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Research on intelligent tourism management based on wireless network development

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Abstract. With the development of China's Internet, wireless network technology has been upgraded, and the rapid development of wireless network technology requires more advanced intelligent information processing technology to match. Therefore, based on the development of wireless network, this paper proposes intelligent tourism Management scheme. Firstly, the Wide & Deep Learning exploratory tourism route recommendation model was constructed. Then the Wide & DSSM exploratory recommendation algorithm combining the traditional recommendation algorithm with the depth model was proposed. Finally, the model and algorithm were tested through experiments. In this paper, the algorithm was used to study the semantic space vectors of both the user dimension and the Travel line dimension, and the data of the user dimension was fully utilized, which brought a significant improvement to the performance of the recommended system.

Keywords: Wireless network, intelligent tourism, recommendation, tour route

1. Introduction

With the extensive application of information technology in the tourism industry, intelligent tourism has come into being and has been paid more and more attention. Intelligent tourism is an important way for China's tourism industry to transform from traditional service industry to modern service industry, and also an important support for China to move forward from a large tourism nation to a strong tourism nation [1]. The rapid and healthy development of modern tourism needs to rely on the power of modern information technology. Unstoppable, the construction and development of intelligent tourism will eventually be reflected in the three levels of tourism services, tourism management, and tourism marketing [2]. First of all, through information technology, tourism companies can achieve more timely supervision and management and real-time control [3]. Secondly, they can better maintain the order of tourism, strengthen the links between governments, tourism companies, tourists, scenic spots and local residents, effectively integrate tourism resources and then realize the management of scientific tourism. Through its unique technology platform, intelligent tourism has promoted tourism enterprises to build their new organizational model with the core of e-commerce [4].

Based on the above background, on the basis of the development of wireless network, this paper puts forward a set of Intelligent Tourism Management scheme. Combining with Intelligent Tourism management, this paper proposes an algorithm for pre-screening travel routes, constructs an exploratory travel route recommendation model based on wide-area in-depth learning, and then combines the traditional recommendation algorithm with the depth model, proposes an additional recommendation algorithm based on wide DSSM, and uses this algorithm to study the semantic space vectors of

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user dimension and itinerary dimension in order to improve the performance of tourism. The performance of tourist route selection recommendation for passenger demand.

The innovation of this research lies in that, based on the perspective of intelligent tourism, the relationship between Intelligent Tourism and tourism system and its innovative role in tourism system are discussed in depth. Combining with the application of Internet of Things technology under the development of wireless network, an exploratory tourism route recommendation model of wide-area in-depth learning is constructed, which is also an innovation of the whole tourism system and a promotion of tourism route. The organizational structure, constituent elements, motive force, mechanism, form and function of system innovation of recommendation model are analyzed in depth.

Based on the development of wireless network, this paper studies the application of Intelligent Tourism Management technology, which is divided into five parts. The first part introduces the background, research methods, innovations and research framework of this study; the second part summarizes the research status of wireless network technology application, which lays a theoretical foundation for this study; the third part proposes an algorithm for pre-screening of tourism routes combined with Intelligent Tourism management, and constructs an exploratory tourism route recommendation model of wide-area in-depth learning. The fourth part combines the traditional recommendation algorithm with the depth model, and proposes a new recommendation algorithm based on wide DSSM, and uses this algorithm to study the semantic space vector of user dimension and run-length dimension. The experimental results show that the model accurately grasps user preferences, but with the increase of the number of recommendations, user preferences are over-generalized, and users recommend. Tourist routes are generally not interested; the fifth part summarizes the full text, points out the shortcomings of this study, and makes prospects for the future.

2. State of the art

Today's wireless networks have become more involved in enterprise information services than simply satisfying users' access needs. The future wireless network will have stronger anti-jamming capability, code division multiple access capability, and high-speed scalability. The development direction is mainly the following three: access flexibility, online security, wireless network and limited network integration [5]. Therefore, the further development of wireless network will be inseparable from the support of data. On the other hand, because of its nonlinearity, input-output mapping, adaptability, fault tolerance, high speed parallelism and self-learning habit, neural network provides important technical support for the development of wireless communication [6]. Deep Learning, on the other hand, can be developed on the basis of neural networks and adopts the structure of hierarchical networks. In the 2006, some scholars proposed an effective method to establish multilayer neural networks on unsupervised data, to put it simply, there are two steps, one is to train one layer of network at a time, the other is tuning, so that the original represents x up to the advanced representation of r and the advanced represents r down Generation x ' are as consistent as possible [7]. The first step is to build one layer of neurons at a time, which is to train a single layer of network. When all the layers have been trained, Hinton uses the Wake-sleep algorithm for tuning. The weights of other layers except the topmost layer are changed into bidirectional, so that the topmost layer is still a single layer neural network, while the other layers are transformed into graph models [8]. The upward weighting is used for "cognition" and the downward weighting is used for "generation". Then use the Wake-sleep algorithm to adjust all weights. Make the cognition and generation agree, that is, to ensure that the topmost layer of the build is able to recover the underlying node as correctly as possible. For example, a node in the top layer represents a human face, so all images of the face should activate the node, and the resulting image should be able to represent an approximate face image. The wake-sleep algorithm is divided into two parts, waking and sleeping.

3. Methodology

3.1. Pre-screening algorithm for tourist routes

Intelligent tourism, also known as smart tourism, is the use of cloud computing, things networking and other new technologies, through the Internet/mobile Internet, with the help of portable terminal Internet equipment, active perception of tourism resources, tourism economy, tourism activities, tourists and other aspects of information, timely release, so that people can timely understand this information, timely arrangements and adjust work and travel plans In order to achieve the various types of tourism information intelligent perception, convenient use of the effect. The construction and development of intelligent tourism will eventually be embodied in the four aspects of tourism experience, tourism management, tourism service and tourism marketing. The current tourism app has been able to better realize the combination of intelligent tourism and wireless network. For intelligent tourism, it is very important to combine with large data to realize tourism preference collection and recommendation. For each round of recommendations, if the scores of user preferences for each tour route of the travel route data set library are calculated, not only the hardware resource requirements are high, but also the time cost is very large. In fact, after each round of user searches for keywords in the app, a preliminary screening of the travel route database can be performed based on these search keywords, and those travel routes that are ranked behind have already had a small correlation with the user search keywords, thus there is no need to spend hardware costs and time costs to calculate their preferences with the user's distance. Information retrieval has been a very mature area of development, where we default to use the TF-IDF algorithm to calculate the word representation to match the most relevant to the Search keyword travel routes, of course, can also choose BM25 algorithm to generate a candidate set list.

$$\alpha_{query} = tf(t,d) \times idf(t,d) = [1 + \log(f_{(t,f)})] \times \log\left(\frac{D}{n_t}\right) \quad (1)$$

Taking TF-IDF as an example, the inverted index is constructed for abstracts, titles and keywords. User query sentences set weights for the summaries, titles and keywords respectively (by manually returning results, subjectively setting parameters), and the sum of the scores of each part is weighted. This article believes that the title of the article is the most important for all the content of the travel route, followed by the abstract and the smallest keyword. Therefore, the formula used in this paper is as follows:

$$\alpha_{query} = 2 \times \alpha_{keywords} + 3 \times \alpha_{abstract} + 5 \times \alpha_{title} \quad (2)$$

$$\alpha_r = 3 \times \alpha_{newquery} + \alpha_{oldquery} \quad (3)$$

Among them, [2, 3, 5] represent the importance of different parts of tour routes. In this paper, we think that in the process of retrieval, the importance of title is the most, followed by content, and the importance of keywords is the least. In this way, based on the TF-IDF, we have a preliminary screening of the tourist Route library and get a candidate set. You only need to sort this candidate set using the WIDE&DSSM algorithm.

Before the Wide & DSSM algorithm is formally built, we first have to process the text information of the travel line into the input required by the model. This part of the work is done in the data generation system. In this paper, the data generation system is divided into two Wide dimensions and the Deep dimension parts respectively. The features of the Wide model consist of the theme features of the tourist route, while the Deep model uses the hidden factor vector of the Word2Vec learning travel route content (i.e., the travel route content is mapped to a high dimensional space, and the high dimensional space vector is used to represent the textual information). After the Data Generation system has processed the travel route set, we have obtained the feature vector of the Wide model and the high-dimensional space vector representing the content of the text in the Deep model. These results will be used as an input to the Wide & DSSM model. Eventually, a user's preference for travel routes will be scored, and the travel route recommendation list will be obtained by sorting the scores. The structure of the Wide & DSSM algorithm is as follows:

The characteristic of the Wide is the subject characteristic of the course $\delta_c = [v_1, v_2, \ldots, v_3]$, and its feature vector is represented as δ_{wide}.

$$\delta_{wide} = \delta_c = [v_1, v_2, \ldots, v_3] \quad (4)$$

The linear regression model used by the Wide dimension has a prediction function of:

$$y = w^T \delta_{wide} + b \quad (5)$$

The weight vector of the feature represented by w, b is biased. In this paper, the optimizer used in the Wide model is the FTRL algorithm, and in order to prevent the L1 regularization, the deep model consists of two neural networks of user dimension and travel line dimension, and the input vector of the neuron network of the user dimension is composed of three parts.

$$\delta_{deep\_user} = concate(\delta_k, \delta_m, \delta_i) \quad (6)$$

Among them δ_m represents a professional mapping vector, δ_i is a mapping vector of research interest, and δ_k is a mapping vector of user preference keywords. The user preference keywords consist of two parts, one is that the user searches for keywords; the other is that the keywords of the rated articles are weighted(the weight is the user's rating), and the top five keywords are taken.

$$\delta_i = \delta_{query_{keywords}} + \delta_{top\_5(rating\ keywords)} \tag{7}$$

In this paper, the recommendation of the route is converted into a multi-classification problem, and the user's preference for the travel route is predicted by judging the category (1 to 5 points) of the route to which the travel route may belong. The prediction function of the model is:

$$p(Y = i\,|x) = \sigma(\omega_{wide}^T \times x_{wide} + \omega_{deep}^T a^{(lf)} + b) \tag{8}$$

Here Y is the score category to which the route belongs, and ω_{deep} is the weight matrix in the model. $a^{(lf)}$ is the activation value of the last hidden neuron. The objective function of the model is:

$$L_i = -\log \frac{e^f yi}{\sum_j^K e^j} \tag{9}$$

Here $K = 5$, the model adopts the joint training method, which is to optimize the feature weight vector of the Wide model and the deep model at the same time. The algorithm inherits the advantages of the traditional algorithm and the Deep model, and overcomes the problem that the traditional recommendation algorithm is easy to excessively user-centered.

3.2. Analysis of Wide model and its characteristics

The main idea of the Wide deep learning model is to complement each other with memory and generalization [9]. On the one hand, the traditional generalized linear regression model can avoid the problem of excessive fitting; on the other hand, the model has appropriate applicability.

Memory refers primarily to the generality or relevance of learning characteristics, and the resulting recommendations are items directly related to items that already have user behavior [10]. The model used in the article is the logical regression (LR). The advantages of logistic regression are simple, easy to scale, and strong explanatory [11–13]. The formula for the linear model is as follows:

$$y = w^T x + b \tag{10}$$

$x = [x_1, x_2, \ldots, x_d]$ is a vector containing d features, $\omega = [\omega_1, \omega_2, \ldots, \omega_d]$ is a model parameter, and b is a bias. The features include the original input features and cross-product transformation features, and the reason for using the cross-product transformation feature is to take into account the correlation between features [14, 15]. Generalization can be understood as the transfer of relevance, and deep learning will proactively learn new feature combinations to improve the variety of recommended items, or to provide generalization capabilities. Generalization is often achieved by using multilayer neural networks to compress high-dimensional space vectors used to represent data semantic information into low dimensional dense space vectors to explore new feature combinations that have never or rarely occurred in the past. In the Deep dimension, the first embedded vector is initialized, and then the minimum loss function is used to optimize the model. The parameter formulas for each hidden layer are:

$$\alpha^{(l+1)} = f(\omega^{(l)} x^{(l)} + b^{(l)}) \tag{11}$$

The F () here is the activation function, l refers to the number of layers, and the predictive function of the model is:

$$P(Y = 1\,|x) = \sigma(\omega_{wide}^T[x, \phi(x) + \omega_{deep}^T a^{(lf)} + b]) \tag{12}$$

Here, Y refers to the predicted binary label, $\sigma()$ is a sig function, $\phi(x)$ function is a new feature set obtained by cross-conversion of original features, ω_{wide}^T is a Wide model feature weight vector, and ω_{deep}^T is a Deep model feature weight vector, $a^{(lf)}$ is the activation value of neurons. Independent training between the models in the general integrated model does not interfere with each other and is only linked together in the final prediction. The difference is that the Wide & Deep model uses a joint training model which simultaneously optimizes the parameters of the two models and the objective function of the model. The Wide & Deep model is trained using a batch of random gradient descent [16–18]. The Wide dimension uses the FTRL optimizer and the Deep dimension uses the AdaGrad optimizer.

Tourism management department has the functions of economic regulation, market supervision, public service and social management. Through the application of modern information technology, Intelligent

Tourism strengthens the relationship and interaction among the elements of tourism industry chain, deeply stimulates and integrates tourism resources and information, and realizes scientific tourism management. Through the information integrated platform, the tourism management department can understand and grasp all the information of tourists in the whole process of tourism activities and the management information of tourism enterprises in real time and accurately, realize the transformation of the supervision and management of tourism industry from passive processing, ex post management to process management and real-time management, and realize the transformation of traditional tourism management mode to modern management mode. We should better maintain tourism order, effectively deal with tourism quality problems, and strengthen information sharing and cooperation between tourism management departments and transportation, health and public security departments. In addition, smart tourism will further promote the construction of tourism e-government, realize the interconnection between regions, improve the level of office automation of tourism management departments at all levels, improve administrative efficiency and reduce administrative costs; provide the public with a smooth channel of tourism complaints and evaluation feedback, strengthen the monitoring of the operation of the tourism market, and enhance the service capacity of the main body of the tourism market. Management ability; realize the monitoring and protection of tourism resources and intelligent management, improve the effectiveness and scientificity of tourism macro-decision-making.

4. Result analysis and discussion

Tourism is a complex and open system, which also includes many small subsystems (such as tourism enterprise subsystem, tourism source market subsystem, tourism support and guarantee subsystem, tourism destination attraction subsystem, etc.). Each subsystem is relatively independent logically and functionally, but for the whole tourism industry chain, each subsystem coordinates and cooperates with each other, and restricts each other to form an organic whole. Real-time information exchange and feedback between subsystems and subsystems, subsystems components and subsystems and environment can promote the effective circulation of the system. The tourism route recommendation model in this paper is to apply information technology such as wireless network and Internet of Things to tourism (innovation technology subsystem) to realize 3A (anytime, any place, anything) information flow in the whole tourism system, so as to make the collection, transmission and processing of information more quickly, accurately and timely, and realize intellectualization, it is shown in Fig. 1.

The purpose of this paper is to verify the advantages of the exploratory recommendation system WDSSM-ReSt○Pker compared with the traditional recommendation system and the recommendation system based on the traditional DNN model. In order to better evaluate the effect of exploratory recommendation, we choose Web of Science Tour Line library for reference comparison [19, 20]. Google Scholar is also widely used as a tourism line data system based on thesis reference extended query, but the data used in this paper WDSSM-Restopicer from Web Of Science. We had the trial people use the same interface, but one was from the Wdssm-Restopicer exploratory engine, while the other two were embedded with the traditional recommendation algorithm LR and the traditional DNN model of the recommendation system, and then through the analysis of user using of the recommended scoring objective indicators to evaluate, and special case analysis was made on the change of preference of the learners. Specifically, the user will make a preference judgment for each recommended travel route. If the user's rating is high, it indicates that the recommended travel route is suitable for the user. To a certain extent, we believe that the information obtained by the user is of high quality, that is, the average rate of increase. At the same time, as the rec-

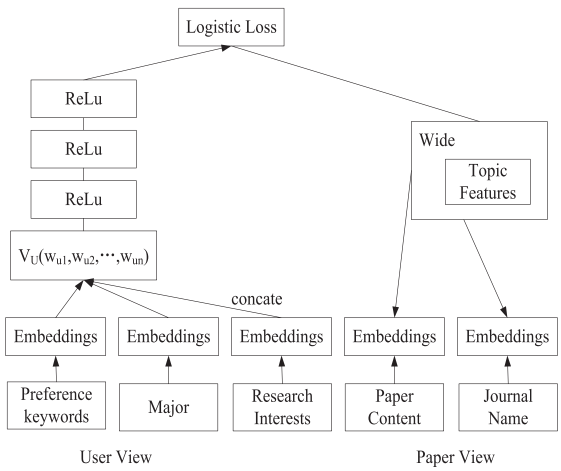

Fig. 1. Wide & amp; DSSM recommendation system model.

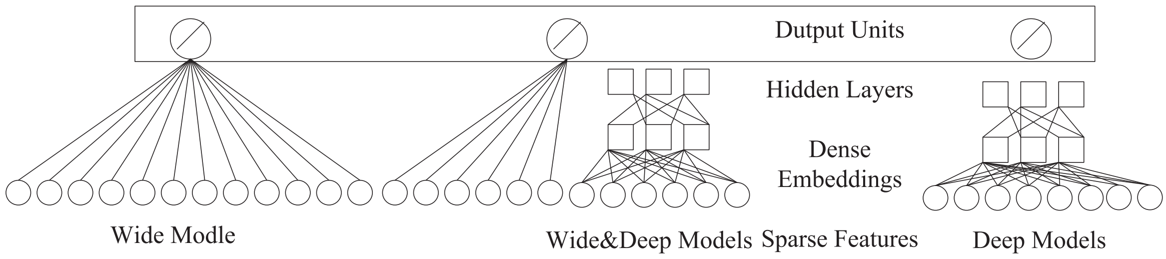

Fig. 2. Wide & amp; Deep model.

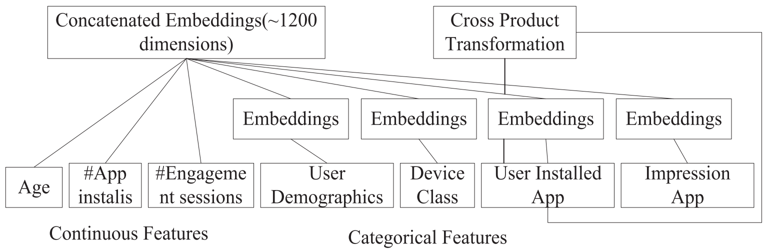

Fig. 3. Wide &a mp; Deep network structure.

ommendation continues, the accuracy of the model prediction will be higher, which means that the prediction error is getting smaller and smaller, that is, the average round-off error decreases. Finally, the analysis is conducted on specific cases and the differences in usage between different systems are compared.

In order to better evaluate the effectiveness of exploratory recommendations and to better understand WDSSM-Restopicer, three sets of experiments were designed. One group is an exploratory recommendation system with built-in Wide & DSSM model (Group A), a group is a recommendation system using a traditional LR model (Group B), and a group is a recommendation system using a DNN model (Group C). Moreover, since the datasets are the important periodical in the information system domain, the doctoral graduate students, postgraduates, and undergraduates of this school were selected as the main experimental subjects for this tour route. Before the experiment, we will first conduct a simple background survey of the subjects, on the one hand, to understand the degree of clarity of their research direction, and secondly to understand their travel line search ability. The important point is that the trial participants were not informed that which one of the three types of systems was used in the trial. At the same time, this paper designed a series of indicators to analyze the specific situation of the trial, including the average (standardized) scoring and predicting the accuracy of scoring, it is shown in Fig. 2 and Fig. 3.

In this experiment, we invited 24 participants; the 24 subjects were graduate students of information Department (Ph. D. 2, Master 17, and 5 undergraduates). These subjects are still not clear about the area of finding a tourist route and have the ability to use the search engines normally. Prior to the experiment, each participant did not know which of the three groups A, B, and C was assigned to. However, we controlled 8 subjects in each group. Due to the relatively large amount of papers that need to be read in the experiment, all participants were required to use the system to perform at least 8 interactions, each interaction returned 5 papers to test. Subjects were required to rate the recommendation results before

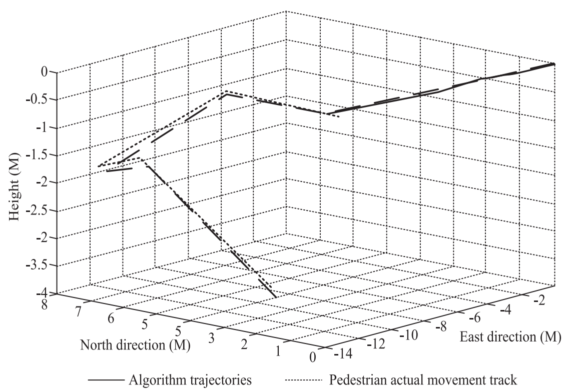

Fig. 4. Average scoring path of A, B and C groups.

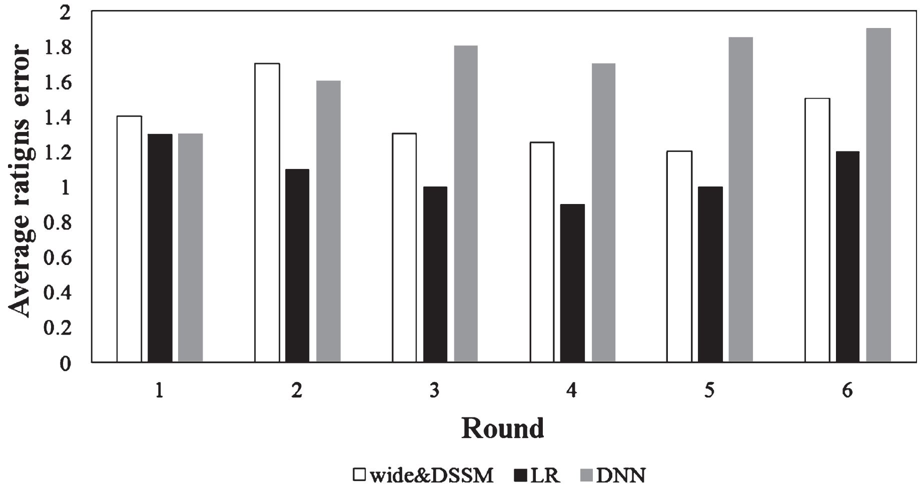

Fig. 5. A, B, C group evaluation index comparison table.

they could continue to recommend. Afterwards, when the participants did not willing to continue using the system (for example, they were not satisfied with the results of the recommendation or found topics), they stopped using them. The result is shown in Fig. 4 and Fig. 5. It can be clearly seen from Fig. 4 that with the increase of the number of rounds, the Wide & DSSM recommendation system model has a significant upward trend in the later period, indicating that our model accurately grasps the user's preferences. Most of the traditional LR recommendation system users' scores gradually decreased after fluctuating at the initial stage. This shows that although the average Wide model is not low, the problem of user-centricity tends to reduce the user's interest in the travel routes recommended by the system. The user ratings using the DNN model recommendation system constantly fluctuate in the early stage and gradually decline in the later period, indicating that the model has excessively generalized user preferences with the increase of the recommendation number, and users are generally not interested in the recommended tourist route.

From the mean absolute error, the three rounds of recommendation results of the initial rounds A, B, and C are all derived from the keyword search algorithm, so the difference is not significant. After the initial shocks, the error of Group A is getting lower and smaller, which shows that the system (compared with Group B, Group C) can explore the tourist route which accords with the user's preference. Among them, the end-round sharing shows the important advantage of Group A. From the perspective of Prediction accuracy, group A system can better recommend the appropriate results, dig out the user's preference earlier, and reduce the prediction error more quickly, it is shown in Fig. 6.

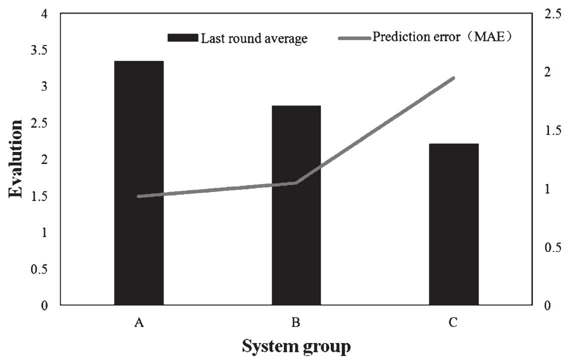

Fig. 6. A, B, C group evaluation index comparison table.

In summary, the Wide & DSSM exploratory recommendation module is strictly divided into three parts: a candidate set generation system, a data generation system, and a scoring system. The division of labor between the systems is clear and independent, which makes the entire recommendation model logical and structured. At the same time, in order to improve the user interaction experience, this paper build the DSSM-Restopicer exploratory recommendation system based on Wide&DSSM exploratory recommendation model using open source web page design framework Django, then designed a series of evaluation indicators and a controlled experiment to evaluate the function of the prototype system.

5. Conclusion

Neural network plays an important role in the development of wireless network technology, and WIDE is a learning model derived from neural network. This paper studies intelligent tourism based on the development of wireless network. Based on the tourism preference, a WIDE exploratory recommendation model was established, and the model was briefly introduced. Secondly, this paper puts forward the WIDE & DSSM exploratory recommendation algorithm, combines the traditional recommendation algorithm with the depth model, utilizes the feature generalization ability of the exploratory recommendation model of Wide, explores the potential interest preferences of users actively in the process of rolling recommendation, and overcomes the problem that the traditional recommendation algorithm is easy to be overly user centered. Finally, the results of the model and algorithm are trained. In terms of the final result, the combination of WIDE exploratory recommendation model and WIDE & DSSM algorithm can avoid the problem of over-generalization of the depth model and improve the accuracy of travel recommendations. For intelligent tourism, it can be applied to the tourism app, to achieve targeted travel advisory pushes, travel route recommendations, etc., and enables visitors to experience good intelligent tourism services even in a wireless network environment.

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