

Incorporating Traditional Cultural Elements in Urban Streetscape Design Using the Internet of Things and Deep Learning

Dongli Si^{1,2,*} and Ning Du³

¹College of Art, Jiaozuo University, Jiaozuo 454000, China

²Graduate School, Emilio College, Manila 0900, Philippines

³College of Distance Education, Jiaozuo University, Jiaozuo 454000, China

With the development of the Internet of Things and deep learning, the styles and designs of urban streetscapes have undergone major changes. For instance, a new trend is emerging: the seamless integration of cultural elements with other streetscape characteristics. This can enhance the aesthetic characteristics of urban streetscape design, significantly improve the quality of urban streetscapes, emphasize traditional cultural elements, apply specific features to modern buildings, and improve the integration of various elements. In this study, we conduct a comprehensive investigation of the current status of urban street landscape settings and examine the integration of traditional cultural elements with modern architectural elements. Our focus on this integration is anticipated to yield valuable insights for urban street landscape design and theory.

Keywords: application research, element, design, traditional culture, urban landscape

1. INTRODUCTION

Due to the development and widespread application of the Internet of Things and deep learning models, digital image technology has penetrated all fields of production and everyday life [1]. The style of urban streetscape design has evolved in a variety of ways. To improve the landscape design features of different streets and different communities, modern design elements and traditional cultural elements need to be integrated effectively. This article proposes an architectural style that is more appealing to residents. The design also meets the requirements of a green, low-carbon architectural style. Using the Internet of Things and deep learning, the elements and technical aspects of streetscape design can be comprehensively analyzed and integrated.

Considering the different stages of construction and the regional characteristics, an urban streetscape is proposed that has distinctive design requirements and approaches. To conduct an effective analysis and comprehensive application of traditional cultural elements, we undertake theoretical research on the combination of traditional elements and modern architectural elements. When designing the architecture, the traditional and cultural elements of the area were taken into account. Hence, research has been conducted to design streetscapes that are modern but also reflect the cultural background and characteristics of the community [2, 3].

The inclusion of traditional cultural elements in a streetscape is a relatively novel means of promoting traditional culture and has become an inevitable development trend to encourage multicultural development and exchanges. By organically integrating traditional cultural elements with modern architectural cultural elements in a city, different

*Corresponding author e-mail: si_dongli@outlook.com

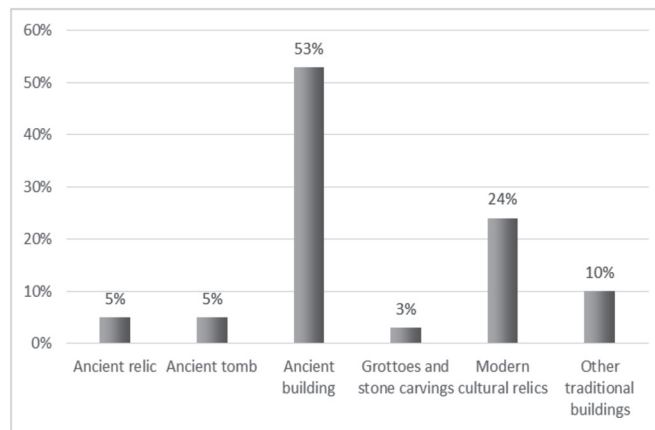


Figure 1 The proportions of major traditional ancient buildings in China.

historical backgrounds can be reflected. Additionally, the complexity and diversity of buildings can reflect their historical and cultural significance. Moreover, it can ensure the survival of the different cultural characteristics of various regions, strongly establish people's cultural identity, and enhance and promote cultural knowledge. When designing a streetscape, the integration of traditional cultural elements can further strengthen traditional Chinese cultural expression, enhance the cultural significance of landscape settings, create a new design for the integration of modern element design and traditional cultural element design, and lead to the creation of a novel design idea [4, 5].

2. TRADITIONAL CULTURAL ELEMENTS IN URBAN STREETSCAPES

2.1 Traditional Cultural Elements in Architectural Design

When designing urban streetscapes, the inclusion of traditional cultural elements and their seamless integration with modern architecture can expand the field of construction design and the diversified development path of traditional cultural elements. During the evolution of Chinese civilization over thousands of years, countless traditional cultural elements have accumulated. Architectural elements that are derived from various other fields, such as animal appearance, the ecological environment, and human activities, have undergone more comprehensive development. Through organic integration with the current design cultural concept, Chinese civilization can further expand the development of traditional cultural elements and effectively improve the cultural significance of traditional cultural elements [6, 7]. Figure 1 shows the numbers and types of significant ancient buildings and other cultural elements.

2.2 Traditional Elements Covered in Urban Street Landscape Design

In the design of urban street landscapes, different architectural elements, such as natural landscapes and animals, are

included. Simultaneously, in the process of landscape design and humanistic and cultural elements, the absorption of historical and cultural elements was realized. Urban streetscape design and development should not only reflect strong cultural heritage in the regional development process but also use trees, shrubs, etc., to ensure green low-carbon environmental protection. Streetscapes should include both natural and human-constructed elements [8, 9].

2.3 Traditional Element Characteristics in Urban Street Landscape Design

When designing an urban streetscape, it is essential to include traditional cultural elements. These cultural elements are important symbols and indications of a region's heritage spanning thousands of years. Cultural elements can fully display the cultural heritage of a region and a street. To preserve cultural heritage, traditional elements must be seamlessly integrated with modern architecture and current-day aesthetic values. When designing a city's sightseeing environment, green vegetation and marked landscape, we should not only fully respect the significance of traditional cultural elements but also effectively avoid various factors that affect cultural propaganda and organically integrate them with current architectural elements [10, 11].

3. APPLICATION DISPLAY OF TRADITIONAL ARCHITECTURAL CULTURAL ELEMENTS IN URBAN STREETSCAPES

3.1 Application of Traditional Architectural Cultural Elements

When developing a streetscape, traditional architectural cultural elements should be fully displayed to reflect the progress of civilization and a strong historical and cultural heritage. Our investigation of traditional architectural cultural elements revealed that with the continuous accumulation and development of traditional Chinese culture, the application of traditional architectural cultural elements has become more widely used in architecture, which is

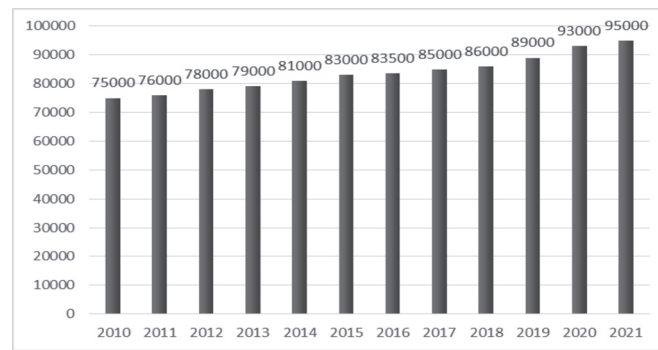


Figure 2 The number of urban buildings incorporating traditional Chinese cultural elements from 2010 to 2021.

evident in distinctive architectural features such as doors, windows, and eaves. Additionally, in different regions and environments, architectural styles can reflect the traditional cultural characteristics of each region. In the process of accurately investigating and grasping the cultural context, we discovered different architectural and cultural elements specific to each region. Through the historical continuity of traditional cultural elements, effective investigations can be better discovered. The application of traditional cultural elements in architecture is very broad. In particular, in the urban street landscape design process, it is possible to discover that traditional cultural elements form during the process of historical civilization development in different regions [12, 13]. The number of urban buildings incorporating traditional Chinese cultural elements into the construction process is showing an increasing trend year by year. Figure 2 shows the number of urban buildings incorporating traditional Chinese cultural elements from 2010 to 2021.

3.2 Integration and Development of Traditional Architectural Cultural Elements and Modern Cultural Elements

The organic integration of traditional architectural cultural elements and modern cultural elements has further promoted and driven the development and innovation of urban streetscapes. Through the effective integration of different regions, and different design concepts, the overall design of a city can be effectively enhanced. In the process of urban landscape design, we must not only highlight the overall application of traditional cultural elements but also combine the development status of modern cultural elements at this stage to organically integrate the overall architectural style of the city. It not only inherited and carried forward traditional culture but also effectively integrated modern culture elements to promote the profound development of traditional culture. Moreover, in the process of integrating traditional cultural elements and modern cultural elements, not only must we effectively balance architectural functions and modern aesthetics but also the form, body, color, function, and aesthetic value in the process of setting up urban street landscape settings. Organic fusion achieves harmony in urban landscape settings. In the process of fusing and developing different cultural elements and in the process of integrating various styles, traditional cultural elements are extracted from

traditional cultural elements, which are clearly representative of cultural elements; this fully integrates the cultural element development trends to realize the cultural heritage of cultural innovation and enhance the setting of urban street landscapes [14, 15].

3.3 Focus on the Application of Traditional Cultural Elements in Landscape Design

When considering traditional cultural elements, the construction and development of landscapes are also important parts of urban streetscapes. As the population density in a city gradually increases, design requirements must fully take humanization into account and use humanity as an important design idea to create urban living areas that meet the aesthetics and life needs of human beings at this stage. In the process of effective cultural coverage and the integration of traditional cultural elements, the setting of landscapes and the integration of green vegetation landscapes must be effectively adjusted and designed to meet the needs and aesthetic value of modern people. Moreover, in the process of effectively designing a green vegetation landscape, we must respect the modern architectural style, use modern architectural materials, and use traditional cultural elements for carving, shaping and application. The material transportation and mechanical requirements meet the requirements of modern urban street design and meet people's needs. In Table 1, the different modes of the learning and application of traditional cultural elements were surveyed, and the results were as follows [16, 17].

4. THE INNOVATIVE DEVELOPMENT OF TRADITIONAL CULTURAL ELEMENTS IN MODERN ARCHITECTURE

4.1 Different Presentations of Traditional Cultural Elements

In terms of the display and presentation of traditional cultural elements, effectively integrating different presentations in the urban landscape setting can greatly promote traditional cultural elements and innovative development paths in modern

Table 1 Different modes of traditional cultural element learning applications.

Number	Learning mode	Way of learning
1	Artificial intelligence	Program that can perceive, reason, action and adaptation
2	Machine learning	Algorithms that can continuously improve performance with the increase in data volume
3	Deep learning	A multilayer neural network learns from aging data
4	Integration learning	Multiple learning modes in parallel

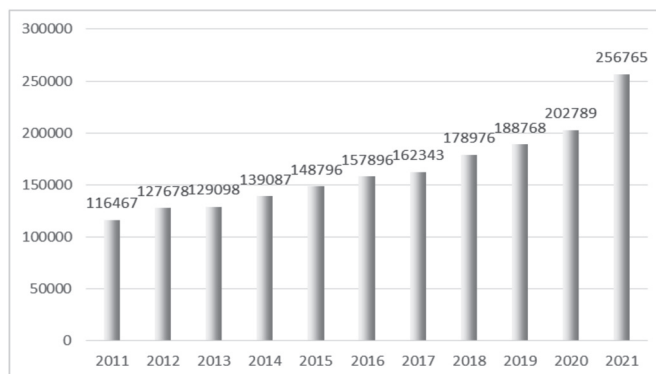


Figure 3 2011-2021 Total output value of domestic construction enterprises changes.

Table 2 Comparison of traditional architectural style and modern architectural style.

Number	Architectural element	Traditional style	Modern style
1	Landscape	Plants, totems, landscapes	Office buildings, buildings, layouts
2	Aesthetics	Nature and cultural heritage	Structure, coordination
3	Spatial structure	Space structure twists and turns	Space structure is full
4	Spatial personality	Cultural connotation	Follow the aesthetics of modern people
5	Mood	Mainly cultural heritage	Pay attention to people-oriented
6	Philosophy	Profound cultural heritage	Heaven and man

buildings. Through direct and indirect methods, traditional cultural elements are integrated into the process of establishing modern urban street landscapes so that every city and street can not only fully display local regional cultural characteristics but also fully integrate modern architectural elements and the background of the times, more vividly reflecting the economic and political development of various regions and unique urban development culture. In the process of organic integration of different traditional cultural elements, different cities and different regional environments also reflect different characteristics. Figure 3 shows the changes in the total output value of domestic construction enterprises from 2011–2021, and the results are as follows.

4.2 Different Expressions of Traditional Cultural Elements

Traditional cultural elements have diverse expressions in modern urban street landscape settings. With different architectural styles and different design concepts, urban architectural styles are different, and people’s demands for urban architecture and aesthetic value orientation are also different, increasing the diversity and enrichment of traditional cultural elements in modern architecture. By using a more distinctive fusion design method, traditional cultural elements

are organically integrated with modern architectural styles and architectural materials, which can not only show the effective publicity and inheritance of traditional cultural elements but also meet modern architectural mechanics and architecture requirements. The design requirements of learning have achieved organic unity and balance. In the process of effectively integrating natural landscapes and humanistic landscapes via mutual references between landscapes, the setting of the entire street and the display of architectural styles are more harmonious. Table 2 compares the traditional architectural style and modern architectural style.

4.3 Fusion and Innovation of Traditional Cultural Elements and the Modern Landscape

The integration and innovation of traditional cultural elements and modern streetscapes is an important means for the effective integration and development of traditional cultural elements and modern architecture. In the process of design and development, it is necessary to effectively inherit and propagate different traditional cultural elements in various regions and, at the same time, organically integrate them with modern culture and buildings to keep pace with the times. To reflect the historical and cultural narratives that

Table 3 In recent years, the country's protection measures for traditional urban architecture.

Number	Post unit	Document	Content
1	State Council	Opinions on the sustainable and healthy development of vinegar construction industry	Promote the protection of traditional buildings
2	Housing and Urban–Rural Development	Outline of the development of construction informatization	Informatization construction of traditional buildings
3	State Council	About further strengthening the outline of urban information development	Cultural protection of urban informatization construction of medium-sized buildings
4	China Survey and Design Association	Engineering survey and design industry informatization work guidance	Survey of historical and cultural monuments
5	State Council	Regarding the guidance of advancing the application of building information models	The fusion of traditional architecture and modern architecture
6	Housing and Urban–Rural Development	New type of national urbanization planning	City street settings retain the traditional elements
7	Housing and Urban–Rural Development	Urban Construction Action Plan	The integration of traditional culture in urban planning

shape a region and its people, it is essential to deeply explore and effectively summarize these stories. By condensing traditional architectural elements with unique cultural significance and integrating them into buildings and urban street landscapes, cities can vividly showcase the traditional cultural characteristics and heritage of the region. Moreover, with respect to the culture of urban landscape settings, in different regions and different ethnic cultural backgrounds, different animals and different totems differ in terms of cultural publicity and guidance (Table 3).

4.4 The Cultural Connotation Brought by Traditional Architectural Elements to Modern Architecture

The application of traditional architectural cultural elements in modern architecture is reflected not only in the overall construction of the city but also in the design of urban street landscapes. It plays an important role in the overall planning and cultural content of a city. By using simplified and abstract methods, we conduct comprehensive investigations on the actual application characteristics of traditional culture and modern architecture. Urban street construction presents an opportunity for such a comprehensive investigations. In the design of urban street landscapes, traditional cultural elements can be used, and natural applications for these elements can be organized, integrated, excavated, and refined to more effectively convey the deep cultural heritage of a region. By constructing an arithmetic measurement method, through quantitative analysis of the number of traditional cultural elements in a street city, the actual deviation in the process of cultural construction and landscape setting in street cultural construction and landscape setting is determined. In the construction of urban streets, the complexity of traditional cultural elements and the effects of modular applications are

analyzed, and the following analysis models are established [18, 19], as shown in (1)-(3).

$$\varphi = \frac{1}{m} \sum_{i=1}^m |x_i - \bar{x}| \quad (1)$$

$$s = S(X)/P(x) \times 100\% \quad (2)$$

$$w = W(x) - W(y)_+(z) \quad (3)$$

Where S is the plot ratio, $S(x)$ is the volume construction area, $P(x)$ is the total land area, and W is the total construction area on the ground.

According to the above analysis model, in the overall design process of urban streets, the size of the plot ratio is a comprehensive level of the application of a region in the urban architectural element. Through effective analysis of the total plot ratio of ground buildings and the coupling of each design element, the development status and application effects of traditional architectural cultural elements can be effectively tracked and investigated.

4.5 The Expression of Traditional Cultural Elements in Modern Landscape Design

In the process of using traditional cultural elements, traditional cultural elements and modern architectural art are organized with modern architectural art in various ways. Using the technique innovation, a series of production methods, such as traditional painting, carving, and imitation, are organically displayed. Moreover, to better apply traditional cultural elements in modern architectural design, the multiple application effects and display methods of traditional cultural elements are organically fused and displayed; in the design of urban street landscapes, landscape settings that integrate multiple elements create urban landscape settings that include not only green vegetation and human landscapes but also deep

humanistic connotations. At the same time, culture between modernity and tradition should be combined and connected. In the process of innovating the application of cultural elements, we must respect not only the deep connotation and cultural heritage of traditional cultural elements but also the demonstration methods of traditional cultural elements in terms of expression.

5. CONCLUSION

In the context of the Internet of Things and deep learning, to better apply traditional cultural elements to the setting of urban street landscapes, we conducted a comprehensive investigation of the current status of urban landscape settings. During the research process, the traditional cultural elements involved in urban street landscape design were organically investigated. In the context of different cultural backgrounds and different ethnic cultural characteristics, the characteristics of the urban street landscape setting were set up to conduct comprehensive investigations and understanding. Traditional cultural elements and modern architectural arts were organically integrated, and they not only meet the deep connotation of traditional culture but also meet the architectural requirements of different architectural art backgrounds at this stage. This meets the aesthetic preferences of the public. The inheritance and promotion of traditional cultural heritage must cover not only the new cultural heritage accumulated through thousands of years of cultural connotation but also modern culture and design art.

Funding

This study was supported by 2019 “Jiaozuo City Government of Henan Province Decision-making Research Bidding Project”: Suggestions and Reflections on the construction of cultural masterpiece and the construction of Fine City Quality Masterpiece (JZZ201944Y).

REFERENCES

1. R. Wei, “A deep learning image recognition method based on edge cloud computing”, *Engineering Intelligent Systems*, 31(1), 5–12, 2022.
2. L. Kevin and Y. P. Fang *Image of the City*. Huaxia Publishing House, 2001.
3. W. T. Cui and Z. Y. Shi, “How to maintain the diversity of regional culture under the global strong culture?” *Shanxi Building*, 2(2), 89–93, 2019.
4. Q. K. Yu, “Construction of Chinese cultural tradition and modern city,” *Journal of Architecture*, 7(7), 19–25, 2010.
5. Y. J. Niu, “Architectural culture naturally views the ‘Tianren unity’ of Chinese architecture from Chinese culture and tradition”, *Zhongzhou Building*, 1(1), 90–95, 2017.
6. L. Liu, “On the penetration of traditional culture in environmental art design”, *Journal of Anyang Institute of Technology*, 4(3), 90–102, 2006.
7. L. Gao, “Talking about the use of Chinese traditional cultural elements in modern environmental design”, *Anhui Architecture*, 1(1), 102–105, 2009.
8. F. Li, “The application and significance of traditional cultural symbols in modern design”, *Anhui Literature*, 8(10), 90–96, 2008.
9. J. D. Peng, “The importance of exploring the stage of ecological planning at the stage of urban control regulations”, *Low-Carbon World*, 10(3), 207–208, 2020.
10. Niu K, “Urban planning points under the concept of ecological city”, *Building Materials and Decoration*, 6(6), 62–63, 2020.
11. C. Y. Gan, “Analysis of urban planning points under the concept of ecological city”, *Jushe*, 8(36), 45–49, 2019.
12. S. Q. Wang, “Application of conceptual design in the design of architectural structure”, *Shanxi Architecture*, 3(6), 26–39, 2006.
13. Y. Q. Lai, “Determination of the load model and method of underground structure design”, *China High-Tech Enterprise*, 8(5), 47–49, 2010.
14. X. Xue, “Neighbor, the practice of building space constituent elements in architectural design”, *Jiangxi Building Materials*, 5, 73–74, 2019.
15. M. J. Yu, “The application research of architectural space constituent elements in architectural design”, *Building Materials and Decoration*, 22, 67–68, 2018.
16. C. R. Yan, “Practical research of traditional architectural elements in architectural design”, *Residential and Real Estate*, 28, 92, 2018.
17. Y. Zheng, “The application research of architectural space composition elements in architectural design”, *Architecture and Decoration*, 11, 32–32, 2019.
18. X. Wu, “On some issues to be paid attention to in the design of architectural structure, commodity and quality”, *Architecture and Development*, 7(9), 90–98, 2011.
19. Z. H. Hu, “Analysis of architectural design”, *China Science and Technology Information*, 4(16), 90–95, 2005.
20. J. Wang, “Design of Intelligent traffic sign image recognition system based on machine learning algorithms”, *Engineering Intelligent Systems*, 2(5), 457–464, 2024.