Great achievements have been made in the construction of new countryside, and rural tourism is an emerging industry. Rural tourism is an industry developed during the construction of new countryside, which promotes the development of rural economy. More and more people are going to the countryside to experience the life and scenery of the countryside. For managers of rural tourism, the dynamic monitoring of rural tourism is an important part. It can monitor the participation of tourists, which also can realize the monitoring of tourist satisfaction with attractions. However, managers only rely on traditional means to dynamically monitor the development of rural tourism, which consumes a lot of human and financial resources. This research uses big data technology to realize the dynamic monitoring and management of rural tourism. According to existing studies, big data technology can dynamically monitor the heat of rural tourism, providing better tourism experience and participation for tourists. Long short-term memory (LSTM) recurrent neural network and convolutional neural network (CNN) can predict the dynamic development process of rural tourism industry well, and the dynamic values of related factors have a good linear correlation.

1. Introduction

The tourism industry has been developed for many years, it also promotes the development of the country's economy, and it also improves the pace of people life [1]. In recent years, the process of new rural construction has achieved rapid development, which has led to the rural tourism development. The development of rural tourism will not only boost the local economy, and it will also raise awareness of the diversity of tourism [2, 3]. The development of tourism will not be limited to landscapes. The more people begin to pursue the scenery and lifestyle of rural tourism. This is also a phenomenon caused by people living in cities for a long time [4, 5]. Rural managers can develop the rural tourism industry based on the historical and cultural characteristics of the countryside and the characteristics of geographical scenery. For local residents, the development of rural tourism will improve their way of life, it can also create more forms of economic development, which will promote the development of multi-form economies in the countryside, and it will improve the overall economy of the countryside level [6, 7]. For travelers, the development of rural tourism will provide travelers with more choices and more ways to experience life. For the government, the development of rural tourism will provide more jobs and more fiscal revenue [8]. Overall, the development of rural tourism will bring more advantages, but it also has many disadvantages. This requires the managers of the rural tourism industry to carry out effective and good management [9].

If rural tourism can be managed effectively, there will be many benefits. However, the failure of management will lead to the disadvantages of rural tourism. This requires managers to be able to achieve dynamic monitoring and management of rural tourism [10, 11]. Managers can formulate effective measures according to the phenomenon of dynamic monitoring and management to prevent the occurrence of malpractices, which will be a necessary and meaningful task. The dynamic monitoring of the rural tourism industry needs to monitor the participation of tourists, which also needs to find out the types of attractions for tourist preferences.
2. Related Work

Rural tourism industry is a relatively popular industry, and its development will promote the development of rural economy. Many researchers have done a lot of research on the related factors of rural tourism industry. Zhou [21] also believed that rural tourism has greatly promoted the economic development of rural areas. He believed that the problems such as unreasonable development and low management efficiency of rural tourism limit the competitiveness of rural tourism. He used big data technology and coupling theory to analyze the current situation and defects of rural tourism. The study found that rural tourism has a positive correlation with efficiency, competitiveness, and environmental index. Under the condition that the environment and competitive power are consistent, the economic benefits of rural tourism will increase by about 30%. Li [22] used SWOT and big data theory to study the feasibility of e-commerce technology in promoting rural tourism. Big data theory can well map the nonlinear relationship between e-commerce and rural tourism industry. At the same time, he used SWOT analysis of the rural tourism industry in the relevant factors, which will find e-commerce to rural tourism industry opportunities. The results show that e-commerce technology can also promote the development of rural tourism industry, the two kinds of interaction. In the early days, the traditional SWOT analysis method was adopted by many researchers to analyze rural tourism. Zhao and Zhou [23] believed that information barriers and market competitiveness have hindered the development of the rural tourism industry. He has conducted related research on the rural tourism industry using information Internet technology and big data technology. It also uses SWOT method to analyze the feasibility of e-commerce technology in rural tourism industry. The research results show that e-commerce technology can solve the problems of marketing and market competitiveness in the rural tourism industry. E-commerce technology can promote the development of rural tourism industry, which can find a more suitable route for local residents. With the development of machine learning algorithms, researchers began to use simple machine learning algorithms to study the factors related to rural tourism. Xu [24] mainly considers issues related to the sustainable development of rural tourism. It uses back propagation neural network (BPNN) method and spatial autocorrelation method to study the spatial variation of rural tourism. It also takes into account the social environment development and the relationship between population development and economic development. The research results show that the evaluation error of the BPNN method is within 0.08% of the actual error range, which proves the feasibility of the BPNN method in
evaluating the sustainable development of rural tourism. Bakdur et al. [25] combined Japan rural tourism as a research object, and it used Monte Carlo method and Bayesian method to study people’s interest and expectation for rural tourism. Through the analysis of these models, the impact of rural tourism on the Japanese economy and the reasons for the economic decline can be obtained. This research is based on the Apache Spark platform for related exploration. Zhu and Jian [26] believed that the spatial distribution of rural tourism industry and weak market competition are relatively big problems. Aiming at this problem, he used the neural network technology to study the spatial distribution of rural tourism industry. He also uses convolutional neural network to solve the problem of spatial feature extraction. The results show that the accuracy of the model is 97.69%. This convolutional neural network model can well predict the spatial distribution characteristics of rural tourism. Compared with other models, the accuracy of this model can be improved by 2.13%. Tang [27] found that the current rural tourism industry needs to have certain characteristics in order to enhance its competitiveness, and traditional methods cannot predict the impact of changes in the market environment on the rural tourism industry. He used the BP neural network method to establish the nonlinear system relationship of the rural tourism industry, and it also analyzed the time evolution characteristics of the rural tourism industry. It can be seen from the above research that many scholars have conducted researches on rural tourism by using big data technology, but there is still no relevant research on dynamic monitoring of the heat of rural tourism. These studies are mainly aimed at the market competitiveness of the rural tourism industry and the impact of spatial layout. This research mainly uses CNN and LSTM methods to study the dynamic monitoring process and factors of rural tourism industry. From the above discussion, the main contributions of this paper are as follows:

(1) This paper is the first to integrate two or more big data technologies to monitor the heat of rural tourism.

(2) This paper can realize the dynamic monitoring of rural tourism hot spots, not only has strong theoretical innovation but also has certain practical value.

3. The Application of CNN Method and LSTM Method in Rural Tourism

3.1. The Integration of Big Data and Rural Tourism. Big data technology can solve nonlinear data processing tasks in the process of dynamic monitoring of rural tourism [28]. Big data technology includes some algorithms such as CNN, LSTM, and machine learning, which has been widely used in many fields [27, 28]. These algorithms can predict and regress the data in the process of dynamic monitoring of rural tourism very well. The dynamic monitoring of rural tourism will include factors such as tourism participation, passenger preferences, and changes in spatial layout. CNN and LSTM technology will extract the characteristics of these rural tourism data to realize the dynamic monitoring of rural tourism [29]. The basic meaning of big data technology is to process a large amount of nonlinear data. It can mine the characteristics of the data from the massive data, and it can also complete the mapping relationship between the data [30]. Its capabilities are mainly related to the capabilities of computers and hardware. For the rural tourism industry, big data technology is capable enough to deal with the nonlinear relationship between these data.

3.2. The System Design and Introduction to CNN Algorithm. The main purpose of this research is to realize the dynamic monitoring process of rural tourism industry through CNN and LSTM technology. It not only needs to collect dynamic data of the rural tourism industry, but also needs to process and forecast these data. Ultimately, it can realize the layout adjustment of the rural tourism industry according to the relationship of dynamic monitoring data. Figure 1 shows the workflow of dynamic monitoring of rural tourism industry using CNN and LSTM algorithms. The data set of this study comes from the relevant data of a rural tourism industry in Anqing. The data will be cleaned and processed. These data will include three factors: tourist participation, tourist preferences, and spatial layout changes in the rural tourism industry. These data will be fed into the CNN. First, CNN performs spatial feature extraction on these rural tourism industries. These data are then fed into the LSTM network layers in the form of time series. These data will be extracted with temporal features in the LSTM network. This system will help the managers of the rural tourism industry to understand the dynamic monitoring process and make decisions.

CNN has been successfully applied in many fields, and its main advantage is the extraction of spatial features. Figure 2 shows the workflow of CNN. CNN mainly includes convolutional layer, pooling layer, activation function, loss function, and other structures. The convolutional layer is a key part of CNN, which completes the feature extraction process for factors related to dynamic monitoring of rural tourism. It mainly uses the filter and the transformation of the sliding step size to realize this process. The main purpose of the pooling layer is to reduce the amount of parameter computation in the iterative process of CNN, which mainly includes up-sampling and down-sampling methods. Most CNN mainly achieves the purpose of the pooling layer through the maximum pooling layer and the average pooling layer method. The activation function is mainly to realize the mapping of nonlinear relationship.

The operation process of CNN mainly includes two processes: forward propagation and back propagation. The optimization process of CNN is similar to that of perceptrons, and it is also an optimization process that requires weights and paranoia. The optimization process for weights and paranoia is shown in equations (1) and (2). The difference between CNN and perceptron operation is that it has a weight sharing mechanism.
3. The Introduction of LSTM Algorithms. The dynamic monitoring process of the rural tourism industry not only involves the extraction of spatial features, but also the extraction of temporal features is a more critical process, because dynamic monitoring is a process that changes with time, which requires the advantages of the LSTM method. The LSTM algorithm is mainly used in the field of speech recognition, which can memorize historical information. The LSTM algorithm can complete the time-related feature extraction very well. Figure 3 shows the workflow of LSTM. As can be seen from Figure 3, the structure of LSTM is quite different from that of CNN. This is because the LSTM structure contains a gate structure, which is why it can memorize historical state information. It mainly includes structures such as input gate, forget gate, and refresh gate, which can complete the fusion of historical state information and input information. The dynamic monitoring process of rural tourism industry is a process with strong time characteristics. This is because the dynamic monitoring process of the rural tourism industry is a continuous process with time.

The equation (6) shows how the LSTM forget gate is calculated. The forget gate will selectively forget and input the historical state information. It will filter according to the size of the weight, and the data with larger weight value will enter the input gate of LSTM through the forget gate. Data with smaller weights will be filtered.

\[ f_t = \sigma(w_f \cdot [h_{t-1}, P_t] + b_f). \]  

Equation (7) shows the input gate structure of LSTM, which needs to complete the input of historical state information and current state information. At the same time, it needs to assign different weights to the two state information. Equation (8) shows the operation of the activation function.

\[ i_t = \sigma(w_i \cdot [h_{t-1}, P_t] + b_i), \]  

Equation (8) shows how the refresh gate of LSTM is calculated. The refresh gate will assign weights to the historical state information and the current state information, so that it can pass the output gate better.

\[ \overrightarrow{C_t} = f_t \times \overrightarrow{C_{t-1}} + i_t \times \overrightarrow{C_t}. \]  

The output gate is a gate structure that outputs historical state information and current state information. Equation (10) shows how the output gate is calculated. Equation (11) shows the operation of the activation function. The activation function can nonlinearize the weights and biases. Without an activation function, the LSTM method is difficult to map features.

\[ L = MSE(q_{\text{real}}^{1}, q_{\text{pre}}^{1}) = \frac{1}{nm} \sum_{k=1}^{N} \sum_{j=1}^{M} (q_{kj}^{\text{real}} - q_{kj}^{\text{pre}})^2. \]  

The basic method of deep learning is the gradient descent method, and the weights and biases are used to find the optimal weights and biases through the gradient descent method. The optimization method of weights and biases is the process of derivation operation. Equations (3) and (4) show the derivation process of the weights and biases.

\[ \Delta w_{ji} = -\eta \frac{\partial E}{\partial w_{ji}}, \]  

\[ \Delta u_{ij} = -\eta \frac{\partial E}{\partial u_{ij}}. \]  

The iterative process of CNN is the process of continuously minimizing the loss function. The loss function is calculated by calculating the difference between the predicted value and the actual value. This study uses the loss of mean square error MSE. The operation process of MSE is shown in equation.
O_t = \sigma \left( w_o \cdot \left[ h_{t-1}, P_t \right] + b_o \right), \quad (10)

\bar{h}_t = O_t \times \tanh \left( \overrightarrow{C_t} \right). \quad (11)

The dynamic monitoring process of the rural tourism industry will include factors such as passenger participation, passenger preferences, and changes in spatial layout. It can be seen that there are great differences in the data of these factors. At the same time, there may be missing and duplication of data. This requires data cleansing and data processing workflows. Data cleaning will add and delete data sets. Data processing will process the data of the data set into data of the same distribution and the same interval, which will facilitate the operation of CNN and LSTM algorithms.

4. Result Analysis and Discussion

The data used in this study come from the relevant data of a rural tourism industry in Anqing which includes data on passenger participation, passenger preferences, and changes in spatial layout. This study will use CNN and LSTM to dynamically monitor and predict the three factors of the rural tourism industry. Figure 4 shows the dynamic change heat map at a certain moment. It can be seen from Figure 4 that the tourists are concentrated in the fringe areas of the tourist attractions, while the distribution of tourists in the central area of the tourist attractions is relatively sparse. Generally speaking, some representative cultural landscapes will be arranged in the central area of rural tourist attractions. In the fringe areas of rural tourist attractions, there will be some snack streets and cultural performances. The places where tourists are concentrated are mainly distributed in snack streets or cultural performance areas, which has certain guiding significance for rural tourism managers. Based on the results of the heat map, village managers can arrange more performances or set up more scenic spots in heat-intensive areas to attract more tourists. This not only will improve the dissemination of local culture through rural tourism, but can also increase local economic income. In the central area of tourist attractions, the low concentration of tourists here may also be related to the change of time.

Tourists’ preference for rural tourist attractions is the key to the success of the rural tourism industry. It will attract more tourists by developing and building more tourist-like attractions. For the dynamic monitoring of the rural tourism industry, the preference of tourists is also crucial, which can be reflected by the concentration of tourists. Figure 5 shows the prediction error of passenger preference using CNN and LSTM methods. From Figure 5, it can be seen that all the prediction errors of tourist preferences are within 3%, which shows that the CNN and LSTM methods can well predict the factors of tourist preferences in the rural tourism industry. The larger error is mainly distributed in the central area of tourist attractions, and the error in the edge area is relatively small. This may be because tourists are more distributed in the fringe areas at different times. In the central area of the scenic spot, the distribution of tourists here will vary greatly with the time, which is also difficult to complete the prediction of passenger preferences for the LSTM method.

Linear correlation is an intuitive statistical parameter that reflects the effect of prediction. It is a way of using \( y = x \) as a measure. Figure 6 shows the linear correlation distribution of passenger engagement. Tourist participation can reflect the popularity of rural tourism projects, and rural tourism managers can find problems in rural tourism projects through the dynamic changes in tourist participation. Therefore, accurate prediction of passenger participation is also the key to dynamic monitoring of rural tourism projects. It can also be seen from Figure 6 that the prediction of passenger participation has a good effect. The
data points of passenger participation are basically distributed on both sides of the \( y = x \) function, and the distance between them is relatively close. The linear correlations of the coefficients with smaller passenger participation are poorer than those of the larger coefficients, but their prediction performance is better. It can meet the dynamic monitoring requirements of rural tourism industry managers.

The curve graph can more intuitively reflect the change of tourist participation over time, which can also reflect the dynamic monitoring effect of rural tourism. Figure 7 shows how the predicted and actual values of passenger engagement change over time. In general, CNN and LSTM methods can predict passenger participation well, and the difference between the predicted value and the actual value is relatively small. Although there are relatively large fluctuations in passenger participation over time, the CNN and LSTM methods can well predict the changes in passenger participation whether it is the trough or the peak area of the numerical distribution. Tourist participation is closely related to the changes of rural tourist attractions. CNN and LSTM can better predict the situation of tourist participation. Objectively speaking, CNN and LSTM methods can better complete the task of dynamic monitoring of rural tourism.

In order to further illustrate the strong temporal characteristics of rural tourism dynamic monitoring, this study compared the prediction accuracy of the single CNN method and the CNN-LSTM method for rural tourism dynamic monitoring. Figure 8 shows the prediction errors of rural tourism factors using a single CNN method. It can be seen from Figure 8 that the CNN method can better match the actual influencing factors of rural tourism dynamic monitoring. The largest prediction error does not exceed 3%. The smallest prediction error is only 1.26%. This part of the error may originate from the time difference less correlated features. Figure 9 shows the prediction errors of relevant features for dynamic monitoring of rural tourism by the hybrid CNN-LSTM method. It can be clearly seen from Figure 9 that the prediction errors are smaller compared to the single CNN method. This shows that the CNN-LSTM method is more suitable for the prediction of the dynamic monitoring task of rural tourism. The largest prediction error is only 2.32%. The smallest prediction error was only
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