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*Retraction*

# Retracted: Research on Collaborative Optimization Model of Tourism Resources and Highway Network Based on IoT Network and Deep Learning

**Security and Communication Networks**

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*Security and Communication Networks* has retracted the article titled "Research on Collaborative Optimization Model of Tourism Resources and Highway Network Based on IoT Network and Deep Learning" [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] Z. Xu and F. Xie, "Research on Collaborative Optimization Model of Tourism Resources and Highway Network Based on IoT Network and Deep Learning," *Security and Communication Networks*, vol. 2022, Article ID 1637348, 10 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*

# Research on Collaborative Optimization Model of Tourism Resources and Highway Network Based on IoT Network and Deep Learning

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With the development of tourism, people's demand and concern for tourist transportation are increasing. Integrating expressway resources into the tourism transportation network is the current trend and direction of expressway network planning. With the rapid development of the Internet, people can easily get the information resources they want, but at the same time, the problem of information overload also arises. The depth of highway access is insufficient, there is a lack of systematic consideration of tourist resources in the area, a systematic tourism network has not been developed, and tourism resources are inaccessible. These issues have stifled regional tourism's fast growth, necessitating research into the convergence of tourist resource development and highway network optimization. The building of highway layouts and the growth of the tourist sector have reached a point where they interact and impact one another, and the degree of this contact has progressively risen. However, there is still a significant disparity in the degree of cooperation across areas. This paper considers the collaborative optimization of tourism resource development and highway network optimization, analyzes its impact on traffic volume distribution, introduces the two-level programming model of collaborative optimization, and determines that the goal of the upper model is to maximize social net income. It also considers the collaborative optimization of tourism resource development and highway network optimization on the basis of clarifying the game relationship between planning decision-makers and traffic travel and considers the collaborative optimization of tourism resource development and highway network optimization on the basis of in-depth learning. For the total investment of tourism construction projects, the time cost saved by highway network optimization, and the total tourism revenue, the lower-level model aims to minimize the travel time of a single user. This paper shows that the layout planning of the regional tourism highway network from the perspective of tourism resources can improve the accessibility of regional high-quality tourism resources and meet the requirements of the coordinated development of highway tourism and resources.



## 1. Introduction

With the wide application and development of deep learning, the convolutional neural network is used in more and more scenes, especially in the field of image recognition, which has achieved a breakthrough development [1]. With the advent of the big data era, deep learning algorithms have been widely used in security, education, medical treatment, trade, transportation, home, and other fields. The transportation network system is very important in the development of the regional tourism economy. The expressway network plays an important role in the transportation system and has an important impact on the accessibility of tourism destinations and the flow direction of tourists. The development of the regional tourism economy puts forward new requirements for the construction of an expressway network [2]. More and more areas began to introduce graphics processors, field programmable logic gate arrays, and other hardware for acceleration in order to meet the diversified needs of computing in the fields of

artificial intelligence, deep learning, computer-aided engineering simulation, graphics rendering, and so on. At the same time, it provides the customization and flexibility that a single architecture lacks while maintaining computational capacity, resulting in heterogeneous computing [3]. Accelerating the development and construction of tourist routes, linking the regional comprehensive transportation system efficiently, enhancing and consolidating tourism service levels, and promoting the quality and efficiency of transportation and tourism have all become key tasks 4, 5. There is a guidance and feedback mechanism between the expressway network and the evolution of the tourism spatial structure. The coordinated development of the expressway network and tourism economy is promoted by improving the expressway network layout, giving full play to the advantages of expressway publicity, optimizing and expanding the tourism development pattern, and creating characteristic high-speed tourism routes [6].

China's tourism industry has achieved a historic leap and has developed into a comprehensive industry with the participation of the whole population and a high degree of industrial integration. It is in the period of building a well-off tourism power in an all-round way, and it will step into the ranks of a preliminary affluent tourism power [7]. Because the traffic demand for the tourist highway network is closely related to the value of tourist resources, the traditional highway network planning method is only partially appropriate for tourist highway network planning and there is little research on fully integrating tourist traffic into tourist highway planning. With the fast expansion of the social economy, tourism is becoming a force that cannot be ignored in the areas of society, culture, and the establishment of international exchanges [8]. With the fast advancement of deep learning, the size of convolutional neural network models in deep learning is expanding to a deeper level, resulting in exponentially increasing computational complexity. A multilayer neural network structure with great fault tolerance, learning, and parallel processing capacity is known as a deep convolutional neural network [9]. It is a network structure that uses a multilayer perceptron, a local connection, and weight sharing to decrease the complexity of the network structure, network model, and number of network connection weights. Because the reasoning process of a deep learning algorithm involves a lot of constant data (weights, offsets, and so on), we may utilize the concept of partial evaluation to optimize the operation and data in advance during the compilation stage [10]. Tourism is a new growth point for promoting regional opening, promoting social harmony, getting rid of poverty and getting rich, achieving a common well-off society, and improving the efficiency of China's overall economic and social development. It has the advantages of low resource consumption, great consumption potential, high employment capacity, and wide development prospects [11].

The scientific and rational layout and planning of the tourist road network is the premise of the healthy development of the tourist road. Although China's tourism industry started late, due to its huge potential consumer market and favorable policy and economic environment, the current tourism development shows the characteristics of rapid growth and sufficient development potential [12]. On the other hand, under the environment of the country's vigorous investment in infrastructure, our country's transportation industry has also ushered in a period of leapfrog development. As a transportation facility, the expressway provides a guarantee foundation for the development of regional tourism. At the same time, its convenient and efficient transportation features make it the first choice for many tourists to travel. The expressway network plays a key role in the operation of the tourism space system [13]. Whether the regional tourism resources can be developed in a large scale and sustainable way will be affected by many aspects, such as the economic environment, policy environment, cultural background, and the distribution of tourist sources. The most critical factor is the supporting transportation infrastructure. In recent years, domestic research on the theory and method of tourism highway planning has also increased day by day. At present, the layout planning of the tourism highway network in our country has not yet formed a systematic and scientific theoretical system [14]. Traffic construction and tourist resource development are often made on an ad hoc basis, with no systematic planning or study. As a result, conducting joint optimization research on tourist resources and road networks is critical, as it has significant theoretical value as well as practical guiding relevance [15]. In terms of theoretical importance, the growth of tourist resources and the building of road networks must be examined from the standpoint of maximizing social investment benefits. In terms of practical importance, the simultaneous arrangement of tourist resource development and road network optimization can assure the maximum of the entire social investment benefit, effectively reduce road passengers' trip time and travel costs, boost travel pleasure to a greater extent, and boost the number of visitors who return.

## 2. Related Work

Literature [16] summarizes the research system of tourism geography from the relationship between tourism supply and demand balance. Based on the discussion of the core edge planning method, it is found that the tourism edge area is an important part of tourism development. Literature [17] applies social network theory to tourism destination network structure analysis, tourism policy networks, tourism enterprises, and tourism destination knowledge management. The research on tourism enterprises mainly focuses on how to make rational use of their own social network resources in order to obtain cheap information resources and establish long-term cooperative alliances. Deep learning is a subfield of machine learning, according to the literature [18]. It seeks to discover the underlying rules of a huge amount of data via data representation learning. To gather and extract high-order data from samples, many processing layers are utilized, including complex structures and nonlinear transformation. The study on the road network optimization issue is mostly represented in the research on the network design problem, according to [19]. The decision variables

may be classified as continuous or discrete depending on the parameters of the optimal road network. The continuous variables represent improvements to current road sections' traffic capacity, whereas the discrete variables represent the issue of new roadways. It has been discovered that the cost of transportation to and from the destination and the cost of living at the destination are significant influencing variables in tourist behaviors.

Literature [20] puts forward the research on the road route selection optimization model, which is actually a combination optimization problem of microroute selection and continuous site selection. Usually, the optimization goal is to minimize the construction cost, user travel cost, and environmental burden, and the horizontal and vertical road linearity and geographical conditions are the constraints. In research methods, regression analysis models, Granger models, elastic coefficients, coupling models, and so on are used to verify the correlation between transportation systems and tourism systems and the inseparability between the development of the tourism industry and the transportation industry is analyzed. Literature [21] uses multiobjective mathematical programming to design a continuous network design model, explains and discusses the network improvement problem with multiobjective decision-making by using the idea of bilevel programming, and establishes a nonlinear bilevel programming model. Literature [22] and others have built a bilevel planning model of the highway network, which considers many factors such as expressway management, earthwork, collinearity of lines, and travel time consumption, and analyze that the model is sensitive to the change in unit construction cost and traffic volume distribution. Literature [23] quantifies the impact of regional highway and railway network accessibility of important transportation facilities across the sea and proposes regional tourist pattern optimization solutions. According to the literature [24], it is vital to combine worldwide tourist resources while also integrating private companies and governmental sectors in order to achieve regional tourism resource collaboration and tourism industry stakeholders. The changing law of accessible spatial patterns of national tourist destinations under the effect of the high-speed rail network is discussed in literature [25]. Small- and medium-sized cultural tourist towns' economic growth and tourism distribution functions are seen to be dependent on adequate transportation accessibility. This research examines the functions of distance, transportation entrance cost, and destination competitiveness using the model technique in order to evaluate the role of transportation in the growth of tourist destinations and create a transportation cost model for tourist destinations.

## 3. Methodology

*3.1. Highway Network Optimization Model.* The optimization design of highway network layout is based on the actual situation of a certain area, and on the basis of considering the status quo of the highway network, the initial planning route is determined according to an appropriate method, the nodes in the area are connected, and then an appropriate optimization target is selected to meet the predicted traffic conditions. To guarantee that the total road network is optimum, a two-layer planning model is built within the restrictions of demand and an acceptable road network size in order to achieve the process of road network layout design in the planning year. Empirical inquiry, mathematical analysis technique, system analysis, four-stage approach, and network design issue have been the primary methodologies of highway network optimization in recent years. Only the connection of large cities was often addressed in past provincial expressway network development, and the connectivity of tourist sites was not included. With the continued growth of tourism and the increasing demand for tourist attraction services, the construction of high-speed tourist roads will become unavoidable. The expressway transportation network is a major means of connecting diverse tourist resources, and its ease and degree of connectivity have become essential requirements for tourism resource development. The establishment and growth of the regional tourist business are dependent on the state of the traffic network. Regional tourist highway systems make up the tourism highway network. It is a highway network system in the planning area that connects tourist resources, key cities, market towns, distinctive villages, and tourism distribution centers. It is different from the general road network and other highway networks. It takes tourist traffic attraction as the main service object and is an organic collection with specific tourism value and internal quality. The accessibility of tourist attractions, the degree of highway network, and the structure of highway grades have a very significant impact.

The process of tourism highway network planning is to take the regional tourism highway network as a whole, through the analysis and evaluation of the current highway network, tourism traffic status, and tourism resources, combine them with superior planning, formulate a reasonable and feasible tourism highway network construction planning scheme according to the regional socioeconomic development and tourism resource development, and determine the scale, layout, construction sequence, and supporting policies and measures. The network structure of tourism flow is shown in Figure 1.

Highway network design is actually a game theory problem. In highway network planning, the focus is to analyze the traffic demand between nodes to optimize the operation efficiency of the whole highway network. Highway network layout optimization is based on the existing highway network. The reconstruction of the existing highway network will have an impact on the layout of new lines. As a result, the effects of new and repaired portions should be addressed simultaneously while optimizing the highway network. Its planning and layout process is a classic two-level decision-making dilemma, in which decision-makers communicate with the public or engage in collaborative decision-making behavior. Microanalysis and a bilevel programming methodology are used to develop the expressway network based on tourist resources. The influence of the projected road network on the demand for tourist resources, as measured by traffic volume, is examined in this

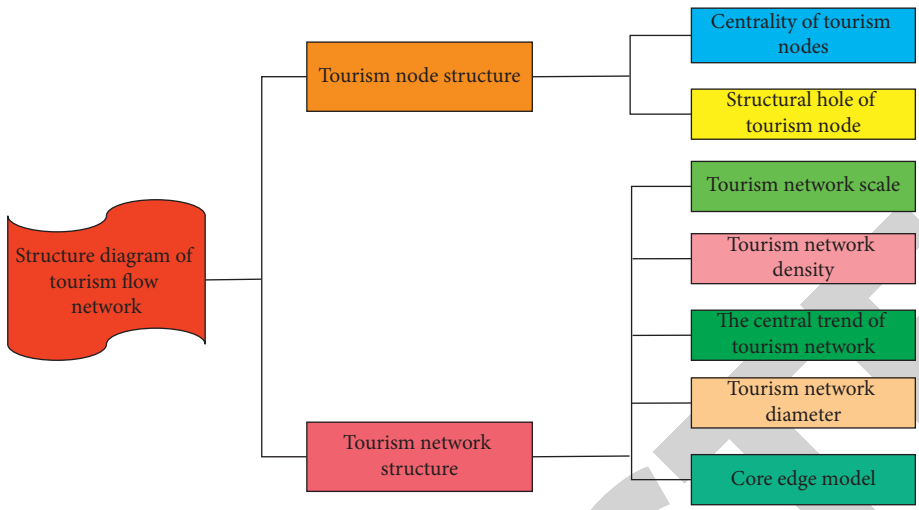


Figure 1: Structure of the tourism flow network.

article. The notion of tourist traffic-generated increase is presented here. The higher model's optimization goal is to reduce the overall travel cost (time) of the whole network system while increasing demand for road network tourist resources. The lower-level model's optimization goal is to reduce a single user's trip costs (time). The user model is broken into two categories: certainty and unpredictability. It is possible that adding new parts, or reconstructing and upgrading existing portions, without taking into account the travel choice behavior of passengers, may increase traffic congestion on the whole highway network. One should calculate and assess the enhanced tourist traffic volume as a result of the improved road network structure when the proposed road network is completed.

*3.2. Collaborative Optimization Model.* The problems of road network optimization and collaborative optimization of tourism resource development involve much attention of road network planners, general road network users, travel road network users, and tourism resource development planners. User-based collaborative filtering recommendation generates a recommendation list for target users according to the opinions of other users. The collaborative filtering recommendation system searches for several nearest neighbors of the target user by using statistical technology, then predicts the score of the target user on the item according to the scores of the nearest neighbors, and generates the corresponding recommendation list. Standardized measurement formula:

$$C'_D(n_i) = \frac{C'_D(n_i)}{n-1}. \tag{1}$$

The algorithm's recommendation process is broken into three stages: data representation, closest neighbor detection, and production of recommendation datasets. Reconstruction of highway networks and collaborative tourism system optimization are fundamentally combination optimizations of facility placement and road network architecture. They both belong to the macro-decision-making level and to the information symmetry cooperative game connection. At this layer, decision-makers must generally begin by considering the system as a whole, as well as the investment and advantages of system decision-making from numerous perspectives and at a deeper level. Starting from the characteristics of deep learning algorithms and deep learning hardware platforms, this paper proposes a deep learning compilation framework for co-optimization of operations and data. The basic criteria for evaluating the algorithm are correctness, readability, robustness, rapidity, and economy. The comparison of the three collaborative filtering algorithms is shown in Figure 2.

The participants in the model can be divided into macrolevel and microlevel, which are typical master-slave game problems. The upper-level planning decision-makers adjust the optimization scheme of the highway network and the investment scheme of tourism projects from a systematic perspective, with the goal of maximizing the investment income. The top-level planning decision-makers update the optimization method based on the derived tourist industry revenue and transportation network parameters after receiving input from the lower-level participants. As a result, after numerous game choices, they will be able to come up with a more satisfying implementation strategy for both parties and attain game balance. The lower-level participants use this information to make their own trip plans and create the necessary travel routes. The external input data receive a response through the convolution layer, and then, the nonlinear transformation processing of the data is completed by the activation layer of the following layer. The convolution itself can also be regarded as a linear transformation. Considering the existence of bias term, the operation of the nonlinear transformation of this radiation transformation is actually a special case of the basic operation in general neural networks. Acquired data can only be used after preprocessing. The accuracy comparison is shown in Figure 3.

The reason for data preprocessing is to further improve the value of data, so as to improve the accuracy of data, improve the accuracy of algorithm, and make the process of

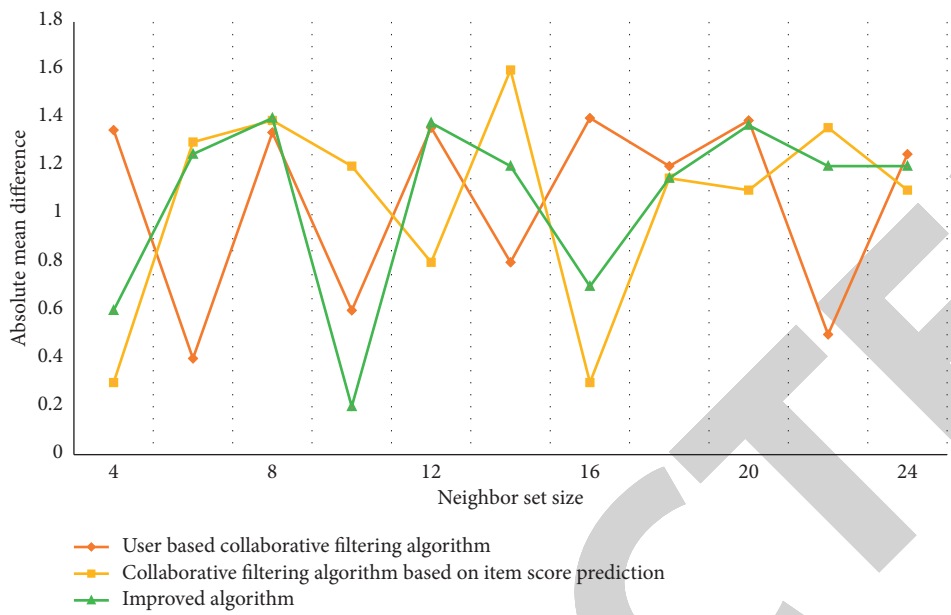


Figure 2: Comparison of three collaborative filtering algorithms.

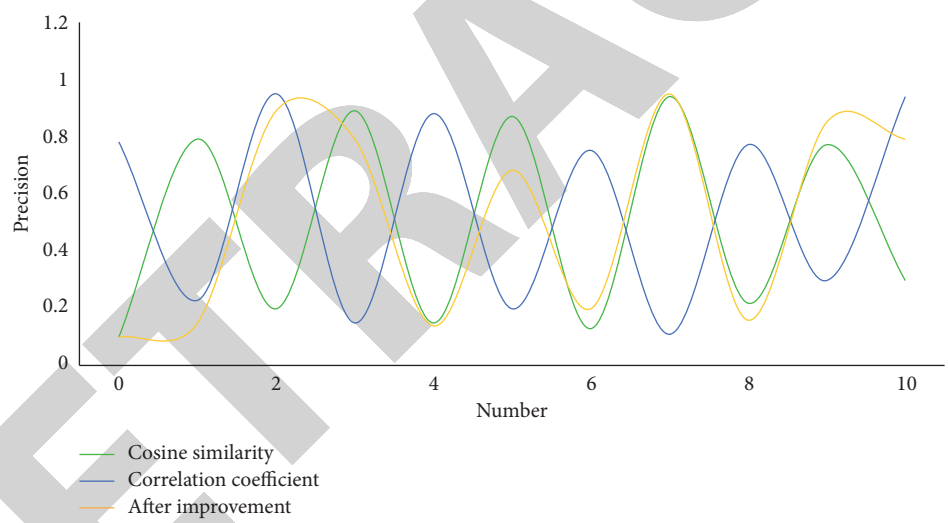


Figure 3: Accuracy comparison line chart.

data mining smooth. The calculation formula of system accuracy is as follows:

$$P = \frac{\sum_1^n p_u(L)}{n}. \tag{2}$$

High-quality data are an important prerequisite and guarantee to get accurate results. Commonly used data processing technologies include data cleaning, data transformation, and so on. Data standardization processing is as follows:

$$\overline{x}_{ij} = \frac{x_{ij} - x_j^{\langle b \rangle}}{x_j^{\langle g \rangle} - x_j^{\langle b \rangle}} * \theta + (1 - \theta). \tag{3}$$

On the basis of the basic survey of tourism resources, comprehensively considering the characteristics and value of tourism resources, the flow of tourists in tourist attractions, the functional classification of tourist roads, and the results of node-level division, the layout of regional tourist roads is carried out according to different functional types and levels. Take one of China's provinces as an example, and look at the development trend of tourist arrivals and tourism revenue. Figure 4 shows the development trend of the number of tourists and tourism revenue in Heilongjiang Province.

The layout design scheme of the whole tourist highway network is formed by superimposing planning routes of various functional kinds to maximize the tourism resource network by linking different levels and types. The dimension of model data is modified according to the operating needs in order to increase the locality of memory access. Data must be interpreted into multidimensional arrays using convolution and other methods. The sequence in which

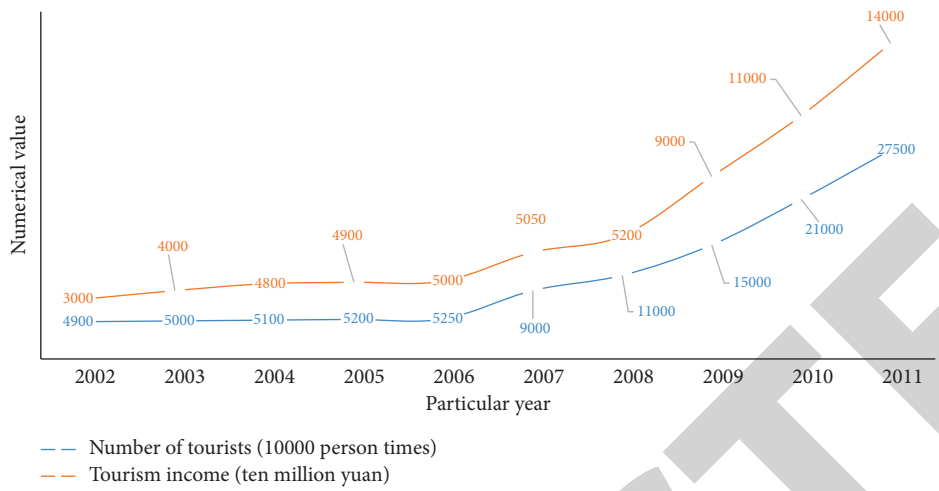


Figure 4: Number of tourists and tourism income in Heilongjiang Province.

multidimensional arrays are arranged has an impact on memory access jump times. It is required to adjust the dimension of the data in order to reduce memory access jumps. Because the road network optimization model is a multiobjective optimization model and there is no such thing as a multiobjective optimization issue, all goals may acquire the best solution at the same time. At this point, most people have chosen the most effective approach, and no objective function can be improved without sacrificing other goals. Figure 5 depicts the changes in accuracy and error as a result of deep learning and optimization working together.

## 4. Result Analysis and Discussion

*4.1. Analysis and Application of the Highway Network Optimization Model.* When using the two-layer optimization model, it is necessary to allocate the traffic flow of the highway network. In addition, the choice of alternative routes is a key factor for the solution of the model, which needs to be determined according to the actual situation of the layout of the highway network and the distribution of tourism resources. Reflecting on the road network, the calculation formula is as follows:

$$L = C \times \phi \times \sqrt{N \times S}. \tag{4}$$

As mentioned in the previous analysis, the development of tourism resources and the construction of highway networks will have an impact on the travel behavior of traffic travelers. This impact includes two aspects: one is the route selection behavior of traffic travelers in the road network, and the other is the activity of traffic travelers engaged in traffic travel, which is reflected in the induced traffic volume generated by road network construction and tourism attraction development. The coupling between the tourism highway network and the tourism resource composite system is shown in Figure 6.

The accessibility numerical index of each location in the regional network is calculated by examining the convenience of a certain place in the area to reach another point through a specific traffic mode. The perfection of the highway transportation network is insufficient, as is tourist assistance. The growth of the highway transportation network is uneven, and ethnic minority communities remain behind the times. This contradicts the state's macrogoal of minimizing regional disparities, attaining shared development, fostering national unity, and preserving national stability. Meeting the transportation requirements of tourist resource development, as well as supporting and promoting the growth of the tourism sector, is tough. The degree of centrality of the tourist transportation network does not need to be computed using classification:

$$C_D(n_i) = \sum_{j=1}^{n} r_{ij}^T. \tag{5}$$

In order to speed up the development of tourism resources and key scenic spots, the layout of the highway network should be optimized in combination with tourism resources to improve the rapid traffic conditions of tourist spots. The comparison between the passenger flow network and the traffic network is shown in Figure 7.

The different levels of the planning nodes of the tourism highway network are determined through the evaluation and analysis of tourism resources in the planning area, as well as the current situation and demand for node traffic access. The layout of different functional types of tourism roads is carried out based on the node-level division and functional value, and the tourism highway network is guided and constructed from the perspective of tourism resources. Infrastructural building projects, such as highway network construction and tourist resource development, have a large initial investment and a lengthy return time. As a result, when using the collaborative optimization model to calculate the total social investment income, the entire project life cycle of tourism resources and highway network projects should be considered, allowing for a better comparison of the schemes' benefits and drawbacks, as well as an easier solution and analysis of the objective function. The objective function is to minimize the absolute weighted sum of the

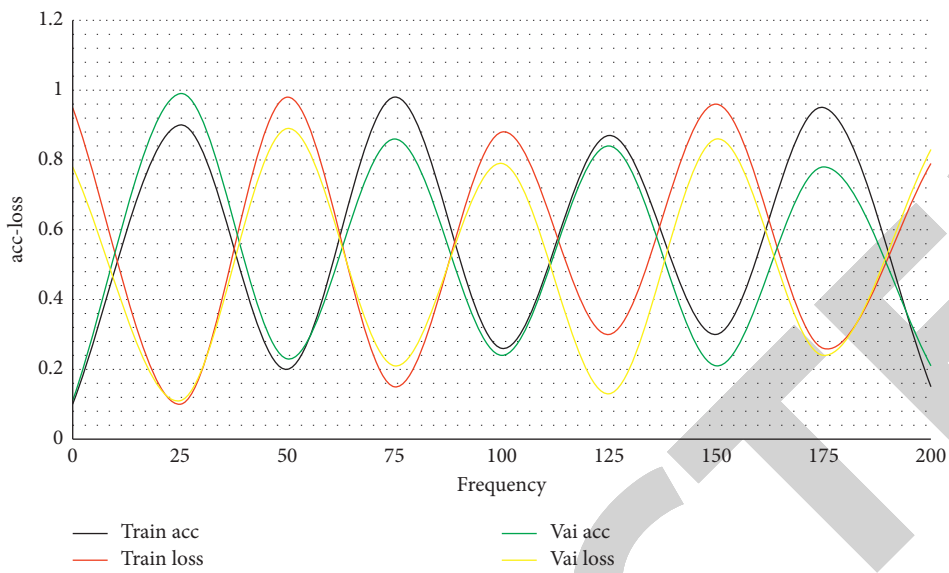


Figure 5: Variation chart of accuracy and error.

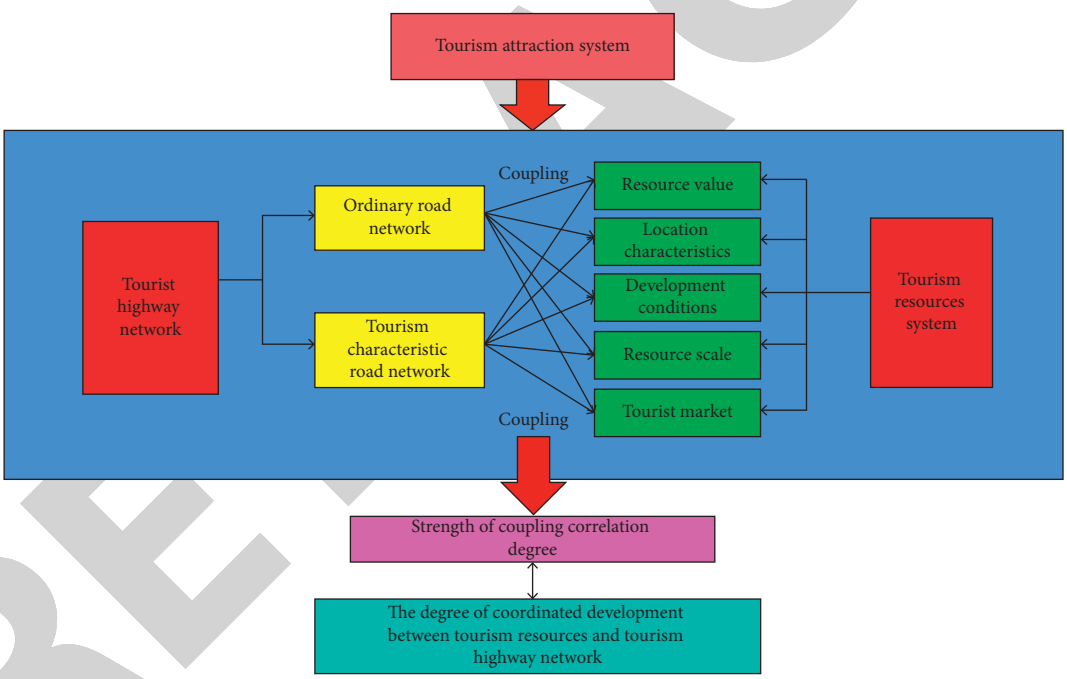


Figure 6: Coupling of the tourism highway network and the tourism resource composite system.

error between the predicted value and the actual value so that the obtained weight coefficient will minimize the error. The calculation formula is as follows:

$$\min R = \sum_{t=1}^{n} \sum_{i=1}^{3} w_i e_{it}. \tag{6}$$

In addition, in the planning of the road traffic network, the aesthetic characteristics of tourism should be considered. In the route design, the road itself should not damage the nature and embellish the nature and the road should be built as an integral part of the natural environment and integrated with nature. At the same time, when the road is under construction, the road itself must be installed. Road greening is appropriate and becomes a part of the landscape. The development scale of a high-grade highway network has great shortcomings, the density is low, and the connectivity is not high, so the accessibility to tourist attractions is not high. Through the research on the optimization method of highway network based on the accessibility of tourism resources, its application is analyzed. The analysis finds that the scale of development of high-grade highway networks is limited by the social economy, geographical location, population size, and land area, as well as the impact of

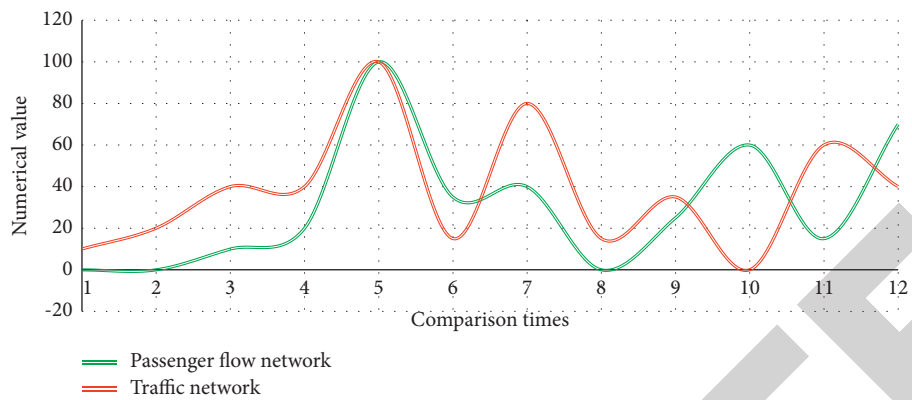


Figure 7: Comparison between the passenger flow network and the traffic network.

passenger and freight traffic. Taking the time impedance factor into account in the accessibility model, the time impedance function is introduced:

$$T_s = \sum_{r=1}^{n} \frac{l_{rs}}{L} \times t_{rs}. \tag{7}$$

From the perspective of time, the accessibility value of scenic spots in the whole region has decreased and the accessibility has gradually improved, which relatively shortens the space-time distance from the source to the destination.

*4.2. Optimization Strategy.* Transportation is the carrying facility for tourists to travel to tourism destinations to carry out tourism activities, and it is also one of the feasibility conditions considered by tourism developers to invest in tourism project construction. That is, transportation is the circulation channel of tourism passenger flow, capital, technology, information, talents, and other elements inside and outside the region, the meridian of regional tourism development, and the skeleton that supports the spatial structure of regional tourism resources and scenic spots in series. First of all, highway transportation network construction and tourism should coordinate with each other in planning. Highway transportation network planning and tourism planning should be done at the same time, with tourism planning coordinating with the transportation department to develop the tourism transportation network in a holistic manner, improving the highway transportation network's function, structure, and network coverage. Because of the topography, transportation facilities are limited, regional natural and cultural tourist resources are underdeveloped and underutilized, and the low technological level and narrow layout of the transportation network restrict the flow rate and flow of tourism. As a result, the growth of regional tourist spatial structure is influenced by transportation technology innovation and development. More tourism resource nodes are connected in series as technical conditions improve, transportation facilities improve, and transportation lines become more popular, providing superior basic conditions for the development of regional scenic spots as well as more choice space and access time for tourists.

Second, the formation of the highway traffic network should be accelerated. The expressway network can promote the development of local rich tourism resources and accelerate the development of tourism, thus accelerating the economic development of ethnic areas. This is also more in line with the goal of harmonious development and stability of all ethnic groups put forward by the state at present. The construction of an expressway network can promote the development of tourism to be more prosperous and support the sustainable development of national economy and society more effectively. Thirdly, the expressway service area should change its function to become a regional tourism distribution center or a comprehensive tourist service area, and adopt "service area plus tourism" as the innovative development management mode to create a regional tourism image, enhance the cultural connotation, and make the expressway service area a new window to display regional development. While speeding up the construction, optimize the hierarchical structure of the highway traffic network, improve the technical level of the whole road network, and strengthen the hierarchical standardization construction of the highway traffic network. Pay attention to the local road traffic network construction in counties and villages, and improve the accessibility coverage of rural roads, thereby providing possibilities for developing tourist attractions and tourism projects. Connect the state's main counties and cities, as well as the state's distribution centers for tourist transportation hubs and certain key tourism transportation hubs, and swiftly communicate with the state's core and essential tourism resources. Finally, create distinctive high-speed tourism routes. Focus on regional collaboration, integrate regional superior resources, integrate and optimize route organization, depend on expressways, and connect regional tourism in a series. Encourage the building of special tourist roads through expanding investment channels, suitably liberalizing business rules, and encouraging the construction of special tourist roads. In contemporary tourism, special tourist routes are becoming more popular. Encouraging private investment in tourism and directing private cash to the construction of special tourist routes may help to develop costly tourism resources and expand tourism.

## 5. Conclusions

In recent years, the application of IoT networks and deep learning has become more and more extensive, especially in computer vision and speech recognition, which has promoted the progress of artificial intelligence technology. The development strategy of the integration of expressway networks and tourism resources will become a trend and direction of highway network planning in the future. Based on the accessibility of tourism resources combined with the reasonable scale and hierarchical structure of the highway network, this paper deeply analyzes the integration research of tourism resource development and highway network optimization construction, constructs the highway network layout optimization model considering the accessibility of tourism resources, and determines that the highway construction cost is the lowest, the traffic impedance of the highway network system is the smallest, and the tourism demand is the largest. The optimal accessibility of the tourism network and the optimal travel of users are the optimization objectives of the model, so as to optimize the operation effect of the whole highway network. From the perspective of tourism resources, the rational layout of the regional tourism highway network can promote the integration of regionally important tourism resources and build a cooperation system. It is the path to opening up the product operation of highway tourism in the future, so as to further realize the integrated development of highway transportation and the tourism industry. Considering the influencing factors of transportation on tourism economic development, this paper explores that the guiding role of expressway networks and tourism spatial structure evolution is guided by the "point axis" effect. The feedback effect of tourism spatial structure evolution on the expressway network is reflected in the demand level of tourism development factor circulation for expressway construction. Based on the consideration of induced traffic volume, this paper constructs the collaborative optimization model of tourism resources and the highway network. From the perspective of planners, with the goal of maximizing social income, this paper reasonably allocates system resources and finally achieves the purpose of collaborative development between systems.

## Data Availability

The data used to support the findings of this study are included within the article.

## Conflicts of Interest

The authors declare that they have no conflicts of interest.

## Acknowledgments

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## References

[1] M. Fu, H Qu, Z. Yi, L. Li, and Y. Liu, "A novel deep learning-based collaborative filtering model for recommendation system," *IEEE Transactions on Cybernetics*, vol. 49, no. 3, pp. 1–13, 2018.

[2] L. Wu, "Collaborative filtering recommendation algorithm for MOOC resources based on deep learning," *Complexity*, vol. 2021, no. 46, pp. 1–11, 2021.

[3] S. Gehrmann, H. Strobelt, R. Krüger, H. Pfister, and A. M. Rush, "Visual interaction with deep learning models through collaborative semantic inference," *IEEE Transactions on Visualization and Computer Graphics*, vol. 26, no. 1, pp. 884–894, 2019.

[4] Y Yang, Z Ni, M Gao, Z. Jing, and D. Tao, "Collaborative pushing and grasping of tightly stacked objects via deep reinforcement learning," vol. 9, no. 1, p. 11, 2022.

[5] Y. Chen, X. Wen, Y. Zhang, and W. Shi, "CCPrune: collaborative channel pruning for learning compact convolutional networks," *Neurocomputing*, vol. 451, pp. 35–45, 2021.

[6] H. Chen, Z. Wang, and L. Zhang, "Collaborative spectrum sensing for illegal drone detection: a deep learning-based image classification perspective," *China Communications*, vol. 17, no. 2, pp. 81–92, 2020.

[7] D. Ji, Z. Xiang, and Y. Li, "Dual relations network for collaborative filtering," *IEEE Access*, no. 99, p. 1, 2020.

[8] H. Yin, W. Wang, W. Hao, C. Ling, and Z. Zhou, "Spatial-aware hierarchical collaborative deep learning for POI recommendation," *IEEE Transactions on Knowledge and Data Engineering*, vol. 29, no. 11, p. 1, 2017.

[9] J. Liu, Y. Wang, Y. Li, F. Jun, J. Li, and H. Lu, "Collaborative deconvolutional neural networks for joint depth estimation and semantic segmentation," *IEEE Transactions on Neural Networks and Learning Systems*, pp. 1–12, 2018.

[10] S. Ali, A. Haider, M. Rahman, M. Sohail, and Z. Y. Bin, "Deep learning (DL) based joint resource allocation and RRH association in 5G-multi-tier networks," *IEEE Access*, vol. 9, no. 99, p. 1, 2021.

[11] P. Milton, "Intelligent and deep learning collaborative method for E-learning educational platform using TensorFlow," *Turkish Journal of Computer and Mathematics Education (TURCOMAT)*, vol. 12, no. 10, 2021.

[12] W. Hu, "Exploring local chemical space in de novo molecular generation using multi-agent deep reinforcement learning," *Natural Science*, vol. 13, no. 9, p. 13, 2021.

[13] M. F. Aljunid and D. Manjaiah, "An efficient deep learning approach for collaborative filtering recommender system," *Procedia Computer Science*, vol. 171, pp. 829–836, 2020.

[14] X. Yan, B. Cui, Y. Xu, Z. Wang, and P. Shi, "A method of information protection for collaborative deep learning under gan model attack," *IEEE/ACM Transactions on Computational Biology and Bioinformatics*, vol. 18, no. 3, p. 1, 2019.

[15] M. C. Hlophe and S. Maharaj, "Spectrum Occupancy Reconstruction in Distributed Cognitive Radio Networks Using Deep Learning," *IEEE Access*, vol. 7, Article ID 14307, 2019.

[16] C. Zhou, J. G. Chase, and G. W. Rodgers, "Degradation evaluation of lateral story stiffness using HLA-based deep

learning networks," *Advanced Engineering Informatics*, vol. 39, no. JAN, pp. 259–268, 2019.

[17] S. Y. Zhang, S. W. Zhang, X. N. Fan et al., "Global analysis of N6-methyladenosine functions and its disease association using deep learning and network-based methods," *PLoS Computational Biology*, vol. 15, no. 1, 2019.

[18] J. Tang, J. Liang, F. Liu, J. Hao, and Y. Wang, "Multi-community passenger demand prediction at region level based on spatio-temporal graph convolutional network," *Transportation Research Part C: Emerging Technologies*, vol. 124, no. 10, Article ID 102951, 2021.

[19] P. Zhou, X. Fang, X. Wang, Y. Long, R. He, and X. Han, "Deep learning-based beam management and interference coordination in dense mmWave networks," *IEEE Transactions on Vehicular Technology*, vol. 68, no. 1, pp. 592–603, 2018.

[20] C. Wang, Q. Zhang, Q. Tian et al., "Learning mobile manipulation through deep reinforcement learning," *Sensors*, vol. 20, no. 3, 2020.

[21] V. Puzyrev, "Deep learning electromagnetic inversion with convolutional neural networks," *Geophysical Journal International*, vol. 218, no. 2, pp. 817–832, 2019.

[22] F. B. Mismar, B. L. Evans, and A. Alkhateeb, "Deep reinforcement learning for 5G networks: joint beamforming, power control, and interference coordination," *IEEE Transactions on Communications*, vol. 68, no. 3, pp. 1581–1592, 2020.

[23] J. Ge, Y. C. Liang, J. Joung, and S. Sun, "Deep reinforcement learning for distributed dynamic MISO downlink-beamforming coordination," *IEEE Transactions on Communications*, vol. 68, no. 10, p. 1, 2020.

[24] X. Chen, S. Leng, J. He, and L. Zhou, "Deep learning based intelligent inter-vehicle distance control for 6G-enabled cooperative autonomous driving," *IEEE Internet of Things Journal*, vol. 20, no. 99, p. 1, 2020.

[25] C. Carter and J. Zhan, "Deep learning for link prediction in dynamic networks using weak estimators," *IEEE Access*, vol. 6, Article ID 35945, 2018.