cannot provide positioning and cannot determine the direction. It makes tourists annoyed and is time-consuming. (2) Manual tour guide and electronic interpreter mode: although tourists can have a certain understanding of the characteristics and humanistic allusions of scenic spots through the explanation of artificial tour guides or electronic interpreters, tourists are in a passive position in the process of tourism. Moreover, it lacks social means such as interaction and sharing, and tourists have no channels to continue to pay attention to the scenic spots after the visit. (3) Network-based tour guide mode: tourists can scan the QR code of the scenic spot with the QR code tool that comes with WeChat or mobile phone and then obtain the explanation data through the network. However, this approach has the following disadvantages: it does not use a dedicated APP scanning tool, and the experience is very poor. It will incur a traffic fee when it obtains the explanation data. When there are many tourists, the signal bandwidth cannot meet the demand.

With the increasing rise of positioning and navigation technology, more and more tourists choose to travel independently. This also puts forward higher requirements for the existing positioning and navigation technology. Tourists need more refined and more user-friendly location information services. Traditional map matching technology is mostly used in intelligent transportation systems, but it is rarely involved in smart tourism. In view of the increasingly developed tourism industry and the growing demand for scenic spot navigation, this paper applies GPS technology to scenic spot navigation and combines the characteristics of scenic spot positioning environment to propose innovative electronic map design, dynamic threshold estimation, etc. This can largely fill the current gaps in this field at home and abroad and make up for the deficiencies.

Augmented reality has many advantages in travel. First, it can improve the popularity of the scenic spot. Tourists can deeply interact with the beautiful scenery anytime, anywhere and have a stronger willingness to go to the scenic spot to experience it for themselves. Second, some cultural monuments and treasures in museums can be effectively protected. Tourists can appreciate those easily damaged cultural relics from a long distance through portable devices and realize the digitization of cultural heritage, which avoids secondary damage to these rare tourism resources. Third, augmented reality tourism can expand the tourism development model and improve service quality. At the same time, the unique functions such as explanation and guidance of the augmented reality system can help tourists understand those attractions that are not open to the public. Visitors can try to virtualize themselves. Integrating themselves with the virtual scene makes them seem to be in those inaccessible scenic spots. Taking pictures as souvenirs will give tourists a stronger sense of immersion in reality. Fourth, the purpose of tourism is to bring happiness to tourists and promote the spread of culture. However, for young people with heavy schoolwork and elderly people with limited mobility, they have fewer opportunities to go to scenic spots. Augmented reality technology that uses digital as a means can better solve such problems. They can experience the beautiful scenery at home and achieve the purpose of relaxation.

The first advantage of the scenic tour guide system is the tourist service upgrade. The system provides tourists with map positioning, scenic spot lists, route recommendation, service signs, etc., so that tourists can get rid of the drawbacks of traditional scenic spots that cannot distinguish between things. It clearly presents the thumbnail view of the scenic spot to tourists, which is convenient for tourists to play. This saves time spent by tourists to find attractions, toilets, and other facilities and improves the experience of tourists. Second, the scenic spot saves costs. It can save the cost of manual tour guide expenses, display the scenic spot information to tourists more comprehensively, and improve the tourists' impression score of the scenic spot. Third, it realizes technology + tourism. The tourism market has broad prospects. The smart tourism represented by the scenic tour guide system will drive the upgrading of the tourism industry and promote the intelligence and informatization of the tourism industry.

The innovations of this paper are as follows: (1) It designs a scenic tour guide system that combines GPS technology and augmented reality technology. (2) An improved GPS technology probability algorithm makes the positioning more accurate. (3) It tests the system before and after the algorithm improvement. The results obtained are more intuitive and can better reflect the characteristics of the navigation system in this paper.

2. Related Work

With the improvement of people's living standards and the intensification of population aging, more and more people in China like to travel, and tourism has become a new cultural industry. Therefore, many scholars have enriched and improved the content of tourist attractions and published some related articles. On the basis of further analysis of the concept of trails, Li proposed a new concept of trail tourist attractions and established a five-dimensional theoretical evaluation framework for trail tourist attractions. He proposed a new concept of trail tourist attractions. It established a theoretical evaluation framework for the five dimensions of trail tourist attractions (i.e., trail resources, trail operations, trail technology, trail management, and trail economic indicators). Li proposed the concept of trail tourist attractions and its evaluation criteria, which is an attempt and innovation in the development of scenic spots, which may give birth to new rules for the development of scenic spots [1]. Haneef et al. discussed how strategic planning for new attractions combined with existing ones will help spread awareness of Expo 2020. Observations from his research can be used by other countries hosting similar events in similar geographic areas to help prepare and map lessons from past experiences [2]. As it is difficult for the service mode and quality of traditional tour guides to meet the diversified and personalized tourism needs, Zhang et al. designed and implemented an intelligent tour guide system running on the mobile terminal. The APP designed by Zhang et al. focuses on graphic, visual, and intelligent display. It can not only provide tourists with personalized self-guided tour services anytime and anywhere, but also contribute to the intelligent management and precise marketing of scenic spots, and it has a good market prospect [3]. The Hall and Ram study examined the relationship between walkability and indicators of successful tourism. This indicator was measured by visitor numbers and Tripadvisor reviews of major UK visitor attractions. It measures walking ability by using the Walk Score (*R*) index. The index assesses the walking potential of a starting point by a combination of the shortest distance to a set of preselected target points, the length of a block, and the density of intersections around the starting point. The Hall and Ram study concluded that if tourists are to be encouraged to engage in active transport at their destination, an assessment of the tourists' walkability and transport choices will be required [4]. Geoffrey claimed that ethnic and minority tourism attract more attention in rural than urban environments. However, few would deny that these views are merely current, as their discussions are in line with the trends of the times. These stem from the impact on the urban landscape and life as well as tourism [5]. Many public service and entertainment industries utilize mixed reality (MR) devices to develop highly immersive and interactive applications. However, recent advances in MR processing have prompted the tourism and events industry to invest in and develop commercial applications. The museum environment exploits the ergonomic freedom of spatial holographic head-mounted displays (HMDs), which provide an accessible platform for MR guidance systems. Hammady et al. presented the design and development of a new museum guide system based on the theory of immersion and presence. This approach examined the impact of an individual's interactivity, spatial mobility, and perceptual awareness in an MR environment. The research aims to create an alternative tour guide system that enhances the customer experience and reduces the number of human tour guides in museums. The results of this study showed a high rate of positive responses to MR guide systems, as well as the functioning of AR HMDs in museum settings. This result strengthened the applicability of the tourism system to enhance the visitor experience in museums, galleries, and cultural heritage sites [6]. However, these studies are biased toward the theoretical aspect, with very few practical applications. Therefore, this paper proposes an augmented reality interactive guide system and method for tourist scenic spots based on geographic location, which can combine theory and practice and make it more convenient for people to visit scenic spots, which has important value and significance.

3. Scenic Guide System Based on GPS and AR

3.1. Tourist Attractions Based on GPS Technology. Smart tourism has developed rapidly in recent years, and some smart tourism products continue to appear in the market. However, for now, there is still a lot of room for improvement in the navigation experience and positioning accuracy in scenic spots using smartphone applications. Traditional GPS technology has been widely used in intelligent transportation systems. It combines positioning information and road network information to determine the vehicle driving on the corresponding road and the position on the road. Most of the current main matching algorithms are for vehicles on urban roads. This is not suitable for pedestrians who use mobile phone positioning in the scenic navigation service. It is mainly manifested in complex positioning environment, low accuracy of positioning equipment, and irregular user movements. Some of the map matching requirements on traditional ITS cannot be met [7, 8].

Tourist scenic spots mainly use "3S" technology (i.e., global positioning system, GPS; geographic information system, GIS; and remote sensing technology, RS) to collect, process, and analyze basic information of scenic spots. In this way, it provides location services for tourists and staff and realizes intelligent monitoring, visual management, and intelligent navigation services of scenic spots. In this way, it can properly move, control, and manage people and vehicles in the scenic spots [9].

The GPS consists of the main control station (responsible for managing and coordinating the work of the entire ground control system), the ground antenna (under the control of the main control station, injecting search texts into the satellite), the monitoring station (the automatic data collection center), and the communication auxiliary system (data transfer). The space portion of the GPS consists of a constellation of space GPS satellites. The part of the user device is mainly composed of a GPS receiver and a satellite antenna.

The principle of GPS positioning is three-point positioning; that is, the specific coordinates of the user are calculated by three known satellites and the user's distance, as shown in Figure 1. In fact, in the process of positioning, there are clock asynchronization problems, for example, the difference between the satellite clock and the receiver clock, as well as various errors such as ephemeris error, atmospheric delay, and multipath effect. If there are only three satellites, the positioning accuracy is difficult to guarantee; therefore, more satellites are required. Practice shows that the more the positioning satellites the user can receive, the higher the positioning accuracy and the more stable the navigation effect [10, 11].

The working principle of the map matching algorithm is shown in Figure 2. (Map matching is the process of associating the ordered GPS positions of operating vehicles with the road network of the electronic map and converting the GPS coordinate downsampling sequence into the road network coordinate sequence. If map matching is not performed, the trajectory of the vehicle may not fall on the road network.) It matches and calculates the coordinates or trajectories of characters obtained by various sensors (such as GPS and DR) and the road network data of the electronic map. It shows the real-time position of the person on the correct road on the map. The map matching process can be divided into two relatively independent processes: one is to find the road the person is currently driving on; the other is to match the current location point to the road the person is driving on [12].

The map matching process is divided into initial matching, intersection matching, and matching on known

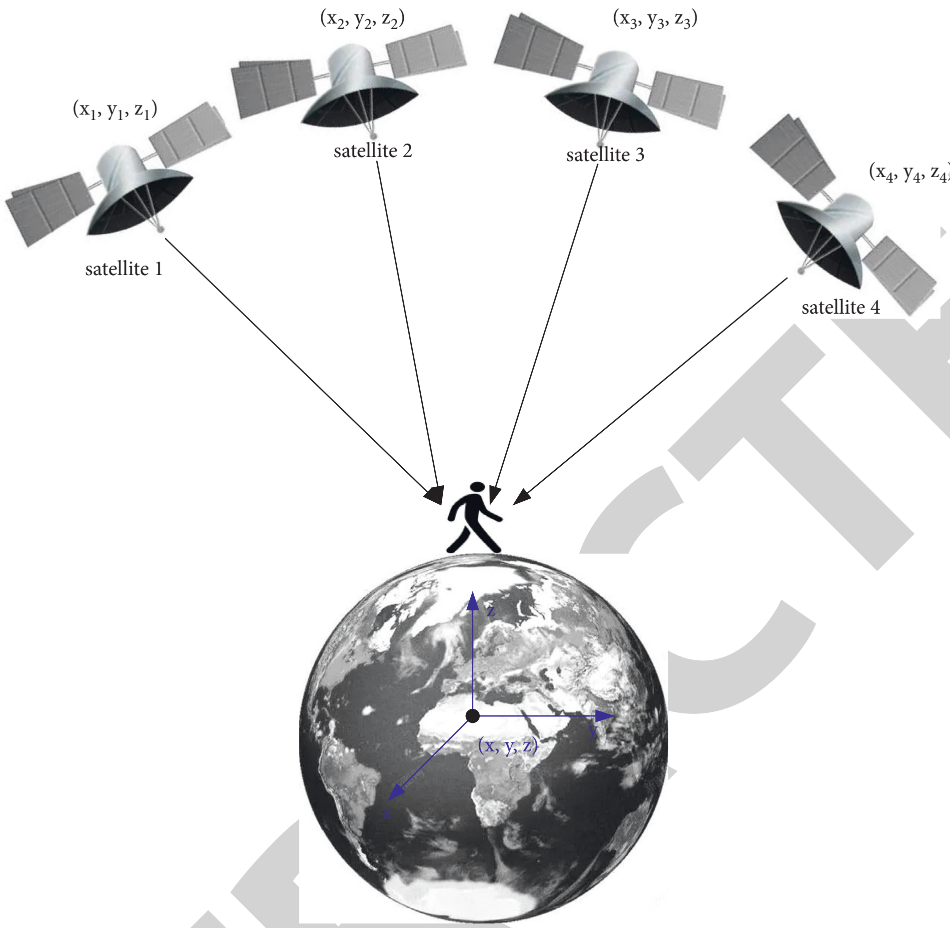

FIGURE 1: GPS positioning principle.

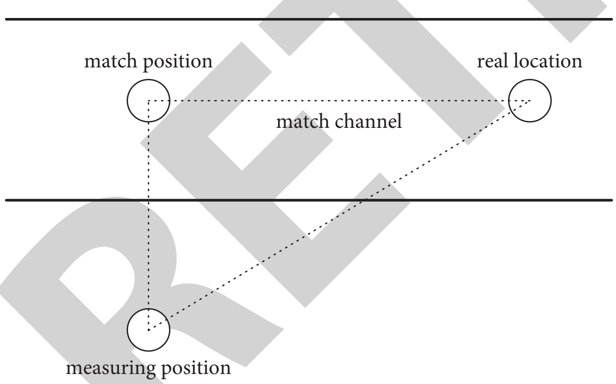

FIGURE 2: The principle of map matching.

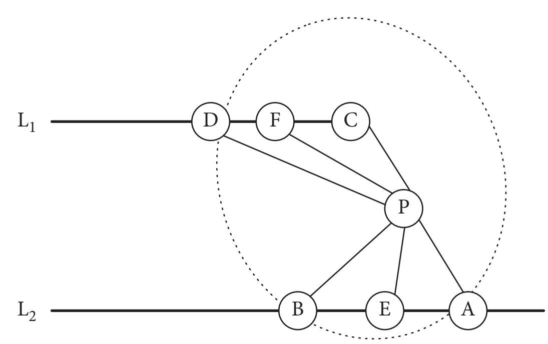

FIGURE 3: Distance and matching method based on equal probability geographic location.

road sections. It is a bit more difficult for the initial matching to determine the user's path because it does not have any historical empirical knowledge. Although intersection matching has historical positioning data, it is faced with the problem of how to determine which road the user will choose next. Matching on its known roads requires projecting GPS positioning points onto known road segments and also requires detecting intersections to determine whether to start road selection.

Equiprobability algorithms measure near and far based on the probability of the target object. It assumes that the true point has an equal probability of occurrence on all road segments within the possible range of the anchor point. That is, it is assumed that the user's true location is uniformly distributed over the possible range. In this paper, error ellipses or confidence intervals are usually used to represent the possible range of users [13, 14].

As shown in Figure 3, when uniformly distributed, the error ellipse can be represented as follows:

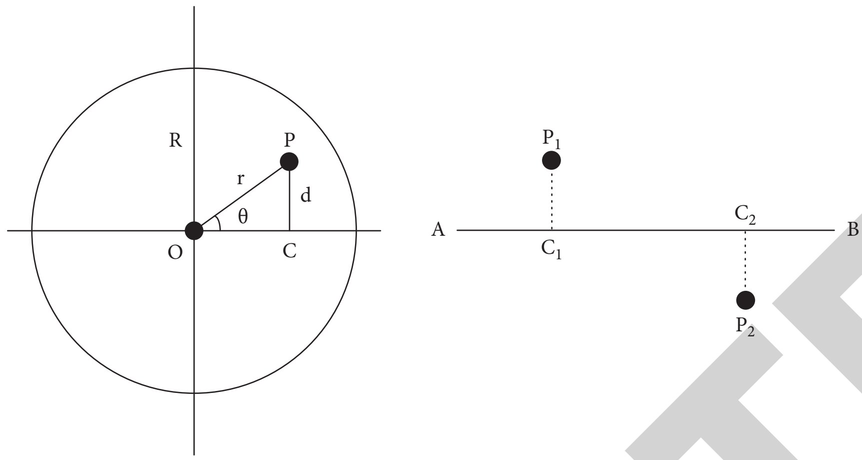

Figure 4: Equal probability dynamic threshold algorithm.

$$f(x) = \begin{cases} k, x \in AB \cup CD, \\ 0, \text{else}, \end{cases}$$
$$\int_{x \in AB} f(x) \mathrm{ds} + \int_{x \in CD} f(x) \mathrm{ds} = 1. \tag{1}$$

A local Cartesian coordinate system is established with the X-axis. It sets x_1 and x_2 as the two ends of the truncated line segment, and its length is L; then, the probability that the positioning point P belongs to each road segment is as follows:

$$P_l = \int_{x_1}^{x_2} f(x) \mathrm{dx} = k(x_2 - x_1) = KL. \tag{2}$$

If the lengths of the two intercepts are L_1 and L_2, then

$$k(L_1 + L_2) = 1,$$
$$P_{l_1} = \frac{L_1}{L_1 + L_2}, \tag{3}$$
$$P_{l_2} = \frac{L_2}{L_1 + L_2}.$$

Its equal probability algorithm is improved as follows:

The dynamic threshold reflects the local positioning error characteristics, utilizing historical data within a certain range. As shown in Figure 4, the user moves along the road AB; P_1, P_2 are two positioning points; and C_1, C_2 are two projected points, but the corresponding real positions are unknown. In this case, it has to estimate the positioning error threshold using historical data, which is called dynamic threshold. On the basis of the assumption of static threshold estimation, it is assumed that θ obeys a uniform distribution; then, the probability formula about is as follows:

$$f(\theta) = \begin{cases} \frac{1}{2\pi}, 0 \le \theta \le 2\pi, \\ 0, \text{else}. \end{cases} \tag{4}$$

For the convenience of calculation, it makes $\theta \sim U$ within $(0, \pi)$; then,

$$f(\theta) = \begin{cases} \frac{1}{\pi}, 0 \le \theta \le \pi, \\ 0, \text{else}. \end{cases} \tag{5}$$

Additionally, $d = r \sin \theta$; then, the expectation of d can be expressed as follows:

$$Ed = E(r \sin \theta) = \frac{2}{\pi} Er. \tag{6}$$

It gets the expectation of the actual error r:

$$u = Er = \frac{\pi}{2} Ed. \tag{7}$$

Then, the variance of d is as follows:

$$D(d) = E(d^2) - (Ed)^2 = \frac{1}{2} E(r^2) - (Ed)^2. \tag{8}$$

Similarly, the variance of r is as follows:

$$\sigma^2 = D(r) = E(r^2) - (Er)^2 = 2\, D(d) + \frac{8 - \pi^2}{4} (Ed)^2. \tag{9}$$

It gets the dynamic threshold:

$$R = u + 2\sigma = Er + 2\sqrt{Dr},$$
$$= \frac{\pi}{2} Ed + \sqrt{8\, D(d) + (8 - \pi^2)(Ed)^2}, \tag{10}$$
$$\widetilde{R} = \frac{\pi}{2} \widetilde{d} + \sqrt{8S^2(d) + (8 - \pi^2)\widetilde{d}^2}.$$

The unequal probability algorithm is as follows:

Assuming that the positioning error size x obeys a normal distribution, there is a density function for x:

$$f(x) = \frac{1}{\sqrt{2\pi}\sigma} \exp\left(-\frac{(x - u)^2}{2\sigma^2}\right). \tag{11}$$

Distribution function is as follows:

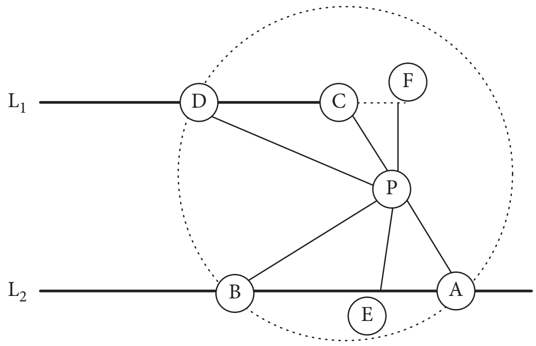

Figure 5: Definition of equiprobability confidence.

$$F(x) = P(X \leq x) = \int_{-\infty}^{x} f(x)dx. \quad (12)$$

As shown in Figure 5, the location point P, which is within the confidence interval of radius R intersects with the two road segments, and the intersection points are AB and CD, respectively. The vertical feet from P to the two road sections are E and F, respectively, and F falls on the DC extension line. Then, the distance to P is calculated as follows:

$$r = \sqrt{x^2 + d^2}. \quad (13)$$

d is the vertical distance, and the probability weight on the ring where the radius r is located is as follows:

$$w = \frac{f(r)}{2\pi r}. \quad (14)$$

Then, the probability that point P belongs to l is as follows:

$$P_1 = \int_{x_1}^{x_2} \mathrm{wdx} = \int_{x_1}^{x_2} \frac{1}{2\pi\sqrt{2\pi\left(x^2 + d^2\right)\sigma}} ex\left(-\frac{\left(\sqrt{x^2 + d^2} - u\right)^2}{2\sigma^2}\right)\mathrm{dx}. \quad (15)$$

u and σ represent the positioning error and standard error.

Using the summation method, the above formula can be simplified to the following:

$$P_l \approx \sum_{x_1}^{x_2} \frac{1}{2\pi\left(x^2 + d^2\right)\sigma} \exp\left(-\frac{\left(\sqrt{x^2 + d^2} - u\right)^2}{2\sigma^2}\right)\Delta x. \quad (16)$$

Δx indicates the increment during calculation.

Therefore, for any intercepted road segment i, the relative probability can be obtained:

$$\widehat{P}_i = \frac{P_i}{\sum P_i}. \quad (17)$$

3.2. Augmented Reality Technology. With the continuous improvement of people's living standards, tourism products and service models are also constantly upgraded. Augmented reality technology provides more interactive modes by fusing computer-generated virtual information into real scenes, allowing tourists to have a stronger sense of immersion in the real world [15].

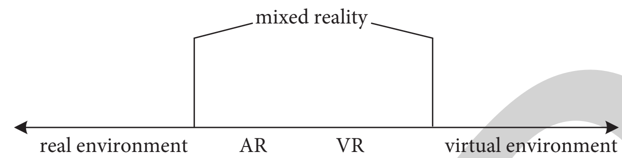

Figure 6: Schematic diagram of the relationship between augmented reality and virtual reality.

Augmented reality technology widely uses multimedia, three-dimensional modeling, real-time tracking and registration, intelligent interaction, sensing, and other technical means. It simulates virtual information such as text, images, three-dimensional models, music, and videos generated by computers and applies them to the real world. The two types of information complement each other, thereby enabling an "enhancement" of the real world. Augmented reality is a further extension and development of virtual reality technology. The two technologies have some connections and differences. The relationship between augmented reality and virtual reality can be shown in Figure 6.

In the augmented reality system, the image acquisition module obtains the video stream of the real scene through the camera and identifies the specific image from the frame of images. The tracking registration module calculates the pose of the camera and locates and tracks the images in the scene. The virtual object generation module uses the corresponding three-dimensional modeling software to generate virtual objects. The virtual-real fusion module integrates virtual objects with real scenes through virtual fusion technology. The output display module is used to display the effect of the fusion of the virtual object and the real scene on the screen. The human-computer interaction module refers to the process where the user controls the system through the interactive interface or some buttons. The core of the system is to solve the problem of how to achieve accurate virtual and real fusion, so that users cannot feel the difference between the virtual scene and the real scene [16, 17]. The core technologies of augmented reality include tracking registration technology, display technology, virtual object generation technology, interaction technology, and merging technology. The module composition of the augmented reality system is shown in Figure 7.

The key to realizing the virtual-real fusion of the target scene is the 3D registration technology. It accurately calibrates the pose information of the real scene through the camera and seamlessly integrates the virtual object with the real world through the three-dimensional registration technology. At present, the virtual reality fusion technology mainly includes three display modes: head-mounted device, mobile device, and projection device. Headsets use displays in helmets to display augmented reality effects. Head-mounted devices have high resolution and good effects but are complicated to operate and expensive, and they are generally used in indoor scenes [18].

Tracking and registration can be achieved through computer vision, hardware devices, positioning systems, etc.

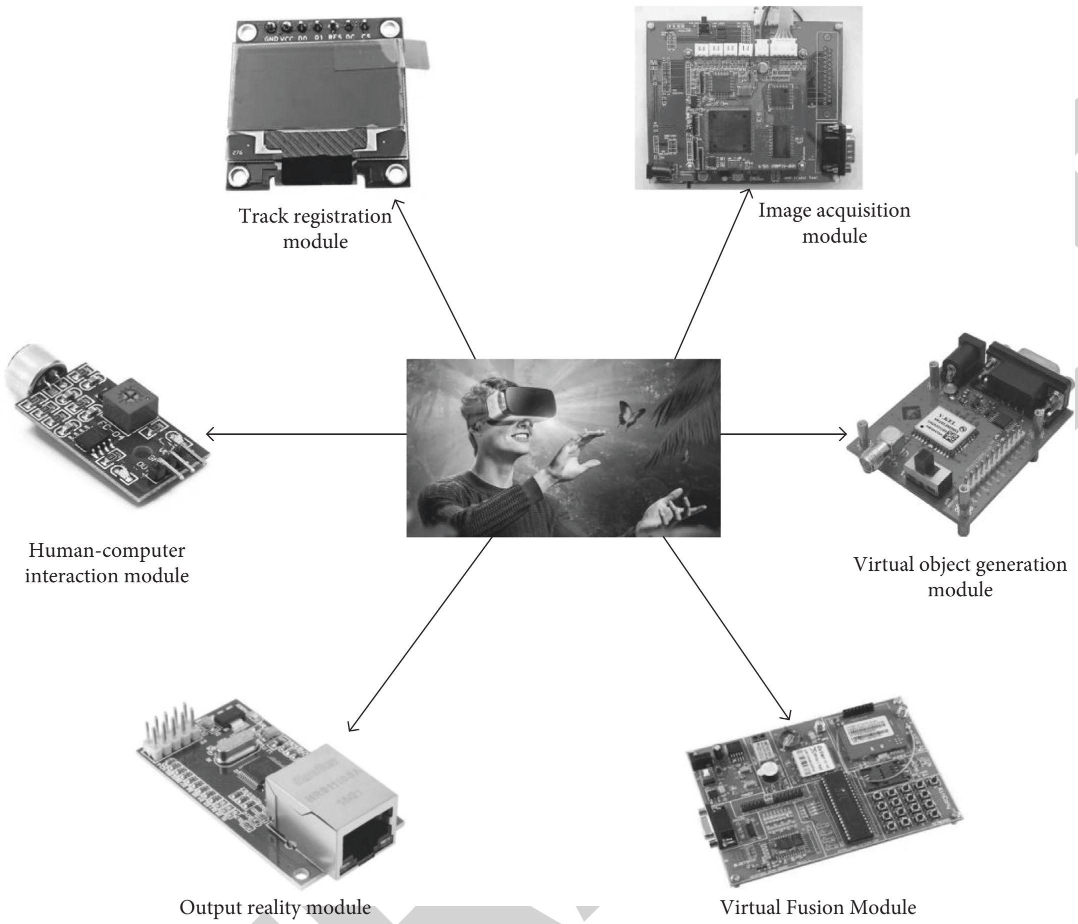

Figure 7: Augmented reality system module composition.

Table 1: Augmented reality 3D registration technology.

Systematization	Based on vision	Based on the sensor
1	Tracking registration based on special flags	GPS-based tracking registration
2	Natural feature-based tracking registration	Inertia-based tracking registration
3	3D object-based tracking registration	Electromagnetic based tracking registration

Research on augmented reality boils down to research on tracking registration techniques. The classification of tracking registration technology is shown in Table 1.

Compared with the traditional tourism system, the augmented reality tourism system mainly has the following advantages. (1) Portability: The system does not require other specific equipment, and it can use the camera equipment that comes with computers and mobile phones. The equipment is simple, easy to operate, and easy to carry. (2) Practicality: The system adopts 3D registration technology based on natural features and does not need to make special 2D labels, so it has stronger practicability and universality. (3) Interactivity: It adds video and audio playback functions and has stronger interactivity. (4) Robustness : It is also the ability of the system to survive abnormal and dangerous situations). By optimizing the digital image processing module process, 3D registration algorithm structure, and virtual-real fusion module process, the system has higher image recognition efficiency and better stability. Other environments have less impact on the system running results, and the system runs faster [19].

3.3. Interactive Navigation System and Method. Due to the large number of scenic spots in the scenic spot, how to choose a reasonable travel route so that tourists can get the greatest satisfaction in terms of time, cost, and travel experience is a common problem for both tourist users and scenic spot managers. The system should collect the user's registration information (age, gender, city, etc.) data and analyze and process the tourist recommendation algorithm on the background server to provide tourists with reasonable travel routes. This can not only allow users to avoid the peak flow of people and save tourists' time, but also reduce the hidden safety hazards of scenic spots and improve the turnover rate of passenger flow [20].

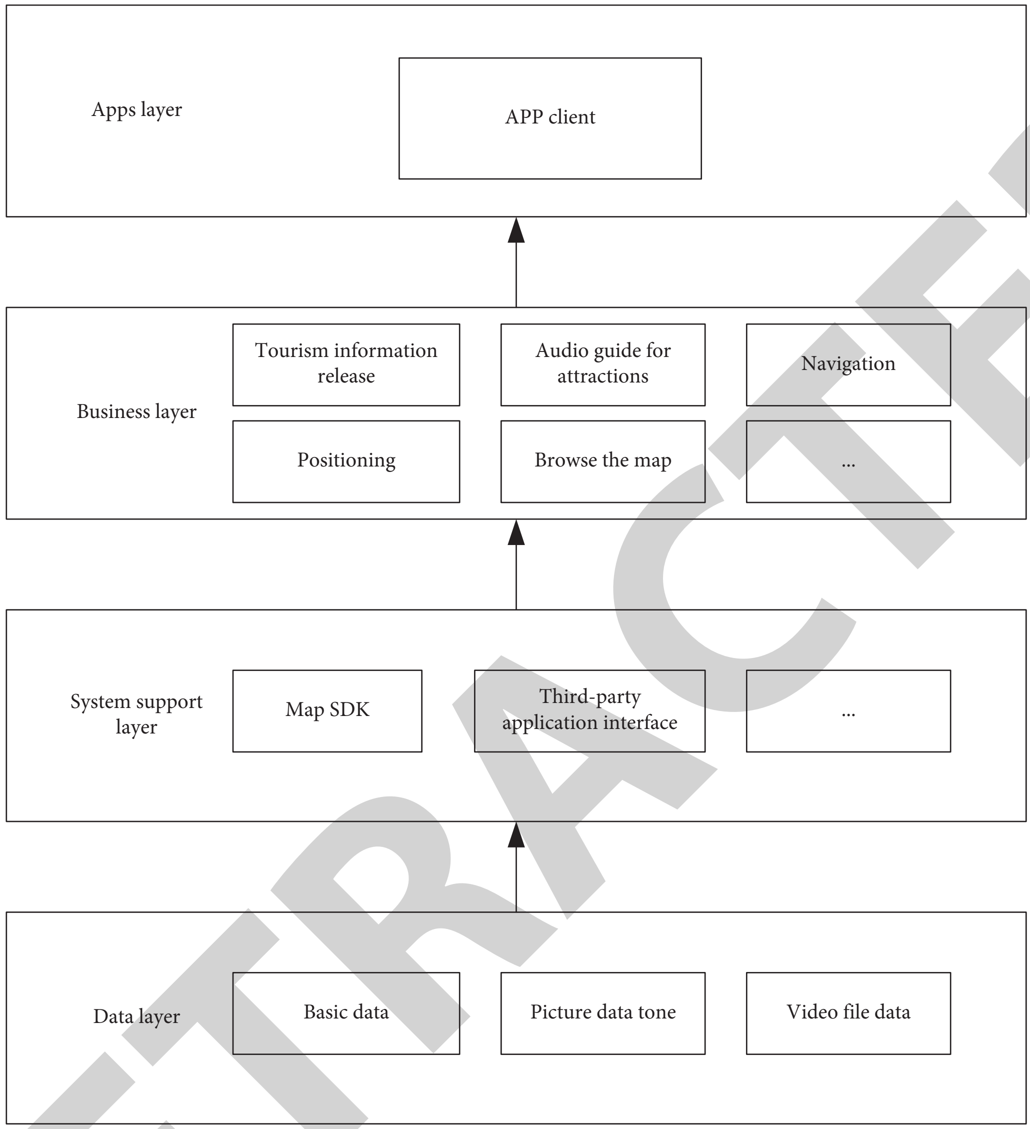

Figure 8: The basic framework of the tourist guide system.

For the server, the functions and services provided by the server itself are more complex due to the large number of interactions with the client. Therefore, the server needs to meet the following requirements in terms of performance: (1) The time from accepting a single request issued by the client to the response should be within 3000 ms. In actual operation, the response time is prolonged due to the influence of network resources and server concurrency. Therefore, it should be ensured that the system can respond in time to meet the normal needs of users. (2) During the peak period of travel, the server may receive thousands of requests at the same time, which requires the system to have a certain ability to withstand pressure. Limited by its architecture, in the absence of clustering, the server can withstand more than 500 concurrent requests. (3) Due to the variety and quantity of data involved in this system, the use of cache technology is a necessary means to reduce server load, and it can also speed up data processing efficiency. (4) The server should clean up junk data in time to free up memory space. (5) The server should have certain scalability. With the development of business and the expansion of scale, the system should reserve interfaces for third-party applications and services. Figure 8 shows the basic frame diagram of the travel guide system.

The mobile client is the interaction tool between the user and the system. It directly affects the user experience. In order to ensure the normal use of users, the app should meet the following requirements: (1) The mobile app should be compatible with the vast majority of Android smartphones in the market. (2) The complete process from a single request to the result display should take less than 5 s. When the display exceeds this time, a reminder should be given to ensure that the user can receive the feedback result in time. (3) The mobile app should guide the user to operate correctly and can handle and make a prompt when abnormal operation occurs, so as to avoid the situation of the program flashing back. (4) The request operation sent by the mobile app should be asynchronous to prevent a request from occupying too many network resources. (5) When the app does not need to use the GPS and map modules, it should

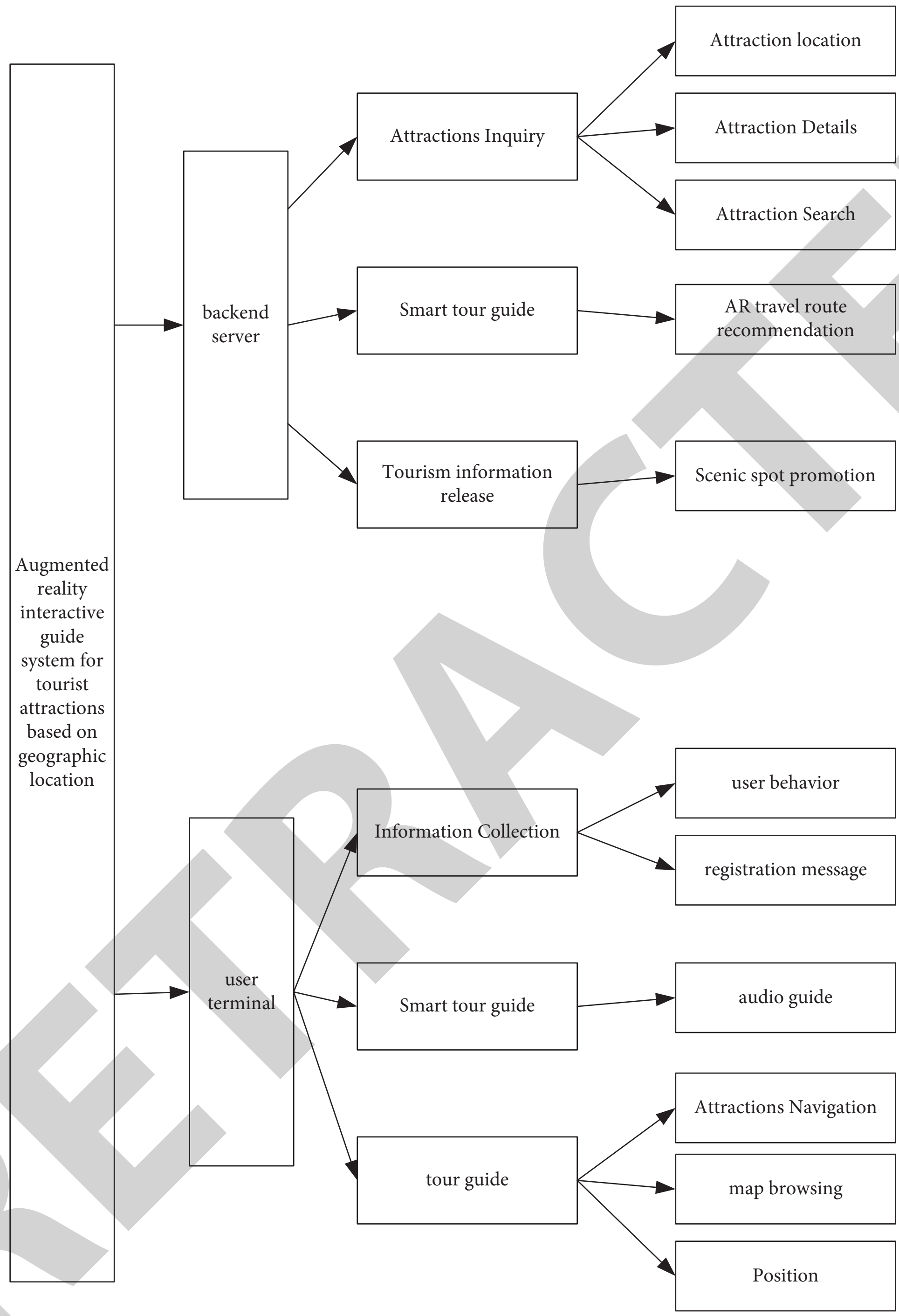

Figure 9: AR interactive scenic tourist guide system.

actively close the process service to release resources to prevent the mobile phone from occupying memory and consuming power for a long time [21].

4. Design and Testing of Scenic Tour Guide System

4.1. Design of Navigation System. The design and improvement of electronic map are generally based on point-line model, such as point, line, and surface in GIS. For example, the problem of this article is to establish an electronic map of personalized scenic spots, so it will not be very large. First of all, it needs to determine the coordinate system, which usually adopts the local plane coordinate system, and then converts the GPS coordinates to the local coordinate system. In many algorithms, roads are represented by line segments. The crux of the matter is determining the width standard.

The maps in general map matching come from GIS. In GIS, dotted lines are generally used to describe road networks. In practice, the road cannot be 100% straight.

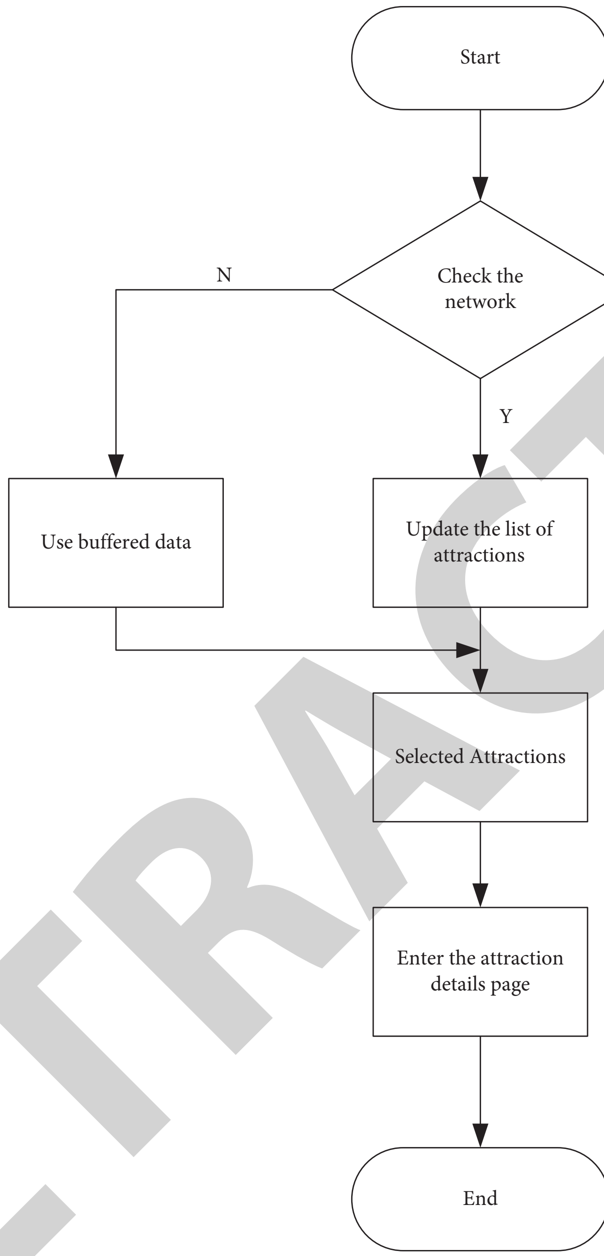

Figure 10: Attraction browsing flowchart.

However, the road is simplified under certain error tolerance conditions, which is convenient for storage and calculation. It is common practice to segment roads. Each segment is represented by a straight line, and segments are connected to form a road. The segmentation principle is generally to take the physically or geometrically representative places such as road intersections or road connections. In the scope of this study, although the GIS is not used, this idea can be used for reference. In this paper, line segment processing is also required when dealing with curved road sections. There are several guiding principles for the segmented roads in this paper; for example, short line segments (the length is less than the static positioning error threshold) cannot be generated, and it is not possible to generate a road section that is indistinguishable from the known road section.

The scenic tourist guide system designed in this paper is mainly divided into client and background server. The details are shown in Figure 9.

The flow of scenic spot browsing is shown in Figure 10.

4.2. Simulation Experiment. This paper tests the designed navigation system, and its test environment is shown in Table 2. The test is mainly aimed at determining whether the interfaces between all modules and submodules are normally combined after each functional module is integrated, whether the jumping and communication between the interfaces are normal and smooth, and whether the connection between the server and the client is normal.

Table 2: System test environment.

Test the hardware or tools	Parameter
Test tools	Appium, LoadRunner
Test the field network	WiFi, 4G/5G
Web server	Apache Tomcat 7.0
Database	MySQL Server 5.5
Development tool	MyEclipse2021
Operating system	Intel Core i7
Server host	The CPU main frequency is 4.2 GHz, with 8 G memory, and the hard disk size is 1 TB

Table 3: Navigation system functional test results.

Code	Input/action	Actual test results	Score
1	Opening the map interface	Correctly locating the current position and displaying the positioning mark	90
2	Opening the map and freely moving, zooming, dragging, or adding markers on the map	Consistent with the expected results, displaying the page normally without lag	95
3	Opening the navigation page and entering the start and end points	Displaying the navigation results correctly, with route and current location displayed on map layers	91

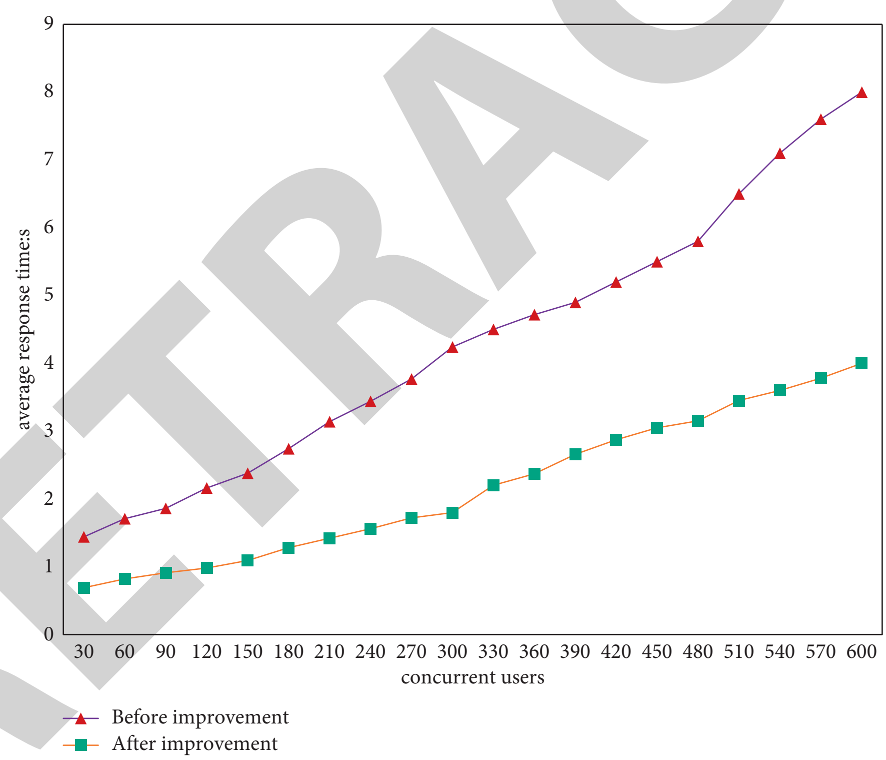

Figure 11: System concurrent response test curve.

4.3. Experimental Results. According to the test, the actual function of the navigation system is summarized and scored. The results are shown in Table 3.

In addition, this paper uses the server and database to test the system's concurrent response through the GPS probability algorithm before and after the improvement, and the results are shown in Figure 11.

It can be seen from Figure 11 that the system probability algorithm is compared before and after the improvement. Before the improvement, the average response time of the first 30 concurrent users was 1.44 s. Finally, when the number of concurrent users is increased to 600, the average response time is 8 s, and the growth rate is about 0.012 s. The improved initial response rate was 0.69. Finally, when the number of concurrent users is increased to 600, the average response time is 4 s, which is half of that before improvement, and the growth rate is about 0.006 s. Therefore, the improved algorithm can obviously improve the response speed.

5. Discussion

With the continuous improvement of the software and hardware level of computers and various portable devices and with the rapid popularization of 5 G communication, the augmented reality tourism system proposed in this paper can bring people a new visual experience. Augmented reality tourism is bound to develop rapidly in the future and has broad market prospects. The natural feature extraction augmented reality tourism system designed and implemented in this paper is still in the initial stage of experimental research. A lot of work still needs to be done before it can be applied to the market in the future.

(1) For the three-dimensional registration technology, it seeks a more accurate calculation method of the homography matrix to improve the accuracy of the three-dimensional registration.

(2) For the human-computer interaction module, the system has only completed a small number of parts, there is no time to conduct more research, and more functions need to be added to enhance the user's immersion in the real scene.

(3) The natural feature extraction augmented reality tourism system studied in this paper only uses one camera and does not consider the depth problem. From the perspective of computer vision, the use of binocular cameras can obtain more accurate pose information and more accurately identify natural features.

6. Conclusions

This paper firstly summarizes the overall content of the full text in the abstract. Secondly, the Introduction introduces the era background of scenic tourism, introduces the characteristics of augmented reality technology, and summarizes the innovations of this paper. The Related Work exemplifies some related researches, in order to understand the current situation of the related content researched in this paper. Then, the theoretical research part first introduces the definition, characteristics, classification, and related algorithms of GPS technology. It then introduces the related content of augmented reality technology (including its concept, characteristics, and composition) and the relevant content of the interactive navigation system and method. It finally designs an interactive tour guide system for AR scenic spots and tests the performance of the system. It concludes that the actual function score of the navigation system is above 90 points. Furthermore, compared with the original one, the proposed probability algorithm has significantly improved the concurrent response speed.

Data Availability

No data were used to support this study.

Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this article.

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