Research Article

Application of Cloud Service in Smart Tourism Management Based on Weighted Average Algorithm

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Tourism has become the main force driving urban economic development. However, there are problems such as low utilization rate of tourism resources and inconsistency of tourism information. The new smart tourism management model can sense tourism resources, tourist information, tourism development, and other information in a timely manner through terminal devices such as the Internet. The core of smart tourism management is to obtain travel information of travelers through cloud service technology, organize travel information, and recommend personalized travel plans for travelers. Apply cloud services to smart tourism management, and use the weighted average algorithm to make regression predictions on passenger information. This paper compares and analyzes the application of cloud service based on the algorithm for calculating the weighted average and the application of ordinary cloud service in smart tourism management through experiments. The experimental results show that the cloud service by adding weights can improve the forecast of the traveler’s information by 36% and 22%, respectively, compared with the cloud service of the ordinary average algorithm. Also, the effect of tourists’ travel experience is 72.2% and 56.3%, respectively. In the forecast of tourism information in tourism resources, tourism economy, and tourism activities, cloud services by adding weights maintain stable economic growth and improve tourists’ tourism experience. The cloud service in the smart tourism management of the weighted average algorithm can formulate corresponding tourism marketing strategies through the integration and prediction of tourism information, enhance the growth of the tourism economy, and improve the tourism experience of tourists.

1. Introduction

With the development of society, the tourism economy has become one of the main economies in the urban economic development. Tourism marketing attracts tourists through various means and maximizes the development of tourism resources, but the effect is not very good. With the development of cloud computing and other information technology, intelligent tourism supported by cloud computing technology has become a new mode of tourism enterprise management. Through mobile Internet and other terminal devices, the travel information of travelers can be obtained, the travel information can be analyzed, and corresponding travel marketing plans can be formulated. Through the application of cloud services, smart tourism can improve the dissemination of tourism information, improve the utilization of tourism resources, and better analyze passenger information, so as to achieve the growth of the tourism economy. The core of cloud services in smart tourism applications is the analysis of tourism information. The weighted average algorithm is a method of calculating the weight of each index value, which can well predict and analyze the information in smart tourism and the future development trend. The application of cloud services in smart tourism management using the weighted average algorithm can improve the better analysis and prediction of tourism information and improve the wisdom of smart tourism, so this paper has research significance.

Cloud services have the ability to integrate resources, and relevant researchers apply cloud services to smart tourism management. Among them, Jin et al. applied cloud services to smart tourism management. Cloud services can well dispatch tourism resources and improve the efficiency of
tourism management [1]. Wu et al. research showed that the use of cloud services to integrate tourism system data can realize the sharing of tourism information resources [2]. Chen et al. research pointed out that cloud service can improve the response time of smart tourism management system and improve the efficiency of tourism management [3]. Lee and Hong pointed out that cloud services can handle complex tourism information problems in smart tourism management, which can improve the efficiency of tourism management [4]. According to Cui and Tan’s research, with the development of the tourism economy, cloud services can improve the processing ability of tourism information through the integration of tourism resources [5]. Cloud service application and smart tourism can improve the calculation of tourism information, but there is a lack of predictive analysis of tourism information.

The weighted average algorithm has simple and highly accurate predictive analysis capabilities, and many researchers have studied the application of the weighted average algorithm to cloud services in smart tourism management. Among them, Cheng S and Wang Z research found that the weighted average algorithm can cooperate with cloud services to analyze and predict tourism information in smart tourism management [6]. Wu et al. found that the cloud service of the weighted average algorithm can improve the processing and analysis ability of tourism data, so as to improve the efficiency of tourism management [7]. Paul Rajan’s research showed that the prediction of travel information through cloud services of the weighted average algorithm can improve the travel experience of travelers [8]. The research of Quadir and Vijayakumar showed that the cloud service’s information prediction accuracy in smart tourism management is greatly improved after the weighted average processing [9]. Li’s research pointed out that the cloud service of the weighted average algorithm can formulate corresponding tourism marketing through the prediction and analysis of tourism information to create a personalized tourism plan [10]. The cloud service of smart tourism management using the weighted average algorithm can effectively predict and analyze tourism information, so as to formulate corresponding tourism marketing plans, but there is a lack of comparative analysis.

We integrate tourism information resources in smart tourism through cloud services to achieve resource sharing and resource exchange. Then, we use the weighted average algorithm to analyze the tourism information and predict the future trend of tourism information. Innovation: (1) The weighted average algorithm is used to analyze the information under the cloud service in smart tourism management. (2) The experiment highlights the advantages of the weighted average algorithm in analyzing the information under the cloud service in smart tourism management by comparing whether to use the weighted average algorithm.

2. Application Method of Cloud Service in Smart Tourism Management

Smart tourism management refers to the use of communication, Internet, and other technologies to collect, process, and analyze the information of tourist attractions or tourists, and then, the analyzed information is used to promote the development of tourism [11]. Smart tourism management is a management model with cloud computing as the core. The model of smart tourism management is shown in Figure 1.

As can be seen from Figure 1, cloud computing is the core technology of smart tourism, which links tourists, tourism workers, tourist attractions, and relevant government units on the smart tourism management platform, through the sharing of tourism resources, to improve the utilization rate of tourism resources and optimize tourism management [12].

2.1. Cloud Service Technology. The underlying logic of smart tourism management is divided into the basic equipment layer, cloud service layer, module layer, and function layer. The functional layer is the module that interacts with users. All resource scheduling and information analysis depend on the processing of the cloud service layer [13]. The smart tourism management structure is shown in Figure 2.

Cloud service is to associate various departments of the system for smart tourism management to realize the sharing of data resources. The main technologies of cloud services are virtualization technology, resource deployment technology, and resource scheduling technology.

2.1.1. Virtualization Technology. Virtualization technology refers to virtualizing real resources and performing operations and processing through virtual devices. The virtual objects can be travel systems, tourism management system servers, and travel resources.

(1) Virtualization of Tourism System. Virtualization of tourism system is because the physical environment of the real tourism system is not on the same device, and the real physical tourism machine and the operating system can be separated through virtual technology. Tourism system virtualization is to solve the geographical isolation of physical machines, so that different physical devices can operate on the same system [14].

(2) Server Virtualization. Server virtualization is to divide a whole piece of tourism system server into many servers in theory, and different servers can realize different functions. Traditional physical multiple servers lead to low resource utilization due to a large number of servers. Virtualization of tourism system servers can improve resource utilization. The process of tourism server virtualization is shown in Figure 3.

(3) Virtualization of Tourism Resources. Tourism resource virtualization is to solve the problem of incompatibility of physical equipment in the smart tourism management system and build a smart tourism management cloud platform through tourism resource virtualization.

2.1.2. Resource Scheduling. Tourism resource scheduling is the use of resources in the tourism cloud service. Different users can schedule tourism resources, allocate resources
Member management
Attraction Management
Travel experience
Tourist behavior insight
Server installation updates on mobile
Attractions inquiry
Smart Navigation
Positioning monitoring

Unified management of cloud services

System hardware support (server, network)

Server virtualization

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Figure 1: Structure figure of smart tourism management.

Figure 2: Structure figure of smart tourism management.

Figure 3: Travel server virtualization.
reasonably, and improve the utilization of tourism resources. The tourism resource scheduling process is shown in Figure 4.

2.2. Weighted Average Algorithm. The weighted average algorithm is a method to analyze the predicted value of the variable in the future time through the known variable value and the number of occurrences of the variable in a period of time [15].

In the application of cloud services for smart tourism management, the cloud services are used to obtain tourism information, and the frequency of occurrence of each tourism information is obtained by observing the number of occurrences of each tourism information within a period of time. The result obtained after the weighted average of all travel information within this period can be used as the cloud service’s prediction of the information of smart travel management. The more accurate the travel information forecast, the higher the travel experience for travelers.

Let the travel information obtained by the cloud service in the smart travel management system be $U = (u_1, u_2, \ldots, u_n)$ during the period from time $t$ to time $(t + k)$, and the frequency of travel information appearing in this period is $M = (m_1, m_2, \ldots, m_n)$.

Then, the total number of tourist information from time $t$ to time $(t + k)$ is

$$A = m_1 + m_2 + \cdots + m_n. \quad (1)$$

In formula (1), $A$ represents the total frequency of travel information.

Simplify formula (1) to get

$$A = \sum_{a=1}^{n} m_a. \quad (2)$$

In formula (2), $m_a$ represents the number of times the $a$-th travel information appears.

Assuming that the predicted value of tourism information after $(t + k)$ is $V$, the formula of $V$ is expressed as

$$V = \frac{u_1 m_1 + u_2 m_2 + \cdots + u_n m_n}{A}. \quad (3)$$

The solution to the predicted value $V$ can also be obtained by calculating the weight $W = (w_1, w_2, \ldots, w_n)$ of each tourist’s information.

$$w_a = \left(\frac{u_a}{A}\right). \quad (4)$$

Therefore, the solution of the predicted value $V$ can also be expressed as

$$V = u_1 w_1 + u_2 w_2 + u_3 w_3 + \cdots + u_n w_n. \quad (5)$$

In formula (5), $V$ represents the predicted value of the weighted average.

The common method for solving the average is to add all the variables that appear and then divide by the frequency of the total tourist information. The solving process of the common average method is as follows:

$$V_1 = \frac{u_1 + u_2 + \cdots + u_n}{n}. \quad (6)$$

In formula (6), $V_1$ represents a predicted value representing an ordinary average.

Because in smart tourism management, the frequency of occurrence of each tourism information is different, and the ordinary average solution method is only suitable for solving the situation where the frequency of occurrence of all elements is the same. The weighted average algorithm shown in the figure adds weight factors, and when the cloud service
predicts and analyzes the tourism information of smart tourism management, it can accurately predict the tourism information at the next moment [16].

That is,

\[
\begin{align*}
R(V > V_1), & \quad u_i \neq u_j, \\
R(V = V_1), & \quad u_i = u_j. 
\end{align*}
\text{(7)}
\]

In formula (7), \( R(V > V_1) \) indicates that the prediction accuracy of the weighted average is greater than that of the ordinary average, and \( R(V > V_1) \).

3. Experimental Design and Results

3.1. Experimental Data. In order to test the application of cloud services by adding weights in smart tourism management, the experiment needs to obtain indicators that can analyze the performance of smart tourism management [17]. The indicator was obtained by means of a questionnaire survey of smart tourism managers. The investigation process is as follows: 5 tourist parks adopting the smart tourism management model were randomly selected, and 200 smart tourism management staff and tourists were surveyed. Investigate what they think can improve the efficiency of smart tourism management, the effect of tourism experience, or the indicators that can reflect the success of smart tourism management. The survey results are shown in Table 1.

In Table 1, the evaluation index with the highest proportion of the number of people is the information and tourism economy of tourists, accounting for 84%, and the number of tourism staff accounting for 17%. Since the proportion of the first four evaluation indicators in Table 1 is more than 75%, the proportion of the latter three evaluation indicators is less than 50%, and the four indicators of passenger information, tourism resources, tourism economy, and tourism activities are selected as the indicators for evaluating the performance of cloud services applied to smart tourism management [18].

3.2. Experimental Design. The experiment tests the performance of smart tourism management through cloud services by adding weights. The experiment will set up experimental groups and controls for testing.

The standard of the experimental group is as follows: the cloud service uses the weighted average algorithm in smart tourism management. The data of the first four evaluation indicators in Table 1 are analyzed and predicted.

The standard of the control group is as follows: the cloud service adopts the common average algorithm in the management of smart tourism. The data of the first four evaluation indicators in Table 1 are analyzed and predicted.

If people want to compare the application of cloud services in the smart tourism management of the weighted average algorithm, people need to control the same variables except the retest algorithm. Therefore, the comparison should be based on the premise of having the same smart tourism management model, the same tourism resources, and the same passenger flow [19].

Before conducting an experimental analysis on the four evaluation indicators of passenger information, tourism resources, tourism economy, and tourism activities, it is necessary to set the observation values of these indicators. The setting of the observation value is based on the importance of tourists and tourism workers to tourism information. The observation value setting of the evaluation index is shown in Table 2.

The experiment investigated 20 smart tourism management parks with cloud service applications in January 2016. Among them, the cloud services of 10 parks used the weighted average algorithm for predictive analysis while the cloud services of the other 10 campuses use common averaging algorithms for predictive analysis. Through the prediction of the two algorithms, the economic changes of the tour park and the tourist experience effect of the tourists are observed to judge the application performance of the cloud service of the weighted average algorithm in the smart tourism management [20–22].

3.3. Experimental Results

3.3.1. Passenger Information. Through the survey, the frequency of occurrence of passenger information (housing, transportation, shopping, scenery, food, entertainment) in January 2016 was as follows: 600, 1000, 1650, 3050, 2050, and 2750. Then, the total frequency of passenger information is calculated by formula (1) to obtain the total frequency \( A = 11100 \). Using formula (6) to find the predicted value of the ordinary average algorithm is \( V_1 = 3 \), and the weights for passenger information are as follows: 0.054, 0.090, 0.149, 0.275, 0.185, 0.248. Using formula (5) to calculate the predicted value of the weighted average algorithm is \( V = 4 \). The forecast of the cloud service average way of the common average shown is to strengthen the collection of traveler shopping information, while the cloud service prediction by adding weights is to strengthen the information collection of tourists’ food. Figure 5 shows the predicted effects of the control group and the experimental group on the tourism park.

In Figure 5, the cloud service forecasting passenger information by adding weights can make the economic growth rate of the tourist park reach 36% after 6 months, while the economic growth rate of the ordinary average cloud service is 24%. Also, in terms of the tourism experience effect, the tourism experience effects of the two methods are 72.2% and 56.3%, respectively. Therefore, in the forecast of passenger information, cloud services based on weighted average can improve the economic growth of tourist parks and the experience effect of tourist travel.

3.3.2. Travel Resources. The frequency of occurrence of tourism resource information (animal resources, meteorological resources, architectural resources, water resources, landscape resources, and site resources) in the survey in January 2016 was 600, 800, 1200, 1400, 1600, and 4000, respectively. Then, the total frequency of tourism resource information is calculated to get \( A = 9600 \). Using formula (6)
to find the predicted value of the ordinary average algorithm is $V_1 = 3$, and the weights for the tourism resource information are 0.063, 0.083, 0.125, 0.146, 0.167, and 0.417. Using formula (5) to calculate the predicted value of the weighted average algorithm is $V = 5$. The predictions of cloud services based on the common average algorithm shown are building resources, while the predictions of cloud services by adding weights are geomorphic resources. Figure 6 shows the predicted effects of the control group and the experimental group on the tourism park.

In Figure 6, the cloud service forecasting tourism resources by adding weights can make the tourism economy continue to grow up to 24%. The average cloud service economy has been growing slowly and regressing for a period of time. In terms of the tourism experience effect, the tourism experience effects of the two methods are 38.3% and 52.5%, respectively. Therefore, in terms of the forecast of tourism resources, cloud services based on weighted average can improve the economic growth of tourist parks and the experience effect of tourist tourism.

3.3.3. Tourism Economy. Similarly, the frequency of occurrence of tourism economic information (accommodation economy, transportation economy, shopping economy, tourism economy, food economy, and entertainment economy) is 400, 400, 1200, 3400, 3600, and 1000, respectively. Then, the total frequency of tourism economic information is calculated to get $A = 10000$. The predicted value of the ordinary average algorithm using formula (6) is

| Numbering | Index                        | Number of people | Proportion (%) |
|-----------|------------------------------|------------------|----------------|
| 1         | Passenger information        | 168              | 84             |
| 2         | Travel resources             | 156              | 78             |
| 3         | Tourism economy              | 168              | 84             |
| 4         | Travel activity              | 152              | 76             |
| 5         | The size of the tourist park | 104              | 52             |
| 6         | Tourism park planning        | 96               | 48             |
| 7         | Number of tourist staff      | 34               | 17             |

| Observations | Passenger information | Travel resources | Tourism economy | Travel activity |
|--------------|-----------------------|------------------|-----------------|----------------|
| 1            | Housing               | Animal resources | Accommodation economy | Housing activity |
| 2            | Transportation        | Meteorological resources | Transportation economy | Traffic activity |
| 3            | Shopping              | Building resources | Transportation economy | Shopping economy |
| 4            | Landscape             | Water resources  | Tourism economy  | Scenic activities |
| 5            | Food                  | Geomorphic resources | Food economy | Eating activities |
| 6            | Entertainment         | Site resources   | Entertainment economy | Entertainment |

Figure 5: Graph of passenger information comparison results. (a) Economic changes in tourist parks. (b) Tourism experience effects.
The weights for the tourism economic information are 0.040, 0.040, 0.120, 0.340, 0.360, and 0.100, and the predicted value of the weighted average algorithm using formula (5) is $V = 4$. The forecast of the cloud service average way is shown as the shopping economy, while the forecast of the cloud service by adding weights is the tourism economy. Figure 7 shows the predicted effects of the control group and the experimental group on the tourism park.

In Figure 7, the cloud service prediction by adding weights can keep the tourism economy growing as a whole, and the average cloud service economy begins to decline in the third month. In terms of tourism experience effect, the tourism experience effects of the two methods are 39.8% and 49.7% respectively. Therefore, in the forecast of the tourism economy, cloud services based on a weighted average can improve the economic growth of tourist parks and the experience effect of tourist tourism.

3.3.4. Travel Activity. The frequency of occurrence of tourism activity information (housing activities, transportation activities, shopping activities, scenic activities, eating activities, entertainment activities) in January 2016 was investigated as follows: 200, 200, 1000, 3600, 2400, and 2400, respectively. Then, the total frequency of tourism activity information is calculated to get $A = 9800$. The predicted value of the ordinary average algorithm using formula (6) is $V_1 = 3$. The weights for tourism activity information are, respectively, 0.020, 0.020, 0.102, 0.367, 0.245, and 0.245, and the predicted value of the weighted average algorithm using formula (5) is $V = 5$. The prediction for the cloud service average way is shown as shopping activity, while the
prediction for the cloud service by adding weights is for eating activity. Figure 8 shows the predicted effects of the control group and the experimental group on the tourism park.

In Figure 8, the cloud service forecasting tourism activities by adding weights and the ordinary average algorithm can maintain the overall growth of the tourism economy. However, the growth rate of the tourism economy under the cloud service by adding weights is faster. In terms of the tourism experience effect, the tourism experience effects of the two methods are 49.3% and 61.0%, respectively. Therefore, in the forecast of tourism activities, cloud services based on weighted average can improve the economic growth of tourist parks and the experience effect of tourist tourism.

4. Conclusion

Through the application of cloud services in smart tourism management based on the weighted average algorithm and the ordinary average algorithm, this paper compares the four aspects of passenger information, tourism resources, tourism economy, and tourism activities. Experimental results show that the cloud service by adding weights can increase the growth rate of the tourism economy and improve the tourist experience effect in terms of predicting the information of tourists. In terms of cloud service forecasting tourism resources, the tourism economic growth rate based on the weighted average method is at least 12% higher than that of the ordinary average method, and the average tourism experience effect is 14.2% higher. In terms of forecasting the tourism economy and tourism activities, cloud services based on the weighted average algorithm can always maintain a stable economic growth rate and a better tourist experience effect. The cloud service in smart tourism based on the weighted average algorithm can better carry out tourism marketing through the integration and prediction of tourism information, so as to improve the tourists’ sense of tourism experience and promote the development of the tourism economy. The application of cloud services is not only reflected in the integration and prediction of travel information but also included intelligent marketing measures such as recommending personalized travel plans. Therefore, expanding the application of cloud services in smart tourism management will be the direction of future research.

Data Availability

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

Conflicts of Interest

The authors declare that there are no conflicts of interest.

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