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A Feasibility Study on the Integration of Traditional Cultural Elements and English Education Space in Housing Design under Cross-cultural Perspective

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Abstract The current English education space has problems such as low utilization of resources, irrational layout design and lack of functional area differentiation, which seriously affects the teaching effect. As an important carrier of national culture, the integration and application of traditional cultural elements in English education space is of great significance, which can not only enhance the sense of cultural identity, but also improve the attractiveness and educational value of the learning environment. This study explores the feasibility of combining traditional cultural elements in housing design with English education space under cross-cultural perspective. The VGG-19 style migration algorithm is adopted to realize the organic integration of the innovative design of traditional cultural elements and English education space through convolutional neural network technology. A feasibility assessment system containing 5 primary indicators and 20 secondary indicators is constructed, and quantitative analysis is carried out using hierarchical analysis and fuzzy comprehensive evaluation method. The experimental results show that the VGG-19 algorithm takes only 0.705 seconds to process a 512×512 pixel image, which is an obvious improvement compared with the 0.905 seconds of the AlexNet algorithm, and the convergence speed reaches 300 rounds of training to be close to the minimum value, while AlexNet needs 2600 rounds. The structural similarity index SSIM reaches 0.179 and the peak signal-to-noise ratio PSNR is 9.942. The results of the feasibility evaluation show that the weights of the level 1 indicators are 0.2249 for cultural integration feasibility, 0.2034 for functional implementation feasibility, and 0.2513 for economic sustainability. The fuzzy comprehensive evaluation affiliation degree is 3.8251, and the evaluation result is excellent grade. The study confirms that the integration of traditional cultural elements with English education space has high feasibility, can effectively improve the quality of teaching environment and educational effect, and provides scientific basis and practical guidance for the design of cross-cultural English education space.

Index Terms Traditional cultural elements, English education space, style migration algorithm, feasibility assessment, cross-cultural vision, teaching environment

I. Introduction

Traditional culture carries the historical memory and spiritual pursuit of the nation, and its application in housing design can be reflected through architectural style, decorative elements, furniture and ornaments, colors and materials [1]-[3]. This application can not only bring visual enjoyment, but also let people feel the charm and warmth of traditional culture, and more importantly, promote the continuation of traditional cultural values and aesthetics [4]-[6]. And in the context of cross-cultural era, traditional cultural elements in housing design are of great significance for the dissemination of Chinese excellent traditional culture [7], [8].

At present, with the deepening of cross-cultural communication, English education continues to grow in importance in China [9]. English is an instrumental language discipline, and the main purpose of its education is to cultivate talents with cross-cultural communication ability to remove language and cultural barriers [10], [11]. And through the integration of traditional cultural elements of housing design in English teaching, to realize the combination of housing and educational functions, not only can intuitively let students feel the charm of traditional cultural elements, but also feel the innovative fusion of traditional culture and modern architecture, which is of great significance for strengthening students' impression of traditional culture and realizing the dissemination of excellent culture in the context of cross-cultural [12]-[15].

As an important carrier of knowledge dissemination and cultural exchange, the design concept and implementation effect of educational space directly affect the quality of teaching and learning experience. In today's era of deepening globalization, English education bears the important mission of cultivating talents with international vision and cross-cultural communication ability. However, traditional English education space design often neglects the integration of local cultural elements, resulting in the lack of cultural identity and homogenization of the teaching environment. Modern education theory emphasizes the important influence of the learning environment on the cognitive development and emotional experience of learners, and a high-quality education space not only needs to meet the basic functional requirements, but also should reflect the cultural connotation and educational value. Traditional cultural elements as the crystallization of national wisdom, contains a rich historical heritage and unique aesthetic value, its effective integration into the design of English education space, not only can enhance the cultural confidence of learners, but also build a bridge for cross-cultural exchanges. Problems prevailing in the current English education space include improper allocation of spatial resources, unclear delineation of functional areas, and lack of attractiveness of the visual environment, which not only affect the implementation of teaching activities, but also restrict the overall development of learners. The rapid development of artificial intelligence technology provides new ideas and methods to solve these problems, especially the breakthrough of deep learning algorithms in image processing and style migration, which opens up a broad prospect for the digital application of traditional cultural elements.

Based on the above background, this study adopts the research method of interdisciplinary integration, combining computer vision technology with educational space design to construct a theoretical framework and practice model for the integration of traditional cultural elements and English educational space. First, through literature research and field survey, the main problems and improvement needs of the current English education space are deeply analyzed. Second, the VGG-19 style migration algorithm is applied to realize the intelligent extraction and innovative application of traditional cultural elements, and to solve the problem of adapting cultural elements to the design of modern educational space. Once again, a multi-dimensional feasibility assessment index system is established, the weights of each index are determined by hierarchical analysis, and the fuzzy comprehensive evaluation method is used for quantitative analysis. Finally, the effect of the algorithm and the feasibility of the design scheme are verified through empirical research to provide scientific guidance for the application of traditional cultural elements in English education space.

II. Research on the Integration of Traditional Cultural Elements and English Education Space

II. A. Problems in the current English education space

II. A. 1) Insufficient utilization of space resources

In the context of the new liberal arts, although the resources of English education space are rich and diverse, the utilization rate of these resources is not high and there are obvious problems. Many colleges and teachers regard the educational space as a single carrying container, ignoring the subjective constructive and social relational issues that exist in it. Educational space is not only a container for educational activities, but also a complex system with subjective constructive and social relations. However, in practice, many colleges and universities still regard educational space as a single container, ignoring its inherent complexity and dynamism. This oversimplified understanding often leads to the waste of space resources and the reduction of educational effects.

II. A. 2) Insufficient attention to the spatial distribution of education

In the current English education, the importance of educational space layout has not been paid enough attention to, and this neglect has brought a series of problems. First of all, the irrationality of educational space layout may hinder the smooth progress of teaching activities. For example, if the seating layout of a classroom is unreasonable, it may result in students' sight being obstructed, making it impossible for them to see the teacher and the blackboard clearly; if the layout of teaching resources (such as books and laboratory equipment) is unreasonable, it may result in students not being able to access and use these resources conveniently. These problems not only affect the efficiency of teaching activities, but also the learning experience and learning effect of students. Second, the homogeneity of the layout of educational space may limit students' learning styles and learning thinking. The traditional layout of educational space emphasizes the dominant position of teachers and the listening and acceptance of students. This layout restricts students' initiative and creativity and inhibits their learning potential. At the same time, the lack of sufficient space for communication and interaction also limits the development of students' cooperative learning and critical thinking skills.

II. A. 3) Unreasonable differentiation of educational space use areas

Correct and effective use of space zoning has an extremely important impact on the development of educational activities, however, in reality, there is irrationality in the division of English education space. A reasonable educational space should have diversified functions, including the traditional teaching area, as well as the communication and discussion area, independent thinking or independent learning area. However, many English teachers nowadays pay too much attention to the traditional teaching area and neglect other types of space. For example, communication and discussion areas and independent thinking areas are not sufficiently equipped or not reasonably designed, resulting in the functions of these spaces not being fully utilized and affecting students' learning. Traditional educational spaces such as classrooms and reading rooms are often overcrowded, while some other possible educational spaces, such as corridors and open spaces, are neglected or left vacant, and the irrational differentiation of educational space use areas has resulted in a waste of space resources and affected the effectiveness of teaching activities.

II. A. 4) Insufficient mining of space for English online education

The utilization rate of resources in English network education space is low, and there are problems such as closed space structure, weak space interactivity, outdated space design concepts and insufficient attractiveness. In the digital era, network education space has become an important part of education. However, in the current English education, the potential of network education space has not been fully explored and utilized.

II. B.English education space design integrating traditional cultural elements

In response to the four English education space problems reflected above, this subsection develops an optimized design plan for English education space from the perspective of stylistic migration of traditional cultural elements in housing design, aiming to enhance the classroom teaching value of English education space.

II. B. 1) Style Migration Algorithm

This subsection is mainly for the specific completion of the Chinese traditional cultural elements style halo application work to do the global planning, first of all, the traditional style migration algorithm is described and explained, and then solved the difficulties encountered in the process of the integration of traditional cultural elements of the design of the English education space.

(1) The basic idea of style migration algorithm

Style migration is often seen as a style image texture information transfer, in order to get the final migration effect, not only to style image texture migration, but also to preserve the semantic information of the original content image, so that the generated target image can have a style image texture style at the same time, but still retains the semantic content of the content image [16], [17]. In our experiments, we take advantage of the high performance of convolutional neural networks and use the image style migration technique in the hope that we can innovate the traditional cultural elements and design an English educational space with more pedagogical value. Learning how to represent the features of an image, how to distinguish the content information and style information of an image, operating separately, using convolutional neural networks to learn images with different style information, and then mimicking these styles to render the content image, this is the basic idea of image style migration technique. The experimental data in this paper is based on VGG-19, which inputs the content image and style image into the convolutional neural network, combines the corresponding effect of its features in a certain layer, adjusts the relevant parameters, and finally obtains the target image we expect.

(2) Traditional style migration based on online image optimization

VGG network is initially used for image classification, the feature representation in the network becomes more abstract as the layers increase, the higher layers discard some of the color and texture information, but largely retain the shape and location of the object, the fifth layer is selected in the topic for content representation. The image style is preserved using the GRAM matrix, which computes the eccentricity covariance of the feature mapping, i.e., the correlation of the two-by-two features. The output image is based on a white noise image, defining the content loss function as well as the style loss function, which is continuously updated with gradient descent so that the resulting image approximates the content picture in terms of content and the style picture in terms of style.

(a) Selection of activation functions

The sigmiod function, the tanh function and the ReLU function are the activation functions that are usually used. The main activation functions used in neural networks at the beginning of the research stage are the tanh function and sigmoid function, which have the characteristics of finite output values, so it is easier to manipulate when used as input values. However, nowadays, as the number of layers of the network increases more and more researchers are using the Relu function or a modification of the Relu function as the excitation function.

The following equation is the expression of Sigmoid activation function:

$$f(z)=\frac{1}{1+e^{-z}} \tag{1}$$

The Tanh function is analytic:

$$\tanh(x)=\frac{e^{x}-e^{-x}}{e^{x}+e^{-x}} \tag{2}$$

Improved compared to the Sigmoid function in cases where its output value is not zero-mean. But the expression of tanh function still has a power function and it has the same possibility of vanishing gradient.

In this paper we use ReLU activation function, ReLU function does not exist power function calculation process, so in time than the sigmoid function tanh function is shorter, in recent years has been widely used, and its function expression is:

$$\mathrm{Re}LU=\max(0,x) \tag{3}$$

ReLU, although simple, is also effective in solving the problem of gradient vanishing that may occur in the positive real region, and improves the training efficiency.

(b) Generation of feature styles

When this white noise image is input into the network, there are different filters in each layer, for example, there are 64 filter sets in the conv1_1 of VGG-19, and each filter corresponds to a different response effect. The initial white noise image and the content image are input into the neural network, and its two-parameter distance function is computed in layer 4 of the network, and the result obtained by doing the difference operation between the two is called the content loss function. The expression is as follows:

$$L_{content}(\vec{p},\vec{x},l)=\frac{1}{2}\sum_{ij}(F_{ij}^{l}-P_{ij}^{l})^{2} \tag{4}$$

The style loss function is understood in the same way as the content loss function, and a Gram matrix G is created to represent its feature associations:

$$G_{ij}^{L}=\sum_{k}F_{ik}^{L}F_{jk}^{L} \tag{5}$$

The loss of l layer can be normalized to:

$$E_{i}=\frac{1}{4N_{l}^{2}M_{l}^{2}}\sum_{ij}(G_{ij}^{l}-A_{ij}^{l})^{2} \tag{6}$$

where A is the representation of the original image in l layers, w is the weight of each layer, i.e., the coefficient of influence of the loss value of each layer, when we want to increase the rendering effect of a certain layer then increase the weight coefficient of this layer, similarly add we want to weaken the rendering effect of a certain layer then reduce this weight coefficient. The style loss function is represented as:

$$L_{style}(\vec{a},\vec{x},l)=\sum_{l=0}^{L}w_{i}E_{i} \tag{7}$$

Through experiments, we found that the stylized images generated through the above steps have slightly abrupt changes between neighboring pixel points, so we considered adding the mean square deviation between neighboring pixel points in the total loss function, so that the results we get will be relatively smoother in terms of visual effect. The expression is as follows:

$$L_{total}=\alpha L_{content}+\beta L_{style}+\gamma L_{pixel} \tag{8}$$

α and β are the parameters that control the degree of stylization of the output image, the greater the proportion of the value of α the closer the target image is to the semantic content representation of the content image, the greater the proportion of the value of β the closer the target image is to the stylized rendering of the stylized image, and γ is the pixel variable's influence factor. Using the optimization algorithm, the total loss function result is calculated to converge to 0. Initially, a random white noise image is input to gradually approximate the content texture of the content image and the feature representation of the GRAM matrix of the style image, which is converted to the target stylized image we want to obtain.

II. B. 2) Design strategy

The first is English education space design style generation: let the style migration algorithm learn how to generate an interior design scheme that meets the user's needs under the given information conditions, and guide the algorithm's learning through the loss function. The second is layout optimization within the English education space: in the case that the English education space design scheme has been determined, let the style migration algorithm learn how to optimize the English education layout under the constraints of the existing space and the location of the teaching equipment placement, such as minimizing the traffic flow. Third, English education space design material selection: let style migration algorithms learn how to choose which materials and colors will be more in line with user needs and aesthetics under the existing English education space design scheme.

Color in addition to the main color, there should be other auxiliary colors, such as for space orientation, identification, safety warnings, furnishings and decorations, etc., should be bright, eye-catching colors, to facilitate the creation of a cheerful, lively, novel environment to enhance the identification and highlight the effect of reflecting the characteristics of the English language education space. Auxiliary colors should be differentiated and contrasted with the main color, but also consider mutual unity and coordination, which requires the use of auxiliary colors can not be too much, otherwise it is easy to cause confusion, fancy feeling. At the same time to consider different functional rooms, different floors, different areas of the color should be a certain difference. Reading room and its area should be a single bright color, is conducive to children in a bright and relaxed environment to concentrate on reading books. In short, the scientific and rational use of color unity and change, stability and balance, rhythm and rhyme and other artistic laws and methods to the environment of the English education environment, will create a more comfortable, beautiful and harmonious educational environment. Considering that some of the current English teaching spaces do not meet the standards, if the space is too high, you can consider roof decoration or hanging some decorations to reduce its space and change the visual sense of emptiness. Whether decorated or undecorated, the top surface is required to be bright in color and high in light reflectivity so as to contribute to indoor and outdoor lighting. Top surfaces in special environments can be differentiated. Character areas can also be painted according to the needs of the activity. The top surface should not be too smooth, so as to help enhance sound absorption and avoid chordal light. If it is a top floor, thermal insulation should also be considered. The top surface decoration should use materials with good heat insulation, flame retardant and fireproof performance, such as gypsum board and keel. Electrical wires should be put into flame-retardant pipes to avoid fires caused by circuit failures, so as to create an English education space that meets students' learning needs.

III. Analysis of case studies

III. A. Style migration algorithm validation analysis

III. A. 1) Experimental environment

In order to verify the effectiveness of the VGG-19 algorithm proposed in this paper, the VGG-19 algorithm proposed in this paper and its comparison with the AlexNet algorithm, the experimental platform adopts the Ubuntu 14.0 operating system, configured with an Intel 9900 CPU, 64GB DDR4 memory, 256GB solid state hard disk, and a GTX2080Ti graphics card. The experiment is mainly based on the Tensorflow deep learning framework, and the images of traditional cultural elements are downloaded from the Internet.

III. A. 2) Comparison of Loss Decline Rates of Different Algorithms

This subsection compares the proposed VGG-19 algorithm with the AlexNet algorithm in terms of the rate of decline of the loss values, and the results are shown in Fig. 1. From the figure, it can be seen that the convergence rate of the proposed algorithm in this paper is significantly faster than the AlexNet algorithm. After close to 300 rounds of training, the loss value of the algorithm proposed in this paper is close to the minimum, while in the AlexNet algorithm, close to 2600 rounds of iterations are required to achieve the same result. From this, it can be seen that by using the VGG-19 algorithm can reduce the feature loss of traditional cultural elements to a certain extent and maintain a certain convergence speed.

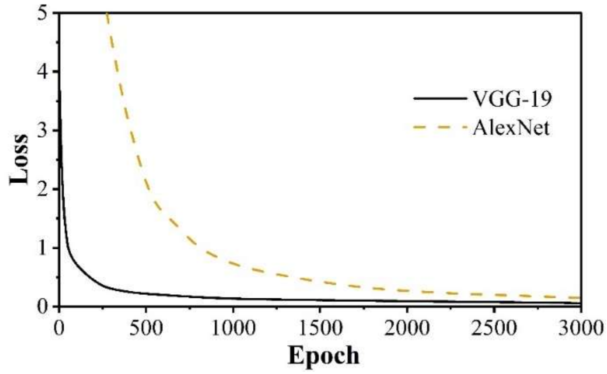

Figure 1: Comparison of loss reduction rates among different algorithms

III. A. 3) Comparison of processing time of different algorithms

This subsection also compares the processing time required by different algorithms for processing the same traditional cultural elements and style images, the results of the comparison of processing time of different algorithms are shown in Table 1. The table gives the time used in processing different resolution images in 500, 1000 and 3000 iterations respectively. While the VGG-19 algorithm and AlexNet algorithm proposed in this paper do not need to iterate after training, although the running speed of the algorithm proposed in this paper is faster, the training time required for its model is very long, and it uses 3500 256×256 pixel images for training, with a total of 3000 rounds of iterations, and a total time of about 240.05 seconds. Fast style migration greatly reduces the running time required by the algorithm while guaranteeing the quality of the generated traditional cultural elements images, making real-time style migration possible, and the VGG-19 algorithm is far better than the AlexNet algorithm, which can well accomplish the traditional cultural elements migration task.

Table 1: Comparison results of processing time of different algorithms

Picture size	Epoch			AlexNet	VGG-19
	500	1000	3000		
128×128	5.23s	26.05s	51.15s	0.088s	0.082s
256×256	15.05s	69.33s	122.35s	0.312s	0.211s
512×512	30.26s	129.28s	240.05s	0.905s	0.705s

III. A. 4) Analysis of migration effects

(1) Evaluation Metrics

Structural Similarity Algorithm (SSIM) is a metric used to compare the similarity of images, which considers not only the brightness, contrast and color information of the image but also the structural information of the image. Image style migration changes the style of the image while keeping the structure of the image unchanged, so the SSIM metrics can be used to evaluate the structural similarity between the content image and the stylized image.The larger the SSIM value, the higher the structural similarity is.The process of calculating SSIM is done by dividing the image into chunks and calculating the luminance, contrast and structural similarity of each chunk, which finally results in the overall SSIM index.The principle is shown in equation (9) Shown:

$$SSIM(x,y)=\frac{(2\mu_x\mu_y+C_1)(2\sigma_{xy}+C_2)}{(\mu_x^2+\mu_y^2+C_1)(\sigma_x^2+\sigma_y^2+C_2)} \tag{9}$$

where μ is the image mean, σ is the image standard deviation, C_1 and C_2 are constants. σ_{xy} is the image covariance. Peak Signal to Noise Ratio (PSNR) focuses on the pixel level difference of the image and evaluates the degree of image distortion by calculating the mean square error between the stylized image and the original content image and the stylized image, respectively.The higher the value of PSNR, the higher the quality of the image. In this paper, PSNR is used to calculate the difference between the generated stylized image and the content image, and the stylized image. The content stylized image pairs are randomly selected and the content differences are calculated based on PSNR (C) and the stylized differences are calculated based on PSNR (S).The principle of PSNR calculation is shown in equations (10) to (11):

$$MSE(X,Y)=\frac{1}{H\times W}\sum_{i=1}^{H}\sum_{j=1}^{W}(X(i,j)-Y(i,j))^2 \tag{10}$$

$$PSNR(X,Y)=10\log_{10}\left(\frac{(2n-1)^2}{MSE(X,Y)}\right) \tag{11}$$

where $X(i,j)$, $Y(i,j)$ represent the pixel values of the image in the corresponding coordinates, H,W represents the height and width of the image respectively, and n represents the number of bits per pixel value.

(2) Analysis of evaluation index results

With the theoretical support of the above evaluation index calculation formula, the migration effect of different algorithms is discussed, and the migration effect of different algorithms is shown in Table 2. Based on the values of the evaluation indexes in the table, it can be seen that compared with the AlexNet algorithm, the VGG-19 algorithm has a higher priority in the style migration of traditional cultural elements, which ensures that the design of the English education space that integrates the traditional cultural elements is more in line with the requirements of the teaching environment of colleges and universities.

Table 2: The migration effects of different algorithms

Picture size	AlexNet				VGG-19			
	PSNR(C)	PSNR(S)	SSIM(C)	SSIM(S)	PSNR(C)	PSNR(S)	SSIM(C)	SSIM(S)
128×128	9.426	9.118	0.136	0.115	9.846	9.901	0.169	0.174
256×256	9.454	9.247	0.132	0.103	9.918	9.884	0.172	0.178
512×512	9.433	9.288	0.128	0.123	9.726	9.942	0.179	0.176

III. B. Analysis of the feasibility assessment of space for English language education

III. B. 1) Evaluation of the indicator system

Based on the relevant information, the principle of evaluation index system construction, and the Delphi method, the feasibility assessment index system of English education space design integrating traditional cultural elements was finally determined, and the evaluation index system is shown in Table 3. The evaluation index system consists of five primary evaluation indexes (cultural integration feasibility X1, functional implementation feasibility X2, economic sustainability X3, social acceptance X4, and innovation extensibility X5) and 20 secondary evaluation indexes (cultural element suitability X11, regional culture recognizability X12, bilingual transformation logic X13, cross-cultural cognitive risk X14, and pedagogical scene suitability X21, Difficulty of technical realization X22, multi-age applicability X23, safety compliance X24, initial investment cost X31, cost-effectiveness of operation and maintenance X32, resource recycling rate X33, potential for commercial expansion X34, willingness of teachers and students to participate X41, cultural identity of the community X42, adaptability to international audiences X43, inclusiveness in terms of accessibility X44, space for technological iteration X51, ability to derive culture and IP. X52, interdisciplinary integration X53, and international communication compatibility X53).

Table 3: Evaluation index system

First-level indicator	Symbol	Secondary indicators	Symbol
The feasibility of cultural integration	X1	Cultural element compatibility	X11
		Regional cultural identifiability	X12
		The logic of bilingual transformation	X13
		Cross-cultural cognitive risk	X14
Feasibility of function implementation	X2	Adaptability to teaching scenarios	X21
		Technical implementation difficulty	X22
		Applicability for multiple age groups	X23
		Security compliance	X24
Economic sustainability	X3	Initial investment cost	X31
		Cost-effectiveness of operation and maintenance	X32
		Resource recycling rate	X33
		Business expansion potential	X34
Social acceptance	X4	The willingness of teachers and students to participate	X41

		Community cultural identity	X42
		International audience adaptability	X43
		Accessibility and inclusiveness	X44
Innovation scalability.	X5	Technological iteration space	X51
		The ability to derive cultural ips	X52
		Interdisciplinary integration degree	X53
		International communication compatibility	X54

III. B. 2) Calculation of evaluation indicator weights

In this study, the hierarchical analysis method is used to calculate the final weights of the final evaluation indicators, which is commonly used to solve the problem of dealing with this kind of complex structure, more entries and not easy to quantify [18]. Yaahp computer software is used to carry out the analysis and calculation, and the steps are constructing the hierarchical structure model, constructing the judgment matrix, analyzing the weights of the indicators and consistency test, and finally arriving at the final weights of the evaluation indicator system. The judgment matrix of each evaluation index is shown in Figures 2~7, and the results of evaluation index weights are shown in Table 4. Through the calculation of the hierarchical analysis algorithm for the evaluation index weights, it can be seen that the five first-level index weight values are 0.2249, 0.2034, 0.2513, 0.1602, 0.1602, and the absolute weights of the second-level indexes are subject to the data in Table 4, and will not be repeated to describe.

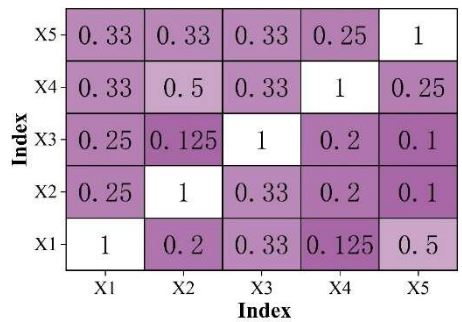

Figure 2: First-level indicator judgment matrix

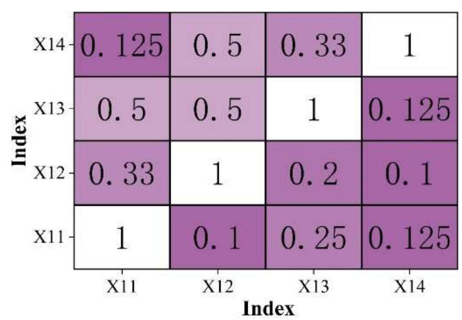

Figure 3: Judgment matrix(X1)

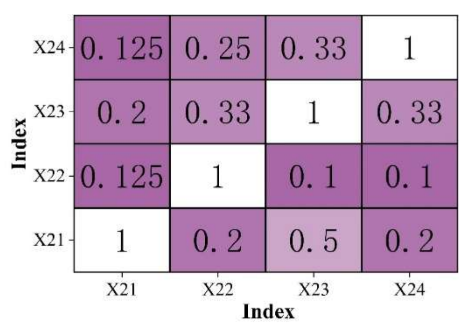

Figure 4: Judgment matrix(X2)

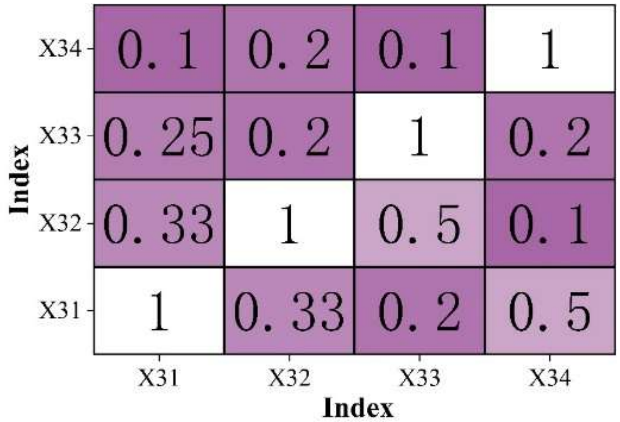

Figure 5: Judgment matrix(X3)

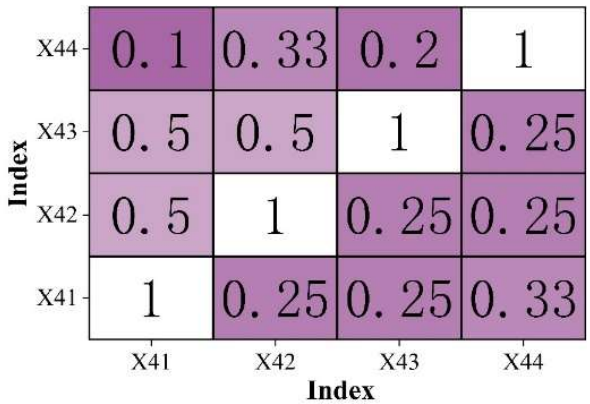

Figure 6: Judgment matrix(X4)

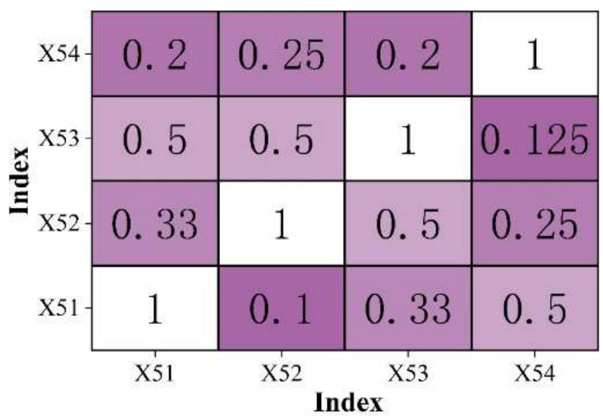

Figure 7: Judgment matrix(X5)

Table 4: Evaluation index weight results

First-level indicator	Weight	Secondary indicators	Weight
X1	0.2249	X11	0.0639
		X12	0.0670
		X13	0.0604
		X14	0.0335
X2	0.2034	X21	0.0388
		X22	0.0589
		X23	0.0589

		X24	0.0468
X3	0.2513	X31	0.0595
		X32	0.0669
		X33	0.0624
		X34	0.0624
X4	0.1602	X41	0.0408
		X42	0.0462
		X43	0.0343
		X44	0.0389
X5	0.1602	X51	0.0443
		X52	0.0348
		X53	0.0443
		X54	0.0368

III. B. 3) Fuzzy integrated evaluation analysis

Fuzzy mathematics is a new science that uses mathematical methods to study and deal with fuzzy phenomena. Based on the theory of “fuzzy set”, it provides a new way to deal with uncertainty and imprecision, and is a powerful tool for describing the information of the human brain today [19], [20]. In recent years, this technology has been widely used not only in many natural science fields such as automatic control, computer and information processing, statistical analysis of data, but also in social science fields such as decision-making, education and teaching management. At present, it is more involved in fuzzy metrics, fuzzy identification, fuzzy reasoning, fuzzy sets, fuzzy retrieval, fuzzy optimization, fuzzy control, and fuzzy decision-making. Because of the fuzzy nature of the evaluation conclusions, the conclusions are thus made more precise and are particularly suitable for the comprehensive evaluation of the feasibility of the design of English education space based on traditional cultural elements.

A school is selected as the case of this study, and five evaluation level affiliations are set, respectively excellent, good, medium, qualified, unqualified, corresponding to scores 5, 4, 3, 2, 1. In this study, 10 experts in this field are taken as the evaluation subject, and the fuzzy comprehensive evaluation judgment matrix is obtained through the evaluation subject's scoring of the evaluation index system of this paper, and the judgment matrix is shown in Table 5. The affiliation degree of the fuzzy comprehensive evaluation judgment matrix of the feasibility of combining traditional cultural elements and English education space is (3.8251, 1.2909, 1.2764, 13463, 2.2593), and under the effect of the maximum affiliation degree, it is concluded that the evaluation result of the feasibility of combining traditional cultural elements and English education space is excellent, i.e., the feasibility of combining traditional cultural elements and English education space is high , which has a boosting effect on improving the English teaching environment and achievement in colleges and universities.

Table 5: Judgment matrix

First-level indicator	Weight	Secondary indicators	Weight	Excellent	Good	Medium	Qualified	Unqualified
X1	0.2249	X11	0.0639	4	2	1	1	2
		X12	0.0670	4	1	1	1	3
		X13	0.0604	4	1	1	1	3
		X14	0.0335	3	1	1	2	3
X2	0.2034	X21	0.0388	3	1	2	2	2
		X22	0.0589	5	1	2	2	0
		X23	0.0589	3	1	2	1	3
		X24	0.0468	4	2	1	1	2
X3	0.2513	X31	0.0595	4	1	1	1	3
		X32	0.0669	4	1	1	1	3
		X33	0.0624	3	1	1	2	3
		X34	0.0624	4	2	1	2	1
X4	0.1602	X41	0.0408	3	1	1	1	4
		X42	0.0462	5	1	1	2	1
		X43	0.0343	5	1	1	1	2
		X44	0.0389	4	2	2	1	1
X5	0.1602	X51	0.0443	3	1	1	1	4
		X52	0.0348	3	2	1	1	3
		X53	0.0443	4	2	2	2	0
		X54	0.0368	4	1	2	1	2

IV. Conclusion

Through in-depth research on the integration mechanism of traditional cultural elements and English education space, the design scheme based on the VGG-19 style migration algorithm is verified to have significant advantages. The algorithm performance test shows that when processing 256×256 pixel images, the processing time of VGG-19 algorithm is only 0.211 seconds, which realizes a significant improvement compared with 0.312 seconds of traditional AlexNet algorithm, and the processing efficiency is improved by 32.4%. The structural similarity assessment results show that the VGG-19 algorithm performs well in maintaining the integrity of the image content, and the SSIM index reaches 0.178, which ensures the visual quality and structural stability of the traditional cultural elements in the migration process. The analysis results of the feasibility evaluation system show that the economic sustainability indicator has the highest weight of 0.2513, reflecting the key position of cost-effectiveness in practical application, while the weight of cultural integration feasibility is 0.2249, reflecting the importance of cultural element adaptation. The expert evaluation results further confirm the feasibility of the integration program, with the excellent level evaluation dominating the comprehensive evaluation by 10 domain experts, and the final affiliation value of the fuzzy comprehensive evaluation indicating that the overall program reaches the excellent level.

This study provides innovative ideas and technical support for the design of English education space, realizing the organic unity of traditional cultural heritage and modern education needs. The constructed evaluation index system and algorithm model have good applicability and promotion value, and can provide personalized space design solutions for English education institutions of different types and sizes. In the future, we can further explore the integration mode of multicultural elements, expand the application scope of the algorithm in the design of larger-scale educational spaces, and contribute to the construction of an internationalized educational environment with Chinese characteristics.

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