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Rural tourism image optimization by big data technology in green environment

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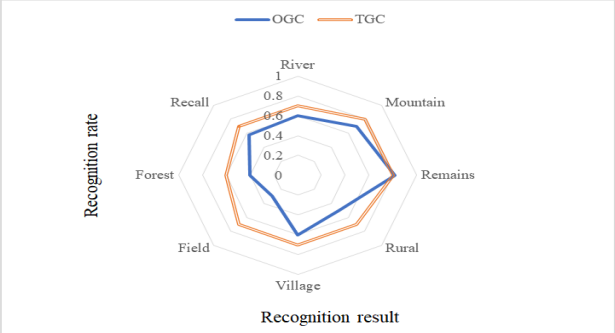
Graphical abstract



Abstract

In recent years, the need for the rapid development of rural tourism in China has resulted in a large consumption of ecological resources, which has seriously damaged the ecological balance of travel destinations. Rural tourism in many parts of China is increasingly lacking distinctive local characteristics. It is difficult to adapt to tourists' requirements for a deeper experience of rural travel. Some measures have been proposed to address these issues. Firstly, the connotation of "green" is reinterpreted based on relevant theoretical knowledge starting from solving the problem of rural tourism community development in China. The questionnaire method is used to screen the indicator system. An empirical analysis is carried out for actual cases. The pictures uploaded by tourists to social media are the main data source. A relatively complete and effective method system for the image research of rural tourism destinations is constructed combined with the visual analysis technology based on deep learning. A dense CNN model producing 10 output parameter combined with various factors is formed to assist the promotion by comparing the differences between the advertising pictures of the tourist destination and the pictures taken by tourists. The results show obvious consistency in the construction scene of the rural travel perception environment. Each tourist destination has its own visual characteristics, as well as differences in various sensory modality types. This research method adopts a combination of subjective and objective and comprehensively examines the scene conspicuousness, distinction, artistic quality, design quality, and time of the pictures. The formed marketing picture research method is more scientific and feasible.

Keywords: Ecological resources, green evaluation, rural tourism image, photo big data, deep learning

1. Introduction

The development of rural tourism is a brand-new attempt to expand China's modern tourism industry in the direction of traditional planting. Tourism has realized the organic integration of ecological agriculture and tourism and is a brand-new cultural industry form (Scherer and Thelen, 2020). The clear proposal and orderly development of China's rural revitalization strategy have brought unprecedented opportunities to China's rural tourism development (Terzić *et al*., 2020). Additionally, due to the continuous expansion of the scope of rural tourism development, the mutual substitution between each other is expanding, and the corresponding market competition is also intensifying the market competition among rural tourist destinations in the competition of the image of the countryside (Dašić *et al*., 2020). Therefore, a charming and distinctive image of rural tourism is particularly important, and it plays a decisive role in solving the problem of how to develop a sustainable and healthy rural tourism economy (Shao *et al*., 2019). In recent years, with the advent of the era of information and data, the research on China's rural tourism image has again ushered in important changes (Skryl *et al*., 2019, and Noh *et al*., 2020).

Photos are the main window to understand the ideology of tourists and the main media to understand the image of the target destination. It plays a key role in the process of expressing the image of rural tourism (Noh *et al*., 2020). Due to the popularization of mobile networks and the accelerated development of artificial intelligence technology, the graphical analysis method by deep learning technology provides an opportunity for the in-depth development of rural tourism image (Zheng *et al*., 2022).

The cognitive function of tourists and the booming computer vision technology provide urgent needs for studying rural travel imagery. The empirical analysis of actual cases takes the pictures uploaded by tourists to

tourism social media as an important data source. It closely combines the traditional rural travel pattern theory with the actual research content and the vision analysis method based on deep learning. This combination forms a relatively comprehensive and reasonable method system for rural tourism research. The system roughly includes two main aspects: the analysis of the visual characteristics of the rural travel form and the reconstruction of the spatial projection form. There are only very few works focus on rural travel bodies scene and visual characteristics of the sensory body and analyze the relationship between the visual characteristics of the perceived body and the space. The projective image reconstruction method mainly proposes a method that integrates a variety of technical indicators to project urban image pictures to rural tourist destinations. This approach is used to facilitate the efficient promotion of rural tourism.

2. Research related theories and model building

2.1. Sustainable development

Sustainable development is a dynamic process, and the degree of sustainable development also changes at various stages of historical development. Therefore, researchers have proposed the strength theory of sustainable development, as shown in Figure 1.

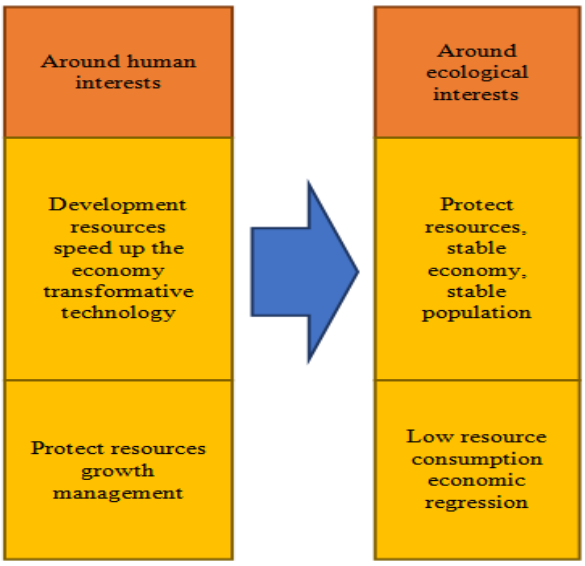


Figure 1 Intensity of sustainable development

In Figure 1, sustainable development is a long-term stable upward trend of China's national economy based on fully considering the acceptable range of the ecological environment. With peaceful coexistence between population and nature, sustainable development formulates long-term economic development plans to use national resources. This way of development can not only meet the needs of contemporary Chinese people but also protect the access to resources, rights, and interests of future generations. The sustainability of the natural environment and economic and social development are the three basic attributes of sustainable development (Rao *et al*., 2022).

2.2. Green development

After the 21st century, green development, as a new way of economic development, has become a core value goal unanimously accepted by people all over the world (Chan *et al*., 2020). This development mode takes the environmental capacity of natural resources and the bearing capacity of social resources as the main constraints. As a result, environmental protection acts as key pillar for sustainable development of society (Fujioka *et al*., 2020). The characteristic of green development is to promote the sustainable development of the economy, society, and natural environment by using the connotation of environmental protection of natural resources. Economic society and ecology are regarded as the main connotation and means of green development (Vinuesa *et al*., 2020). The green development of tourism is to maintain the original nature and maintain the harmonious balance between man and nature. This balanced development model between man and nature is most suitable for the trend of this era and in line with China's current situation. Under the general principle of sustainable development, the green development strategy will help accelerate the development of China's tourism industry and enter a new chapter in the century (Thacker *et al*., 2019).

3. The concept of the travel image

Tourism Destination Image (TDI) has expressions such as "travel shape," "travel mood," "destination shape," and "destination image." However, the academic community widely agrees that image and shape should be used as equals (Cham *et al*., 2021). Scholars have various explanations for the image of tourist destinations, as shown in Figure 2.

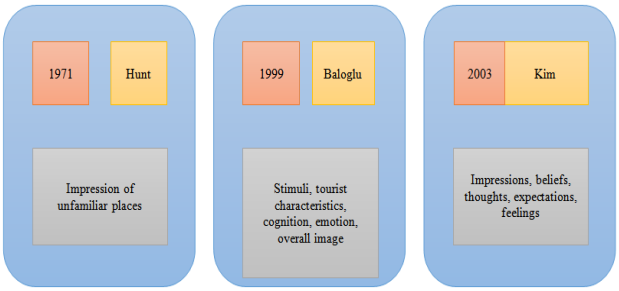


Figure 2 Definition of tourist destination image

In Figure 2, ideology refers to the tourist's concept and cognition of the object attribute of the tourist destination. Emotional form refers to the subjective feelings and attitudes of tourists towards the tourist destination. The combined effect of knowledge image and emotional image form the overall appearance of the destination (Xiao *et al*., 2020). Broadly speaking, all these research results highlight the complexity of tourist destination image construction. Most research results regard the destination image as an abstract three-dimensional structure (Sekhniashvili, 2021).

3.1. The process of tourism image construction

The establishment of a tourist destination image is an objective process that is directly affected by many factors and changes repeatedly (Claessens *et al*., 2020). The formation process of the tourist destination image is

continuously perfected by scholars based on previous research, as shown in Figure 3.

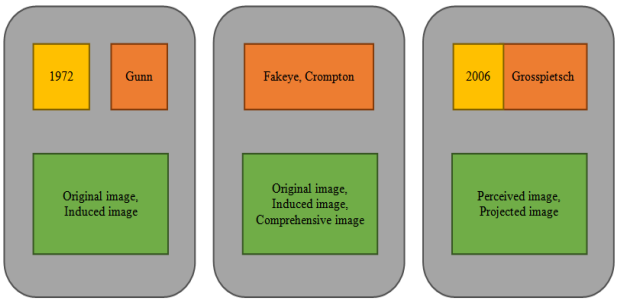


Figure 3 The formation process of tourist destination image

In Figure 3 the image of a tourist destination is disturbed for various reasons. In essence, the image of a tourist destination is an abstract concept that cannot be accurately described, evaluated, and mastered. The resulting tourism destination images must be different due to the differences in the understanding of the tourism destination image among various stakeholders and various tourist groups (Barber and Pope, 2019). Therefore, it is necessary to compare whether there is a difference between the cognitive imagery of tourists and the target projection imagery of DirectX Media Objects (DMO) and to evaluate whether the target imagery projected by DMO has been successfully transmitted to and recognized by tourists (Preece *et al*., 2019). Target projected imagery is altered by more explicitly identifying group differences in target imagery and employing strategies that satisfy both DMO stakeholders' and tourists' needs and interests.

4. Research practice of photos in tourism image

In the digital era of mobile Internet, the rise of the Internet and social media has greatly changed the way tourists travel, creating a network platform for tourists to disseminate travel reviews, share travel experiences, and various travel-related information. Tourists can use social media platforms to share photos or texts at any time to convey their feelings about the travel destination (Gama *et al*., 2021). Visual content is universal and objective, and it is easier to be remembered or recognized by cognitive subjects than textual content. Photos are more conducive to the study of image cognition of tourist destinations.

Modern travel is essentially a visual perception activity (Du *et al*., 2019). Photos are the main window to understand the thoughts and emotions of travelers and the main medium to understand the appearance of the destination and play a major role in the process of expressing the appearance of travel. As the main carrier of the visual landscape, the direct subjective feelings, and experiences of tourists expressed in the photos put forward a new perspective for the depiction of travel destinations. Therefore, research based on the visual content of photos has increasingly become a new mode of travel image dissemination (Shaheen and Cohen, 2019).

4.1. Study area selection and TGC photo big data

This investigation selects a county with the honorary title of "China's Most Beautiful Village" as the place where the case occurred. The county has a history of human civilization for more than a thousand years. It has one 5A-level scenic spot, fourteen 4A-level scenic spots, four national-level historical and cultural villages, and nine provincial and municipal historical and cultural villages. At present, the county's red tourism resources have covered the whole of China, and it is currently the only 3A-level tourist attraction named and the county seat with the largest number of 4A-level and above scenic spots in the province.

The photos of tourists on the Internet contain much useful information closely related to the tourist, destination, and time. This information provides a new perspective for studying tourist activities, destination image, and marketing (Ferrer-Rosell and Marine-Roig. 2020).

This study obtains photos of the studied scenic spots from a website. A sample of randomly selected travel photos is shown in Figure 4.

Figure 4 Sample travel photos

In Figure 4, the website adopted is an online travel community portal in China, which aggregates the travel experience content shared by most Chinese tourists. Additionally, the website is also a travel community sharing portal in China focusing on tourists' Time Gain Compensate (TGC), which emphasizes the originality of the shared content. The combination of comments and photos on the online platform can get a more realistic travel experience, so it has great research value (Hasan *et al*., 2021). The researchers can understand how tourists actually felt about the destination from the content they uploaded. 54,676 TGC photos are collected from 36 national key rural tourism sites.

5. DenseNet neural network model

Currently, Densely Connected Convolutional Networks (DenseNet) are widely used neural networks with higher anti-fitting properties (Qi and Zhang, 2020). Compared with the convolutional neural network (CNN) model with a higher network level, DenseNet obtains better anti-fitting characteristics and network stability through feature reuse technology, making the network range simulated by DenseNet narrower and the parameters smaller. Once the image is passes for evaluation, features are stored separately for retraining the system. This simulation achieves better experimental results in many aspects

(Singh *et al*., 2021). The connection method of DenseNet is shown in Figure 5.

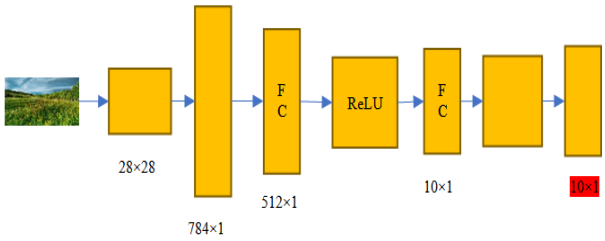


Figure 5 Densenet model network structure

In Figure 5, a training set is established using the previously collected tourist destination and rural tourism photo data. Data Split ratio is 70:30 for train and test. In operation, there is enough labeled image information and huge computing power in the training process (50*50*3 is the input size of an image), so few researchers train CNN models from scratch. Based on the pre-trained weights of the ImageNet dataset, this study trains a DenseNet model with a 161-layer architecture through transfer learning and uses the model to classify and predict the photos of tourist destinations in various villages. The confusion matrix classified on the test set in the model and the misclassification results of tourist destinations in each village are used to analyze the degree of similarity between tourist destinations. The output parameter 10x1 means, 10 different classes of the images taken from the tourism place.

5.1. The salience of the composition scene in the photo

In order to evaluate the representativeness and characteristic function of a certain travel scene in the tourist destination, Term Frequency-Inverse Document Frequency (TF-IDF) is used to evaluate the importance of a specific scene in the comprehensive image structure of the tourist destination and to calculate the weighted evaluation of image value. TF-IDF is a weighted technical means for information retrieval and text data mining. The core idea is to assume that an element appears most frequently in a specific set and rarely appears in other combinations. That is, it is considered that this element has a more high-weight type classification ability. TF-IDF is shown in Eqs. (1)-(3):

$$\text{TF-IDF}(i,t,T)=\text{tf}(i,t)*\text{idf}(i,T) \tag{1}$$

$$\text{tf}(i,t)=\frac{n_{i,t}}{\sum_k n_{k,t}} \tag{2}$$

$$\text{idf}(i,T)=\log\frac{n_T}{\left|\{t\in T, i\in t\}\right|+1} \tag{3}$$

The $\text{TF-IDF}(i,t,T)$ indicator fully considers the frequency and scarcity of all tourism scenarios. $\text{tf}(i,t)$ represents the total number of times that scenario i is found in all scenarios t in the destination and is the total frequency of the scenario divided by the total frequency of all tourism scenarios in the destination. $\left|\{t\in T, i\in t\}\right|$ denotes the number of tourist destinations, including scene i. n_T represents the total number of tourist destinations. According to the scene importance obtained by TF-IDF, the scene saliency of each picture is calculated separately. A weighted summation of the matching degree between the scene of the candidate photo and the important image of the rural tourist destination is carried out. The scene saliency S_1 of photo p is shown in Eq. (4):

$$S1=\sum_{i=1}^{n}(5\text{-}i)*(11\text{-}A_i) \tag{4}$$

A_i represents the importance ranking of the i-th scene identified by the photo p in the corresponding tourist destination. If the i-th scene is not an important scene corresponding to the tourist destination (ranked outside the top 10), then $A_i=0$. Based on the saliency threshold 5 and is kept as the multiplication factor of maximum tourist destination 10.

5.2. Solving the judgment matrix by sum method

The methods of calculating the weight coefficient include sum, root, power method, etc. Here, the sum method is adopted.

Columns normalize the judgment matrix A to obtain the matrix Q. In the matrix Q, the calculation of any element q_{ij} is shown in Eq. (5):

$$q_{ij}=\frac{A_{ij}}{\sum_{k=1}^{4}A_{kj}} \tag{5}$$

In the normalized matrix Q, the sum of each row is calculated to obtain the vector $\alpha=(\alpha_1,\alpha_2,.....,\alpha_i)^T$. α_i is shown in Eq. (6):

$$\alpha_i=\sum_{j=1}^{n}q_{ij} \tag{6}$$

The vector α is normalized, and the weight vector $W=(w_1,w_2,.....,w_i)^T$ is obtained. The calculation of w_i is shown in Eq. (7):

$$w_i=\frac{\alpha_i}{\sum_{k=1}^{4}\alpha_k} \tag{7}$$

In the decision-making process of representative pictures of rural tourism destinations, the distinguishability of pictures is an important indicator.

5.3. Consistency check

Due to the complexity of the selection strategy of destination representative photos in rural travel, it is highly subjective when constructing the evaluation matrix. The consistency test of the judgment matrix is shown in Eqs. (8)-(10):

$$\lambda_{max}=\frac{1}{n}*\sum_{i=1}^{n}\frac{(AW)_i}{w_i} \tag{8}$$

$$CI=\frac{\lambda_{max}\text{-}n}{n\text{-}1} \tag{9}$$

$$CR=\frac{CI}{RI} \quad (10)$$

n represents the number of indicators; λ_{max} represents the maximum eigenvalue of the matrix; CI represents the consistency index; RI represents the random consistency index. The consistency ratio CR does not exceed 0.10, indicating that the judgment matrix is relatively consistent, and the analysis can be continued. If the CR is greater than 0.10, it is necessary to check the cause of the inconsistency and correct the judgment matrix accordingly. Finally, λ_{max}=6.5065 and CR=0.0558<0.1 indicate that the judgment matrix passes the consistency test, the consistency is acceptable, and the subjective weights of the obtained indicators are credible.

6. Results of model test

6.1. A survey of tourists' rural experience preference

The form of the website is used to distribute the survey questionnaires. The rural feeling preferences of nearly 150 Chinese rural tourists are investigated. The questionnaire's content mainly includes six items of the rural travel experience: rural scenery, special products, farmhouses, farming machinery, farm work, and custom performances. The survey data is shown in Figure 6.

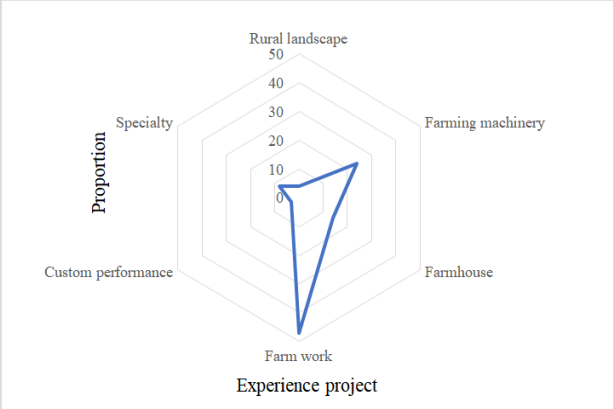


Figure 6 Perception survey of tourists' rural experience preference

The number of tourists who experienced farm work and farming machinery was 47% and 24%, respectively. The number of tourists who experienced farmhouses, special products, rural scenery, and custom performances decreased in turn. Tourists are more inclined to in-depth experience projects such as farming and entertainment activities and machinery. This type of project not only has strong local characteristics but also adapts to tourists' requirements for diversified feelings, which enhances the depth of tourists' feelings.

6.2. Rural tourism scene detection based on Places365-CNNs

The commonly used Places365-CNNs are adopted to extract the constructive features of the perceived environment of rural tourism destinations. The algorithm realizes the scene analysis of TGC photo data. Based on the visual characteristics of images, Places365-CNN automatically counts the degree of matching between different realistic scenarios and images, infers all the contextual information in the images, and outputs the most likely realistic scenarios in probabilistic order. The open-source Places365-CNN includes the parameters of the DenseNet161 pre-trained CNN model. Places365-CNN model structure and scene detection results are shown in Figure 7.

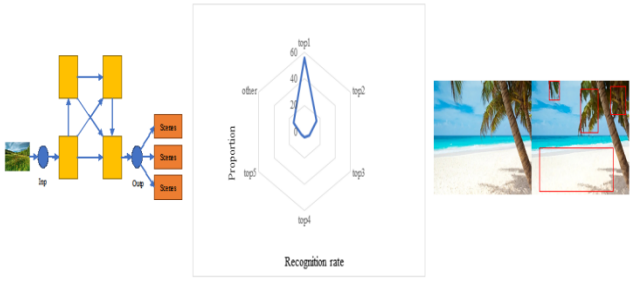


Figure 7 Places365-CNN scene detection, (a) The structure of the Places365-CNN model , (b) Scene discrimination results, (c) The red box highlights the prediction results.

In Figure 7, the expected scene scores are reflected in the previous convolutional layers to obtain the class activation graph. The red box part is the discriminative graph range of the top1 tourism scene detection in the expected results, making the conclusion more explanatory. The results show that in the validation set, the top1 accuracy of the DenseNet161 model is 56.16%, and the top5 accuracy reaches 86.15%. Therefore, the DenseNet161 network model can extract tourist scenes from the collected TGC photos.

6.3. Comparison results of differences in the visual representation of tourist images

This part compares and analyzes the pictures of publicity advertisements of the relevant interest groups in the tourist destination and the pictures taken by tourists and explores the difference between the tourism image projected by the relevant interest groups and the tourists' perceived image. Firstly, a total of 36 Occupationally-Generated Content (OGC) pictures about the rural tourist destination are obtained from the relevant travel agency network. Then, the aesthetic and technical quality of each image is calculated separately, and the implicit scene in the image is determined and compared with the three-way features in the TGC image. The comparison results are shown in Figure 8.

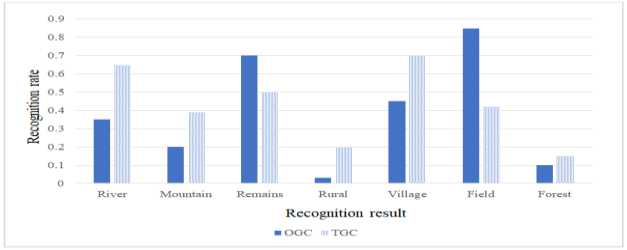


Figure 8 Comparison of OGC and TGC photos

In Figure 8, OGC pictures are often perfect front-of-stage photos and have higher artistic quality and technical texture. The pictures are taken by tourists when they perceive the image representation of the destination is more realistic. This also reflects the tourist destination image formed by OGC, which will be transmitted to tourists through various new media forms to generate image pull. Since the official pictures mostly use photography techniques and means, it is relatively professional photography. So, each stakeholder will select or shoot the complete pictures on the travel site as image projection forms for publicity. However, when potential tourists come to the travel destination for an on-the-spot experience and see the actual tour scene leaving the filter, they will feel disappointed due to the huge gap in their image.

The image connotation perceived by tourists is relatively rich and diverse, while the tourist scenes covered in the photos taken by OGC are simpler and more concentrated. The scenarios of "field farming" and "ancient construction sites" accounted for a large proportion and are much higher than other categories. These two scenarios correspondingly exceed the proportion in the TGC image. It shows that OGC focuses on displaying the tourism resources of rural and cultural architecture. This is mainly because the tourist destination is one of the best agricultural towns in the country and one of the best viewing places for rapeseed flowers, as well as one of the best-preserved areas of the ancient architectural complex. The excellent visual representation of such touring scenarios dominates OGC's promotional images. Figure 9 shows the comparison results of recall rates for different types of OGC photo travel destination recognition.

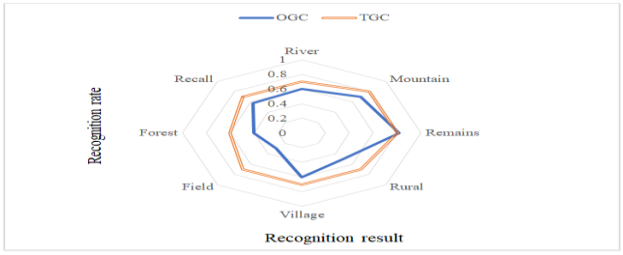


Figure 9 Recall rate of different types of OGC photo tourist destination recognition

In Figure 9, OGC images have lower recall rates than classified TGC images. This also shows that the tourism image projected by various stakeholders using OGC images (It is Activation layer) has a lower recognition rate than that of ordinary tourists. Statistical studies have confirmed that the quality of photos in the other six categories is significantly lower than the accuracy of TGC photos, except that the ancient building relics and TGC photos have the same classification accuracy. This situation may be affected by two aspects: the DMO shapes or projects the image more casually; the DMO shapes the projected image too finely. When these appearances seen by tourists cannot be reproduced at all, a psychological gap will be formed, which will lead to a decline in recognition of the travel destination and seriously affect the travel brand.

7. Conclusions

Visual research has important significance in the process of establishing the image of rural tourism. Since the traveler's photo is the most direct record of the objective living material and natural environment of the tourist destination, it is the direct expression of the city image of the tourist destination. Therefore, a TGC picture represents the general perception of tourists on the city image of the tourist destination. At present, although there is still a lack of a mature framework for integrating rural tourism image theory with tourist image data, tourist photos, as a direct representation of real space elements, are closely related to rural tourism image theory. This study takes the photos of a tourist destination in a county as an example. A research framework that combines a relatively scientific and effective rural tourism image theory with the visual analysis technology of travelers' pictures is formed by using the relatively mature big data analysis technology and deep learning research methods and good results are obtained from this research. There are still some defects due to the limitations of the author's understanding and technology. The form is more efficient, objective, and accurate than traditional questionnaires and field surveys. It also achieves an important breakthrough in sample size. However, based on the network, while satisfying the openness, it also increases the unknown. So, it is impossible to understand the actual situation of tourists. Although the tourist photo data contains a large amount of information about the rural tourism scene, it cannot fully describe the realistic and complex emotional expression of tourists to the destination after traveling and has certain limitations in expressing the image and emotional characteristics of tourists.

References

Barber M., and Pope J.C. (2019). Does party trump ideology? Disentangling party and ideology in America. *American Political Science Review*, **113**(1), 38–54.

Cham T.H., Lim Y.M., Sia B.C., Cheah J.H., and Ting H. (2021). Medical tourism destination image and its relationship with the intention to revisit: A study of Chinese medical tourists in Malaysia. *Journal of China tourism research*, **17**(2), 163–191.

Chan H.P., Hadjiiski L.M., and Samala R.K. (2020). Computer-aided diagnosis in the era of deep learning. *Medical physics*, **47**(5), 218–227.

Claessens S., Fischer K., Chaudhuri A., Sibley C. G., and Atkinson Q.D. (2020). The dual evolutionary foundations of political ideology. *Nature Human Behaviour*, **4**(4), 336–345.

Dašić D., Živković D., and Vujić T. (2020). Rural tourism in development function of rural areas in Serbia. *Економика пољопривреде*, **67**(3), 719–733.

Du M., Cheng L., Li X., and Yang J. (2019). Investigating the influential factors of shared travel behavior: Comparison between app-based third taxi service and free-floating bike sharing in Nanjing, China. *Sustainability*, **11**(16), 4318.

Ferrer-Rosell B., and Marine-Roig E. (2020). Projected versus perceived destination image. *Tourism Analysis*, **25**(2-3), 227–237.

Fujioka,T., Mori M., Kubota K., Oyama J., Yamaga E., Yashima Y., and Tateishi U. (2020). The utility of deep learning in breast ultrasonic imaging: a review. Diagnostics, **10**(12), 1055.

Gama C.M.F., Portugal L.C.L., Gonçalves R.M., de Junior S.S., Vilete L.M.P., Mendlowicz M.V., and Pereira M.G. (2021). The invisible scars of emotional abuse: a common and highly harmful form of childhood maltreatment. BMC psychiatry, **21**(1), 1–14.

Hasan N., Bao Y., Shawon A., and Huang Y. (2021). DenseNet convolutional neural networks application for predicting COVID-19 using CT image. *SN computer science*, **2**(5), 1–11.

Mohd Noh A.N., Razzaq A.R.A., Mustafa M.Z., Nordin M.N., and Ibrahim B. (2020). Sustainable Community Based Ecotourism Developement. *PalArch's Journal of Archaeology of Egypt/Egyptology*, **17**(9), 5049–5061.

Mohd Noh A.N., Razzaq A.R.A., Mustafa M.Z., Nordin M.N., and Ibrahim B. (2020). Future Community-Based Ecotourism (CBET) Development. *PalArch's Journal of Archaeology of Egypt/Egyptology*, **17**(9), 4991-5005.

Preece D., Becerra R., and Campitelli G. (2019). Assessing emotional reactivity: Psychometric properties of the Perth Emotional Reactivity Scale and the development of a short form. *Journal of Personality Assessment*, **101**(6), 589–597.

Qi Y., and Zhang J.Z. (2020). DenseCPD: improving the accuracy of neural-network-based computational protein sequence design with DenseNet. *Journal of Chemical Information and Modeling*, **60**(3), 1245–1252.

Rao X., Qiu H., Morrison A.M., Wei W., and Zhang X. (2022). Predicting Private and Public Pro-Environmental Behaviors in Rural Tourism Contexts Using SEM and fsQCA: The Role of Destination Image and Relationship Quality. Land, **11**(3), 448.

Scherer E. and Thelen T. (2020). On countryside roads to national identity: Japanese morning drama series (asadora) and contents tourism. *In Japan Forum*, **32**(1), 6–29.

Sekhniashvili G. (2021). A REVIEW OF WINE TOURISM DESTINATION IMAGE STUDIES FROM 2001 TO 2020. *Geo Journal of Tourism and Geosites*, **37**(3), 757–767.

Shaheen S., and Cohen A. (2019). Shared ride services in North America: definitions, impacts, and the future of pooling. *Transport reviews*, **39**(4), 427–442.

Shao Y., Chen Z., Xiao H., Zhu Z., and Li B. (2019). Integrating environmental parameters and economic benefits to analyze the ecological agriculture (EA) application in the mountain rice paddy system of Chongqing, China. *Environmental Sciences Europe*, **31**(1), 1–10.

Singh D., Kumar V., and Kaur M. (2021). Densely connected convolutional networks-based COVID-19 screening model. *Applied Intelligence*, **51**(5), 3044–3051.

Skryl T., Osipov V., and Vorozheikina T. (2019). On the way to ecological agriculture: decision-making process in agrarian state policy. In IOP Conference Series: *Earth and Environmental Science*, **274**(1), 012066.

Terzić A., Drobnjakovic M., and Petrevska B. (2020). Traditional Serbian countryside and second-home tourism perspectives. *European Countryside*, **12**(3), 312–332.

Thacker S., Adshead D., Fay M., Hallegatte S., Harvey M., Meller H., and Hall J.W. (2019). Infrastructure for sustainable development. *Nature Sustainability*, **2**(4), 324–331.

Vinuesa R., Azizpour H., Leite I., Balaam M., Dignum V., Domisch S., and Fuso Nerini F. (2020). The role of artificial intelligence in achieving the Sustainable Development Goals. *Nature communications*, **11**(1), 1–10.

Wen Y. (2022). Analysis of Regional Economy Development on Local Environmental Protection and Natural Resources Utilization from the Perspective of Big Data. *Journal of Environmental and Public Health*, *2022*.

Xiao X., Fang C., and Lin H. (2020). Characterizing tourism destination image using photos' visual content. ISPRS *International Journal of Geo-Information*, **9**(12), 730.

Yekimov S, Sobirov B, Turdibekov K, Aimova M, Goncharenko M. Using the Digital Ecosystem in Tourism Clusters in Green Tourism. *InInternational conference Ecosystems without borders* 2022 (105–111). Springer, Cham.

Zheng W., Qiu H., Morrison A.M., Wei W., and Zhang X. (2022). Rural and Urban Land Tourism and Destination Image: A Dual-Case Study Approach Examining Energy-Saving Behavior and Loyalty. *Land*, **11**(2), 146.