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Embedded Systems Revolutionizing Aesthetic Design in Architecture: Exploring the Intersection of Big Data and Internet of Things

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Abstract. The construction industry is an important industry related to people's livelihood, and the development of the construction industry is the pillar of a country's economic development. At present, the scale of my country's construction industry is in a state of expansion, but the development of its aesthetic consciousness is in a sluggish state. There are many problems in the development of architectural design in our country. (1) Weak awareness of overall architectural environmental design and functional design. (2) Lack of design for a large number of concentrated buildings. (3) Weak awareness of innovation. In order to solve these problems, we built an optimization model for the application of aesthetic design in buildings based on big data and Internet of Things technology, and obtained relevant data about the environment and users as well as some information about the building itself through Internet of Things sensors, combined with aesthetic elements, from top to bottom Go to the ground to plan every detail of the architectural design. Apply big data and Internet of Things technology to each process of architectural aesthetic design.

Keywords: big data, Internet of Things, aesthetic practice, architecture; Embedded Systems Revolutionizing
DOI: https://doi.org/10.14733/cadaps.2024.S8.105-116

1 INTRODUCTION

The construction industry plays a very important role in the development of the whole society. Architecture can not only meet the needs of people's lives, but also the main place for people's activities. At the same time, it is also an inexhaustible driving force for the development of human society. Up to now, the construction industry has a rich cultural background and a very mature

business model. The construction industry plays an important role in promoting economic and social development and improving people's satisfaction with society [17][9].

With the continuous development of the global economy, the development of the world's construction industry is on the rise. Construction in Asia, especially East Asia, is booming. Since the reform and opening up, my country's construction industry has developed rapidly. After entering the 21st century, the construction industry has become the pillar industry of my country's economic development. At present, the scale of investment in my country's construction industry continues to expand, and the trend of informatization transformation is accelerating. The overall situation is in a state of prosperity and development. However, the development of architectural aesthetics in our country is sluggish, and the buildings are stereotyped and lack innovation. Architecture lacks cultural identity, lacks formal beauty, and does not really integrate natural and social elements into the construction process.

The aesthetic design of the building is a problem that must be considered in the implementation of the building, and the architectural design is related to the user's aesthetic needs and aesthetic orientation. Architectural aesthetics is the experience of a country's overall building construction and the shape and color matching of each component of the building after a long period of precipitation. It is affected by many factors, and it is constantly developing and dynamic. If the aesthetics of architecture cannot be improved, then there will be no essential development of the construction industry. Architectural aesthetics is affected by many factors, personal emotions, religious beliefs, and cultural heritage are all important factors that affect architectural aesthetics. However, in the specific implementation process, the integration of aesthetic elements into the architectural design process mostly relies on the designer's subjective emotions. This design method has low design efficiency and low user satisfaction [21][30].By incorporating embedded systems thoughtfully, architects can enhance the user experience while maintaining the desired aesthetic qualities of the building.

With the advent of the information age, the development of industrial technology has created a large amount of semi-structured and unstructured data, resulting in a sharp increase in the size of the data, thus entering the era of big data. The era of big data has made people aware of the preciousness of data, and how to mine useful information from massive data has become an urgent problem to be solved. The Internet of Things technology is developed on the theoretical basis of the Internet, which has a certain significance of the times. With the development of information technology, especially the birth of the Internet of Things, people's lives have undergone earth-shaking changes. The Internet of Things is an Internet that connects things and things. It breaks through the boundaries between people and things, and things and things. It expands the main body of confidence transmission from people to everything in the world. The use of the Internet of Things must rely on some devices, such as Internet of Things sensors, RFID technology, positioning systems, etc. [14][27].

This paper focuses on the impact of IoT sensors on the construction industry. The Internet of Things and big data are widely used in many industries, such as finance, medical care, and public management. The same big data and Internet of Things are also widely used in the construction industry. The Internet of Things can monitor various parameters in the construction process, and solve the disadvantages of traditional artificial construction through intelligent control. The application mode of big data and Internet of Things is shown in Figure 1 [10][15].

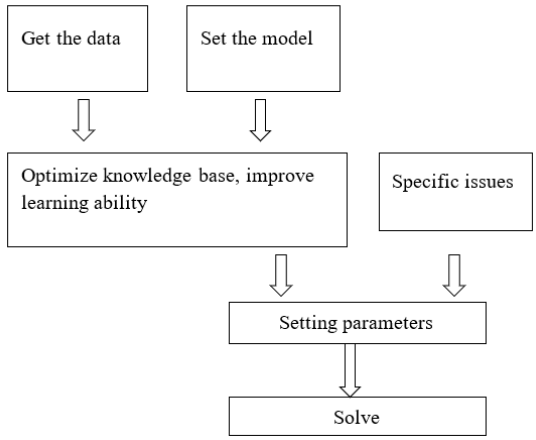

Figure 1: Application Modes of IoT and Big Data.

2 THE PRESENT SITUATION OF THE DEVELOPMENT OF AESTHETIC DESIGN OF ARCHITECTURE IN MY COUNTRY

My country's construction industry is on the rise, and the scale of the industry is expanding. Figure 2 shows the industrial scale growth ratio from 2001 to 2020 [2][26].

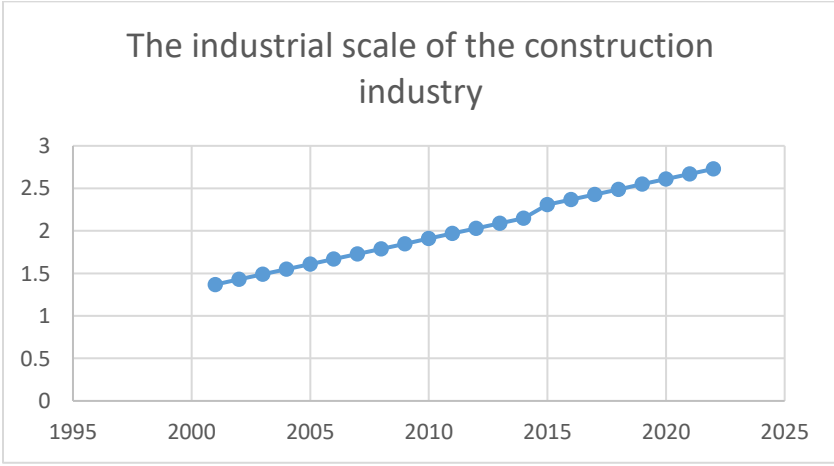

Figure 2: Growth Ratio of Construction Industry Scale.

2.1 Weak Awareness of Overall Architectural Environmental Design and Functional Design

Insufficient consideration of the integrity of the building. Architectural space involves spatial function, spatial design, spatial dimension, activity space and circulation space, etc. In the process

involved, we must start from the overall environment of the building, consider these sub-spaces, pay attention to people's aesthetic consciousness, psychological elements, etc. Subspace planning [22][8].

2.2 Lack of Design for a Large Number of Concentrated Buildings

One of the characteristics of the design of the construction industry is that it pays more attention to the design of isolated and important buildings, but it does not pay enough attention to the design of large buildings, such as schools and hospitals, which are composed of multiple buildings. The buildings in places such as schools and hospitals are often the same. The buildings in these places take practicality as the ultimate goal and abandon the aesthetic needs of the building [5][6].

2.3 Weak Awareness of Innovation

Innovation is the driving force behind the continuous development of the construction industry. Innovation in the construction industry includes design innovation and technological innovation. Technological innovation can help the construction industry implement buildings with more refined craftsmanship, while design innovation is the soul of architecture, which can essentially improve the beauty of buildings and promote the development of the construction industry. Technological innovation can speed up construction and save construction funds, which is directly related to the cost of construction implementation. The domestic construction industry pays more attention to technological innovation than to design innovation. The design innovation and development of the construction industry is a certain degree of difficulty. At present, the design innovation and development of my country's construction industry is still in a very sluggish state, and the design innovation awareness of the construction industry is weak [19][23].

3 ARCHITECTURAL AESTHETIC DESIGN OPTIMIZATION MODEL BASED ON BIG DATA AND INTERNET OF THINGS

3.1 Model Ideas

Big data and the Internet of Things can perceive and acquire massive data in real time, and can perceive information such as changes in the building environment, user behavior, and building usage. The perceived mass data, combined with the needs and usage of the building itself, is used to construct the space environment and new architectural forms. Carry out personalized facade design, interactive architectural device configuration, and personalized service design, through the decoration of various elements, improve the overall innovation and personalized design of the building, and improve the aesthetic characteristics of the building.

Obtain relevant data of the environment and users, as well as some information of the building itself through IoT sensors, and combine aesthetic elements to plan the details of the architectural design from top to bottom. Apply big data and Internet of Things technology to each process of architectural aesthetic design [29][18].

3.2 Model Representation

Key step 1: In order to accurately understand the environmental information, user information and building information of the building, we must obtain relevant information through the IoT sensor. The IoT sensor can collect building information on the physical terminal in real time and return to the background quickly Processing equipment, processing. The specific process of IoT building information is shown in Formula (1), where $F_{sc}(t)$ the result of the first data $F_{sc2}(t)$ is $F_{sc}(t)$ the result of the second iteration of the result.

$$\begin{cases} F_{sc2}(t) = F_{sc}(t) + \Delta F_{sc}(t) - \Delta F_{sc}(t)\Delta F_b(t) \\ F_{sc}(t) = F_b(t) + \Delta F_b(t) - \Delta y_b(t)\Delta F_{sc}(t) \end{cases} \tag{1}$$

Key step 2: The types of building information acquired through the Internet of Things are complex and high-dimensional. To analyze and process these data, normalization must be performed. Due to the different types of data, a comprehensive normalization method must be adopted. Formula (2) is a summary operation for the standardized results in Formula (1) [25][28].

$$F_{L,total}(t) = F_w(t) + F_v(t) + F_{tr}(t) - F_{sc2}(t) - F_{b2}(t) \tag{2}$$

Key step 3: The weights of building information analysts acquired by the Internet of Things are different. In order to conduct a reasonable analysis of these information, the information must be weighted. Among them $C(p)$, each data is represented, $D(p)$ and the weight of each data is represented. Formula (3) is a weighted calculation of the results of different dimensions obtained from the operation of Formula (2).

$$P(p) = C(p) \cdot D(p) \tag{3}$$

Key step 4: The building information acquired by the Internet of Things may contain a large amount of noise data, and it is necessary to remove the noise data through related operations. The Formula (4) is to screen the data, remove the data that does not meet the requirements according to the operation result of the Formula (3), and further operate. $s(p)$ is positive noise data, but $m(p)$ is negative noise data [3][16].

$$s(p) = \frac{\sum_{q \in \psi_p \cap (I \setminus \Omega)} C(q)}{|\psi_p|}, m(p) = = \frac{|\nabla \boldsymbol{I}_p^{\perp} \cdot n_p|}{\alpha} \tag{4}$$

Key step five: After processing the data, in order to combine aesthetic design elements, we must incorporate relevant aesthetic design elements into the obtained building information. Common aesthetic design elements are shown in Table 1.

Elements	*Connotation*
The beauty of form	*Expression of architecture*
	Type of building
	Structure of the building
	Symmetry and equilibrium
Functional beauty	*Use function*
	Cognitive function
	Aesthetic function
Technical beauty	*Processing technology*

	Production style
Material beauty	*Use of materials*
	The choice of color

Table 1: Common Aesthetic Elements.

Key step six: Integrate the analysis data with the aesthetic elements, the integration mode is shown in Formula (5).

$$A(x) = f(x, a) \tag{5}$$

Among them, the Formula (6) transforms the form of the data, and the Formula (7) is used to combine different categories of data, and the combination uses the "and" operator to combine the two categories of data in a binary manner. It can be known from Formula (8) that K1 and K2 are two fusion modes for data, K1 is the processing mode for successful fusion, and K2 is the processing mode for fusion failure. The Formula (9) is to re-standardize the most obtained data [11][20].

$$G_1(S) = \frac{C_1(S)}{R_1(S)} \tag{6}$$

$$G(S) = G_1(S) + G_2(S) = K_1 Tin(S) + \frac{K_2 Lout(S)}{1 + Tout(S) \cdot Lout(S)} \tag{7}$$

$$K_1 = D \cdot P \cdot L \cdot \frac{St - E \cdot Test}{T}, K_2 = \frac{1 + E \cdot Test - Item \cdot D}{St \cdot Lin} + D \cdot L \tag{8}$$

$$G(S) = \frac{K_1 K_2}{K_1 S^3 + K_2 S^2 + S + 1} \tag{9}$$

Key step seven: Personalize the design of the building based on the obtained data. The above-mentioned obtained data includes the relevant information of the user's usage data set building and the combination of aesthetic elements, and can be designed top-down according to the user's requirements. Decompose the entire building system into multiple physical subsystems, the formula used in the decomposition is shown in Formula (10), this formula mainly combines big data, Internet of Things and fuzzy sets, and its specific mode is shown in Figure 3.

$$\frac{1}{2}\sum_{j,l=1}\left\|v_j - v_l\right\|^2 a_{jl} = \sum_{j=1}^{n} v_j^T v_j s_{jj} - \sum_{j,l=1}^{n} v_j^T v_l a_{al} = tr(V^T SV) - tr(V^T AV) = tr(V^T LV) \tag{10}$$

There are two main reasons why traditional data processing methods cannot realize real-time data processing. On the one hand, the amount of data acquired by IoT sensors is too large, and traditional methods cannot bear the massive amount of data generated by IoT sensors. Second, the construction industry has very high requirements for data pursuit, and a small mistake may lead to the failure of the entire project. Data fusion technology can basically solve these problems, and its core algorithm is shown in (1) below:

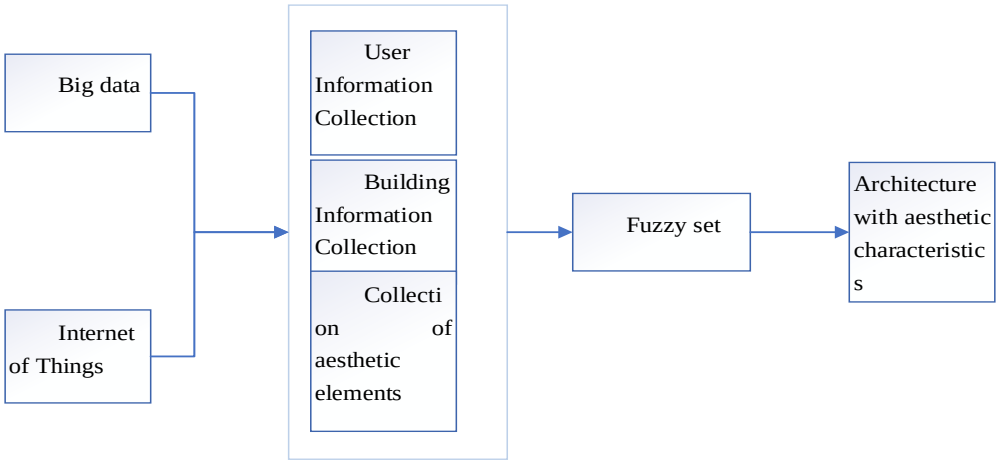

Figure 3: Structural Schema of the Formula.

Step 8: The core processing logic for these data is shown in the Formula (11)-(14) [13][4].

$$\frac{1}{2}\sum_{j,l=1}\left\|v_j-v_l\right\|^2 a_{jl}=\sum_{j=1}^{n}v_j^T v_j s_{jj}-\sum_{j,l=1}^{n}v_j^T v_l a_{al}=tr(V^T SV)-tr(V^T AV)=tr(V^T LV) \tag{11}$$

$$O=Q_1+\lambda Q_2+\beta Q_3=\min_{U\geqslant 0,V\geqslant 0}\left\|X-UV^T\right\|_F^2+\lambda tr(V^T LV)+\beta\left(\left\|o\odot(VB-Y)\right\|_F^2+\gamma\left\|B\right\|_{2,1}\right) \tag{12}$$

$$u_{ij}=u_{ij}\sqrt{\frac{(XV)_{ij}}{(UV^T V)_{ij}}} \tag{13}$$

$$x_j\approx Uv^{(j)}=\sum_{i=1}^{r}v_j^{(j)}u_i \tag{14}$$

Step 9: Presentation of the final result. Through the upper limit steps above, the building system is analyzed into various subsystems, and each part of the subsystem is systematically designed. The final presented model can be shown in Table 2.

Subsystem	*System property set*	*Design indicators of each attribute of the system*
System 1	*{a1, a2, a3...an}*	*{a1:(n1, n2, n3...)},* *{a2: (n1, n2, n3...)},* *{a3: (n1, n2, n3...)},* *{an:(n1, n2, n3…)},*
System 2	*{b1, b2, b3…bn}*	*{b1:(n1, n2, n3…)},* *{b2:(n1, n2, n3…)},* *{b3:(n1, n2, n3…)},* *{bn:(n1, n2, n3…)},*
System 3	*{c1, c2, c3...cn}*	*{c1:(n1, n2, n3…)},*

		{c2: (n1, n2, n3...)}, {c3: (n1, n2, n3...)}, {cn:(n1, n2, n3...)},
…	*…*	*…*

Table 2: Output Result.

3.3 Model Evaluation

In order to further confirm the effectiveness of the model, we need to further evaluate the model. Its advantage is that it is objective and true, it can analyze large-capacity data, and the time complexity and space complexity of the model are high. The model is evaluated through the convolutional neural network, and the final evaluation results are shown in Table 3.

Project	*Value*
Prediction Accuracy of Building Subsystems	*95.32%*
Parameter Prediction of Building Materials	*82.3%*
Satisfaction with the Design of Architectural Aesthetic Elements	*98.12%*
Overall Reliability	*79.8%*

Table 3: Evaluation Value of Convolutional Neural Network.

It can be seen from Table 3 that after the evaluation of the convolutional neural network model, it is found that the model constructed this time has the prediction accuracy rate of the architectural subsystem, the parameter prediction of building materials, the satisfaction degree of the design of architectural aesthetic elements, and the reliability of the overall architectural design All have satisfactory results, proving the practicability of the model.

3.4 Model Application

To further verify the applicability of the model, we partnered with a company. The team provides technical support and guidance, and uses the model and technology provided by the team during the design process of a building to carry out the aesthetic design of the building. The team supervises the process of architectural design and collects relevant data in a timely manner. The final experimental results are shown in Figure 4. This evaluation adopts the percentage system, and the performance of the new model in the four evaluation indicators is higher than that of the old model, especially in the indicator of aesthetic design. The model has high practicality and usability [1][12].

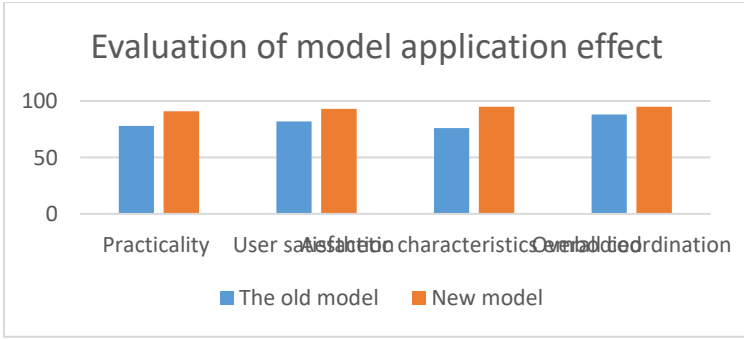

Figure 4: Model Application Effect Evaluation.

3.5 Model Significance

This model integrates big data and Internet of Things technology into the architectural design process, integrates aesthetic elements into the overall building through scientific design, and solves the problem that my country's architectural needs are stereotyped and lacks innovation. However, this model also has certain limitations. Using the model to integrate aesthetic elements will follow a fixed pattern. Although it can improve user satisfaction to a certain extent, it cannot bring about an overall change in the aesthetic design of the construction industry.

4 APPLICATION STRATEGY OF AESTHETIC DESIGN IN ARCHITECTURE

4.1 Architectural Style Combined with Emotional Elements

Architecture is designed for people, and the aesthetic design of buildings must meet people's aesthetic needs, entrust people's emotions, and bring personal beautiful experiences. To provide human beings with a personalized and comfortable living environment and architectural space. In the process of architectural implementation, the concept of people-oriented should be implemented to meet the needs of contemporary people for architecture. People-oriented, in the design process, people's willing is the main design element, reflecting the higher design requirements for architectural aesthetics. The concept of aesthetic design should also return to reality and human society itself, with the primary goal of creating a healthy and comfortable living environment. On the premise of satisfying the basic needs of people, incorporate elements with aesthetic characteristics, and do not overly pursue avant-garde and novel architectural styles. The transitional avant-garde architectural style is out of date in terms of aesthetic presentation. It should be based on values, adopt a people-oriented concept, integrate aesthetic elements of nature and society, and create an architectural style that conforms to the social development model [24].

4.2 Architectural Style Combined with Natural Elements

Nature and society are two important factors in the formation of architectural style. To promote the application of aesthetic elements in the construction industry should start from two aspects. In terms of natural environment, promote the transformation of the construction industry to green and environmental protection, integrate environmental protection design into the concept of architectural design, integrate the aesthetic elements reflected in the natural environment with architectural styles, and apply natural elements from multiple aspects. In the specific implementation process, natural elements can be highlighted from the aspects of material, shape, color and so on. For example, we can choose fresher colors, pure natural building materials, and translucent designs to highlight the beauty of nature. Similarly, the development of the construction industry is also closely related to the development of society. The development of society involves concepts such as blood relationship, kinship, and family, which are closely related to the long history and culture of the Chinese nation.

4.3 Architectural Style Combined with Environmental Elements

Only when the aesthetic design is combined with reality can it reflect the beauty of architecture, so to strengthen the application of aesthetic design in architecture must strengthen the integration between architectural design concepts and actual engineering implementation. Architectural design is just an expression of aesthetic consciousness, and architectural implementation is to show this aesthetic consciousness. When we implement the actual project, due to the limitation of the environment, resources and other factors, there are various difficulties in the construction process [7].

5 CONCLUSION

The construction industry is an important industry related to people's livelihood, and the development of the construction industry is the pillar of a country's economic development. At present, the scale of my country's construction industry is in a state of expansion, but the development of its aesthetic consciousness is in a sluggish state. There are many problems in the development of architectural design in our country. (1) Weak awareness of overall architectural environmental design and functional design. (2) Lack of design for a large number of concentrated buildings. (3) Weak awareness of innovation. In order to solve these problems, we built an optimization model for the application of aesthetic design in buildings based on big data and Internet of Things technology, and obtained relevant data about the environment and users as well as some information about the building itself through Internet of Things sensors, combined with aesthetic elements, from top to bottom Go to the ground to plan every detail of the architectural design. Apply big data and Internet of Things technology to each process of architectural aesthetic design. This model integrates big data and Internet of Things technology into the architectural design process, integrates aesthetic elements into the overall building through scientific design, and solves the problem that my country's architectural needs are stereotyped and lacks innovation. Finally, based on the status quo of the application of aesthetic design in architecture, we put forward relevant suggestions. Architectural style combines emotional elements, architectural style combines natural elements, and architectural style combines environmental elements.

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REFERENCES

[1] Fan, K.; Li, B.X.; Cheng, X.Y.: Aesthetic Thinking of Ming and Qing Architectural Design, Grand Stage, (07), 2012, 146-147. https://doi.org/10.15947/j.cnki.dwt.2012.07.134.

[2] Feng, S.: Research on Architectural Design of Art Museum Based on Aesthetic Experience Theory, Central Academy of Fine Arts, 2020. https://doi.org/10.27666/d.cnki.gzymc.2020.000014.

[3] Guo, H.Y.: Aesthetic Features of Old Industrial Building Renovation from the Perspective of Technical Aesthetics, Industrial Architecture, 45(03), 2015, 54-58. https://doi.org/10.13204/j.gyjz201503012.

[4] Li, S.: Tadao Ando's Architectural Design Aesthetics Viewed from Sumiyoshi's Longhouse. Enterprise Herald, (15), 2012, 258-259. https://doi.org/10.19354/j.cnki.42-1616/f.2012.15.179.

[5] Li, S.Y.: The Application of Mathematics in Architectural Design, Modern Property (Mid-day Journal), (09), 2019, 88. https://doi.org/10.16141/j.cnki.1671-8089.2019.09.077.

[6] Liang, T.Y.: Talking About Architectural Aesthetics and Architectural form-Interpretation from the Direction of Contemporary Western Architectural Aesthetics, Urban Architecture, 16(12), 2019, 114-115. https://doi.org/10.19892/j.cnki.csjz.2019.12.048.

[7] Liu, J.; Su, J.M.; Zhou, J.: Form and Content in Architectural Design-on the Architectural Design of Shanghai Himalaya Art Museum, Furniture and Interior Decoration, (01), 2012, 18-19. https://doi.org/10.16771/j.cnki. Cn43-1247/ts.2012.01.003.

[8] Lu, Y.: Early 20th Century German Neo-Objectivist Architectural Design and its Thought Exploration, Southeast University, 2019. https://doi.org/10.27014/d.cnki.gdnau.2019.003921.

[9] Peng Y.: Research on Japanese Contemporary Architectural Aesthetics-Taking Kazuyo Sejima as an Example, Architecture And Culture, (01), 2022, 206-207. https://doi.org/10.19875/j.cnki.jzywh.2022.01.081.

[10] Ruan, Y.Q.: Research on the Renovation of Old Industrial Buildings from the Perspective of

Structural Appearance, South China University of Technology, 2020. https://doi.org/10.27151/d.cnki.ghnlu.2020.004205.
[11] Wang, D.D.: Architectural Design and Theoretical Research of Comprehensive Teaching Buildings in Universities, Journal of Yangtze University (Natural Science Edition), 10(31), 2013, 123-125. https://doi.org/10.16772/j.cnki.1673-1409.2013.31.030.
[12] Wang, H.: Architectural Aesthetics Mind and Objects-Dual Category of Chinese Traditional Architectural Aesthetics (1), World Architecture, (07), 2012, 110-113. https://doi.org/10.16414/j.wa.2012.07.023.
[13] Wang, H.: Architectural Beauty and Abundance-Dual Category of Chinese Traditional Architectural Aesthetics (2), World Architecture, (08), 2012, 114-117. https://doi.org/10.16414/j.wa.2012.08.005.
[14] Wang, J.H.; Xiao, Z.G.: Analysis of I.M. Pei's Architectural Aesthetics. Furniture and Interior Decoration, (02), 2021, 101-103. https://doi.org/10.16771/j.cn43-1247/ts.2021.02.023.
[15] Wang, Y.T.: Shanshui City Theory and Architectural Design Practice Under the Influence of Shanshui imagery 1980-2019, Tianjin University, 2020. https://doi.org/10.27356/d.cnki.gtjdu.2020.002395.
[16] Wu, H.; Xiao, Q.; Zhang, S.L.: Interpretation of Architecture from the Perspective of Fractal Architecture Aesthetics-Taking TOD'S Building in Omotesando, Tokyo, Japan as an example, Chinese and Foreign Architecture, 07, 2014, 79-81. https://doi.org/10.19940/j.cnki.1008-0422.2014.07.023.
[17] Wu, Y.; Huang Y.F.: Measures and Values of Flexible use of Gestalt Theory in Architectural Aesthetics, Science and Technology Wind, (07), 2022, 151-153. https://doi.org/10.19392/j.cnki.1671-7341.202207049.
[18] Xia, W.Y.; Xue, J.W.: Analysis of Architectural Skyline Based on the Perspective of Traditional architectural aesthetics, Huazhong Architecture, 34(12), 2016, 135-138. https://doi.org/10.13942/j.cnki.hzjz.2016.12.032.
[19] Xiao, B.: Talking About the Application of Architectural Psychology in Architectural Design, Smart City, 4(10), 2018, 33-34. https://doi.org/10.19301/j.cnki.zncs.2018.10.020.
[20] Xu, W.G.; Luo, D.; Ye, Y.; Lu, P.; Liu, J.: "Digital Penetration" and "Parametricism"-Interviews and Dialogues on "Digital Technology and Architectural Design", World Architecture, (09), 2013, 17-35. https://doi.org/10.16414/j.wa.2013.09.001.
[21] Yang, O.H.: Research on Architectural Design of Experience Bookstore Under the Internet Background, Dalian University of Technology, 2021. https://doi.org/10.26991/d.cnki.gdllu.2021.002310.
[22] Ye, L.: Application Research of Mathematics in Architectural Design, Science and Technology Information, 17(36), 2019, 245+247. https://doi.org/10.16661/j.cnki.1672-3791.2019.36.245.
[23] Yu, X.S.; Han, R.F.: Appreciation of Gothic Architectural Aesthetics, Shanxi Architecture, 43(30), 2017, 29-30. https://doi.org/10.13719/j.cnki.cn14-1279/tu.2017.30.016.
[24] Zhang, N.M.: A Preliminary Study on the Aesthetic Significance of Diaojiaolou Residential Architecture in Chongqing, National Art, (01), 2012, 103-105. https://doi.org/10.16564/j.cnki.1003-2568.2012.01.002.
[25] Zhang, Q.: The Influence of Arts and Crafts Movement on Architectural Design, Journal of Chifeng University Natural Science Edition, 32(06), 2016, 147-148. https://doi.org/10.13398/j.cnki.issn1673-260x.2016.06.056.
[26] Zhang, R.J.: Traditional Aesthetic Expression of Chinese Contemporary Architecture-Taking IM Pei's Architectural Design as an Example, Urban Architecture, 17(02), 2020, 94-95. https://doi.org/10.19892/j.cnki.csjz.2020.02 .032.
[27] Zhang, S.Y.; Wang, Y.: Image Presentation Under Classical Geometric Forms in Architectural Design, Huazhong Architecture, 39(01), 2021, 1-5. https://doi.org/10.13942/j.cnki.hzjz.2021.01.001.

[28] Zhang, W.: Differences in Chinese and Western Architectural Aesthetics, Science and Technology Vision, (15), 2015, 95. https://doi.org/10.19694/j.cnki.issn2095-2457.2015.15.070.
[29] Zhou, Q.Z.: Research on Architectural Aesthetics of Traditional Villages a Case Study of Huangling Village in Wuyuan County, Communication and Copyright, (06), 2017, 126-128. https://doi.org/10.16852/j.cnki.45-1390/g2.2017.06. 049.
[30] Zhu, Y.L.: A New Order Without Objects-Analysis of the Evolution of Suprematism from art to Architecture from the Perspective of Architectural Aesthetics, Urban Architecture, 18(10), 2021, 136-141+160. https://doi.org/10.19892/j.cnki .csjz.2021.10.31.