Application of Interactive Installation Art Design Based on Generalization Theory

Lin Liu, Yue Mi(✉), Xinyi Cheng, and Yu Shi

Hubei University of Technology, Wuhan 430070, China
747894020@qq.com

Abstract. This paper combines the theory of empathic design to explore the new ideas of interactive installation art design with the theme of natural environment. Through the discussion on the development of interactive installation art, we analyze the necessity of integrating the theory of empathy, and secondly, we use the theory of empathy combined with emotional design to construct an interactive installation art design model, and combine it with the design practice of the Lake Island in Zhongshan Park, Wuhan, to verify its feasibility. Through the practice of this project, it is concluded that the interactive installation based on the empathic theory and the emotional communication between people is two-way, which can more effectively give the experiencer a rich sensory experience, and with the help of the empathic experience to expand and deepen the perceptual dimensions, and obtain a deep emotional experience, which has feasibility and practicality.

Keywords: Synaesthesia Theory · Interactive installation art · Emotional Design · Ecological · Human-Computer Interaction

1 Introduction

Against the backdrop of an increasingly deteriorating global environment, more and more artists have begun to utilize this theme to explore the relationship between human beings and nature in a variety of artistic forms. As an emerging form of art creation, interactive installation art, through the form of interaction to increase the bond between the audience and the work, in order to enhance the dissemination of art information, to demonstrate a higher emotional value, has gained the favor of many art creators and experiencers. This paper is oriented to the realization of the emotional value of the experiencer, and proposes to build a design theoretical model based on the theory of empathy and apply it to the design of interactive devices, using multi-sensory stimulation and psychological resonance to enable the audience to further communicate with the works in depth, and bring a richer emotional interactive experience to the experiencer, and to provide a new perspective for the contemporary design of interactive device art.

M. Rauterberg (Ed.): HCII 2024, LNCS 14717, pp. 180–195, 2024.
https://doi.org/10.1007/978-3-031-61147-6_13

2 Interactive Installation Art Concept and Development

Interactive installation art is a kind of art form that can interact with the audience by utilizing multimedia technology and the combination of ready-made products. With the change of technology, it has gradually evolved into an art form that combines interactive technology and art creation. Through computer graphics, information acquisition and processing, and arithmetic and other ways of inputting and outputting all kinds of data, and displaying them in the space through carriers, it allows the audience to interact with the works and get a richer, more vivid and real experience. Interactive installation art can not only stimulate the audience's imagination and creativity, but also promote people's understanding and awareness of art, science and technology and culture. It is an art form that crosses over the interactive field and the art field, and has a strong synthesis.

2.1 International Development of Interactive Installation Art

Interactive installation art originated in the early 19th century as ready-made art, and through the development of light art, performance art, etc., it became a popular art form in the Western art world in the 1990's. With the advancement of technology, more and more designers connect interactive installation art with nature to create art. With the advancement of technology, more and more designers are linking interactive installation art with nature to create art.

For example, "Sense Energy" is a "fantasyland" to be created in 2022 by the international design and creative firm CRA-Carlo Ratti Associati in collaboration with the architect Italo Rota, utilizing 500 m of digitally curved copper tubes, photovoltaic electricity, and a large number of other materials. The designers used 500 m of digitally curved copper tubing, photovoltaic panels, and synthetic materials to create an interactive sensory path, and the whole installation is intended to use the game to demonstrate the connection with the world of energy, and through the interaction between people and the installation to stimulate thinking about the efficiency of energy use in the real world. London-based architectural and creative firm ecoLogicStudio created the world's first microalgae air-purification biotechnology playground in Warsaw, using wood, glass and algae reactors. The shape of the building is predominantly wood, wrapped in an ETFE membrane to protect the algae reactors, creating an algae greenhouse, while the space is used as a playground and outdoor classroom, providing a place for people to have fun and relax. From the above cases, it can be seen that the development of interactive installation art is more mature, beginning to break away from the constraints of indoor space to the development of public space, with multi-level sensory communication and the combination of the surrounding environment, to build a new sensory experience for the experience of the person in order to obtain a richer emotional connotation.

2.2 Development of Interactive Installation Art in China

The development of installation art in China is relatively short. Especially influenced by the American Pop artist Rauschenberg, it was only recognized and emerged in the 1980s. in August 1985, the famous American Pop artist Rauschenberg held an exhibition of installation art using readymade products at the National Art Museum of China, which aroused Chinese artists' understanding of and concern for installation art. With the passage of time and the progress of art development, interactive installation art has continued to develop and grow in China, and become a form of art creation respected by artists. The work "Urban Breathing", presented at the 9th Architecture Biennale, focuses on the carbon cycle of the city in the form of an installation. It utilizes four balloon columns made of semi-transparent film and a built-in fan to form "exhalation" and "inhalation", simulating the process of carbon cycle. At the same time, short films of urban life, music sampling urban noise, and sounds of nature were played on a loop to create an immersive experience.UK Studio created an interactive bamboo installation - Tree of Life with bamboo, a natural material, to show the power of nature to the world. The entire installation uses bamboo and ropes to connect with a towering tree, making the tree also a part of the installation and providing shade and resting places. The entire installation uses bamboo and ropes to connect with a towering tree, making the tree also a part of the installation and providing shade and rest places. The audience can get a situation similar to an outdoor bonfire and establish a harmonious relationship between humans and nature.

From the above analysis of China's interactive installation cases, it can be seen that China's installation art development time is relatively short, the entire interactive installation art is based on visual expression, relatively single, less interactive, difficult to evoke the audience's deep emotional cognition, while the western countries have long been the development of the installation art as a kind of "multi-sensory art", which strengthens the deeper connection between the experiencer and the work, and better expresses the creator's intent This reflects the fact that Chinese installation art still has a long way to go. This reflects that Chinese installation art still has a lot of room for progress and development potential.

3 Overview of Relevant Theories

Under the wave of experience economy, people are more in favor of those products that can touch their emotions, and the combination of emotional design and generalization theory can make the design have stronger perceptual functions, thus triggering multi-level experiences for users, and creating a design product that combines memories, products, and experiences for users. In the following subsections, this paper will provide an overview of the General Sense Theory and Emotional Design, which will provide theoretical support for the design thinking model of this paper.

3.1 Overview of Generalization Theory

Synesthesia, also known as alliance or transference, is a cross-modal sensory experience in which stimuli from different senses merge to produce different cognitive experiences [1]. The study of synesthesia can be traced back to the ancient Greek period, when philosophers were investigating whether the color of music was a quantifiable physical quality. It was later formalized in the 17th century by Wendt of the German school of linguistic psychology, and translated into English as "Synesthesia", an extension of the Greek word meaning "a joint expression of the senses". In 1945, Merleau-Ponty developed a new interpretation of synesthesia, and in his book Phenomenology of Perception, he emphasized that the commonality of the body's synesthesia is based on the sensory perception of the body's illustrations, and that synesthesia is the superimposition of the body's organs on each other by means of arousal in order to achieve the purpose of perception [2], for example, when people see different colors, they will have a different emotion for the color or the perception of the temperature. Sensory interoperability is based on the cognitive foundation of human beings, processing the acquired external information and combining it with human beings' own past experiences and emotions to achieve diversified experiences, and it is a conscious and spontaneous perceptual activity of human beings.

China's research on the theory of synesthesia was firstly put forward by Qian Zhongshu in his book "Synesthesia" and applied to the field of literature, which believes that "human synesthesia is based on association", "the senses of sight, touch, hearing, taste and smell can often be connected with each other, and the domains of the eyes, ears, tongue, nose and body can not be separated from each other. The fields of each organ can be divided into no boundaries, such as color can have temperature, sound can have image, warmth and cold can have weight, and smell can have sharpness, etc." [3]. The characteristic of the sense is to deepen from shallow to deep, superficially speaking, it is to stimulate the occurrence of another sense by one sense, and in-depth exploration is to achieve the mutual transformation and projection of each sense through the multiple perceptual images caused by external stimulation, so as to form the experience of "through". According to Chen Yude's methodology in The Spiritual Heart of Wonderful Enlightenment - A Treatise on Artistic Communication, communication can be categorized into three main types, namely, sensory displacement, superimposition of multiple senses, and interoperability of imagery [4]. Sensory displacement belongs to the shallowest level of perceptual experience, i.e., after the senses are stimulated by the outside world, they are able to trigger the combination of another or more than one type of sensory stimulation, which is the most basic perception and lacks a deeper emotional experience. Multi-sensory superposition is a multidimensional experience that integrates multi-sensory perception and perceptual cognition on the basis of mutual perception and combination of senses, and at the same time triggers a chain reaction of perceptual cognition, such as imagination, association, and so on. Imaginary intercommunication belongs to abstract experience, which is a kind of through-sense experience that integrates subjective emotion on the basis of perceptual cognition, rational

cognition and cognition of objective things, so that the outside and the inside can be integrated with each other and obtain high-level feelings. Through the analysis of the literature above, it can be seen that empathy is a way of perceiving the external world, and it guides people's daily life by the mutual influence of each organ of perception, so the theory of empathy is not only a specific field of a single discipline, but also the use of integrated disciplines (Figs. 1).

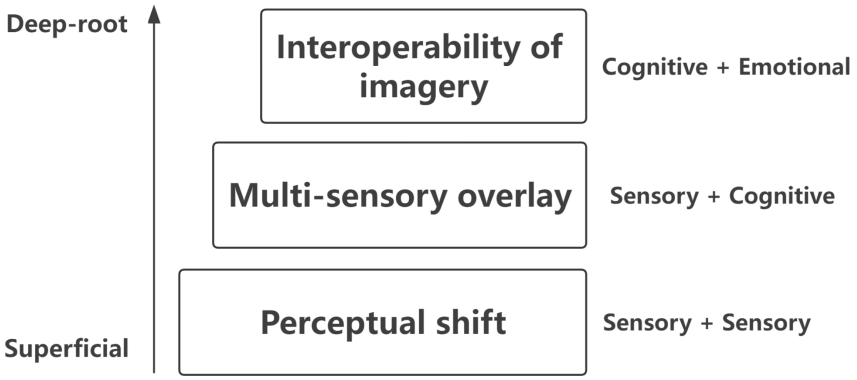

Fig. 1. Three levels of Synesthesia

3.2 Overview of Emotional Design

Emotional design was firstly proposed by Donald A. Norman, a famous American scholar, in the book "Design Psychology: Emotional Design", which refers to the design theory that while maintaining rationality and scientificity in the design process, it is also necessary to add certain emotional factors in order to satisfy the psychological needs of users [5]. The book points out that human brain activity is mainly divided into three levels: instinctive layer, behavioral layer and reflective layer. The instinctive layer is the user's direct perception of the product's appearance. Behavioral layer is the user's feeling of the practicality of the product, and reflective layer is the user's overall feeling of the product, including the product experience, self-feeling and so on. The three levels from shallow to deep bearing progressive relationship, the three interrelated, from the instinctive layer of visual stimulation and then triggered by the behavioral layer of interaction, through the behavioral guidance of the product, the user in the use of the process of obtaining the product experience to stimulate emotional resonance. Emotional design not only provides a solid theoretical foundation for product design and other design fields, but also provides a complete theoretical framework for many design researchers (Fig. 2).

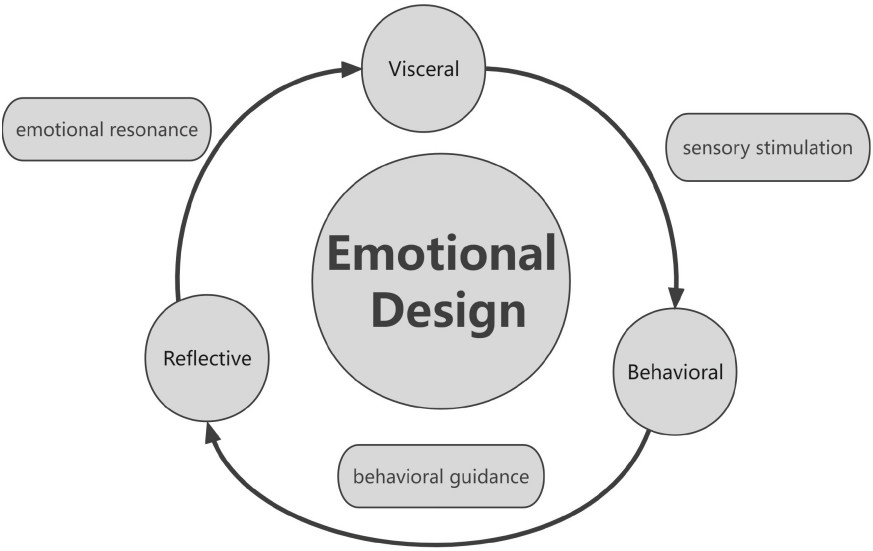

Fig. 2. Three Levels of Emotional Design

4 Interactive Installation Design Practice of "or Symbiosis, or Imbalance"

4.1 Interactive Device Design Method Based on Generalization Theory

This paper combines the theory of empathy and emotional design to construct an overall model for the design of the interactive installation with the theory of empathy as the main focus and emotional design as the supplement. Supported by the theory of empathic transformation, it determines the three levels of empathy, i.e., sensory displacement, multi-sensory superposition, and interoperability of imagery, and on the basis of which it establishes that this installation is presented in an interactive way. At the same time, combined with the emotional design, from the three perspectives of instinctive layer, behavioral layer, and reflection layer, we establish the modeling, material, structure, site selection, and interactive mode of the installation, combining the above analysis with the three levels of flux, respectively, from the "superposition of the senses transformation", "combination of senses and association, cognition ", "the combination of sensation and association, cognition", "the combination of cognition and emotion" are transformed to the interactive device, using the three levels of empathic experience and the three levels of emotional design theory to carry out different experience design for the interactive device. The first layer of the interactive device is the instinctive layer, mainly through the device modeling, materials, structure to give a certain degree of users and the device to achieve visual stimulation of the sensory experience. The second layer is the behavioral

layer, where the audience interacts with the device to reach a sensory cognitive resonance through the surrounding environment, the audience's cognition and psychology. The third layer is the reflection layer, using the audience's mental imagery, completing the sensory transformation in the interactive behavior, generating emotional experience, and obtaining deeper emotional resonance through the information and connotation conveyed by the interactive device (Fig. 3).

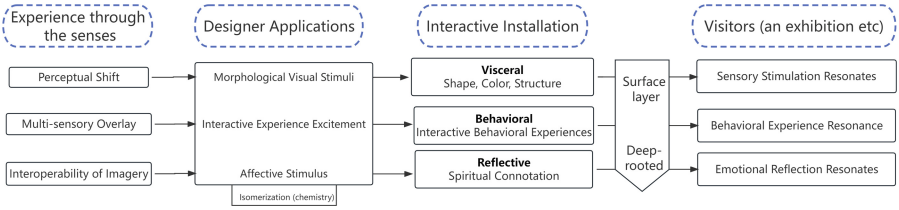

Fig. 3. Interactive Device Synesthesia Experience Model

4.2 Pre-scenario Research

Project Site Selection. This project is based on the principle of proximity to the project site selection, from the geographic location of Wuhan Zhongshan Park is surrounded by man-made buildings, and Zhongshan Park has an ecological environment that makes its existence more like the only "natural purity" in the downtown area, the front of the park is the main entrance, the number of people visiting the park is higher. However, as the visual center of the front area, the lake island is the area with the least number of visitors in the landscape part of the whole front area. From a spatial point of view, it is surrounded by water, but it is poorly connected to the surrounding environment, which makes it impossible to realize a more complete functional zoning plan. Through the field study of the island, from the functional point of view, there is only a Chinese traditional hexagonal wooden brick pavilion for passers-by to rest, and the landscape plants for ornamental use have not played their ornamental effect. In general, the island has a good shade and rest, summer function, but compared to other parts of the landscape tends to be ordinary, can carry out a single activity, stopping the crowd is small, so that this piece of "visual center" is buried. In addition, the existence of the island in the center of the lake is more like an isolated island that has not been overly interfered by man, and still retains part of its original appearance, so the island in the center of the lake was chosen as the placement area for this installation design.

Crowd Analysis. Before carrying out the main body of the landscape planning and design installation of the lake island, this project carries out a preliminary analysis of the crowd activities around Zhongshan Park. In order to make the analysis more authentic and effective, this paper conducted a field study, mainly at 9:00 a.m., 3:00 p.m. and 6:00 p.m., and randomly selected a total of 100

tourists in the park in the form of questionnaires to understand the basic information of the park tourists and tour preferences, such as the number of times a week for the tourists to visit the park, the sightseeing time period, and so on. Through the field research and questionnaire survey, it can be seen that the largest number of tourists in Zhongshan Park are middle-aged and elderly people aged 51–60 and over 60, and the occupation of the crowd is mostly retired people, followed by people aged 26–30, and the occupation of the crowd is mostly full-time housewives, and due to the special nature of the occupation of the full-time housewives, they need to lead the children to do outdoor activities, and they also become the main group of tourists in Zhongshan Park. From the viewpoint of visitors' trajectory of action in the three tour areas, the number of tourists in Zone 1 is medium, but Zone 1 is mainly a landscape area, almost no amusement facilities, and lack of attraction for the lower age groups. Therefore, in the design process, it is necessary to increase the interactive features as the main focus, so as to increase the number of low-age people, increase the vitality of the lake island and the whole Zhongshan Park Zone 1 (Fig. 4).

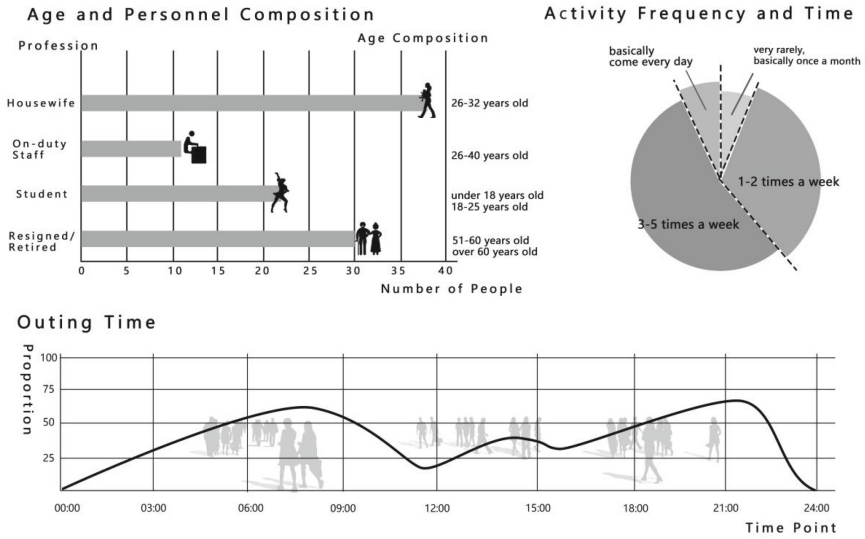

Fig. 4. Crowd Analysis Chart

4.3 Project Planning

Thematic Orientation. This paper explores the relationship between human beings and the natural environment as the theme of the current relationship between nature, nature is the basis for human survival and development, however, with the rapid development of human economy, resulting in serious damage and pollution of the natural environment. Countries around the world have also

actively launched policies to respond to this change. In 2015, the 193 member states of the United Nations formally adopted 17 Sustainable Development Goals (SDGs) at the summit, of which the 15th development goal, terrestrial ecology, was proposed to protect, restore and promote the sustainable use of terrestrial ecosystems. Echoing this call, this project takes the relationship between human and nature as its theme, and uses installation as the main body of the design, utilizing the interactivity and strong visual impact of installation art to awaken people to re-examine nature and their own behavior.

The relationship between humans and nature is broadly categorized into two types in the creative theme:

1. To divide nature roughly into three major categories, human-animal-plant, and to maintain harmony and balance among the three, so as to achieve the great harmony of nature and harmonious coexistence between human beings and nature.
2. Nature and human beings are in a state of confrontation, and human behavioral activities continue to devour nature, and human beings and nature are beginning to be out of balance.

Element Extraction and Morphological Derivation. This project focuses on human beings and vertebrate animals that symbolize natural beings in the selection of design elements, extracting their common point - the spine, which is an important support for animal activities. This paper abstracts the spine, extracts the curved lines and begins to deform them, using them as the outer contour lines of the main device. From the spine as a whole, a single spine bone is extracted as the shape structure of the device monolithic will be simplified into a box, repeated arrangement, see Fig. 5. curved lines and arrangement of the box for the combination, to get the initial form of the device, the shape and vertebrate spine and thorax is more similar to present a state of support and protection. From the topographic point of view, the left half of the whole lake island is facing the mainland, which is in an open space posture, and tourists are easy to concentrate here, and the upper left corner is in a lower terrain, so the entrance is arranged here, and the main body of the device is placed in its visual center. From the perspective of the greenery, the curved shape and amplitude of the greenery corresponds to the flat lines of the whole installation. The form of the installation presented by the irregular lines and the continuous frame organized by the ring beams form a unique monumental nature, which as a geometric form becomes the starting point of the whole design: the dialogue between man and nature.

Interaction Modes and Material Selection. The constructive nature of the installation is reflected in the assembly and articulation, with all components prefabricated and connected by high-strength bolts and mortise-and-tenon joints, the materials of which are shown in Fig. 6. The columns of the installation have a maximum height of 3.8 m and a minimum height of 2 m. The beams are articulated with rectangular square tubes, which form a solid enclosure in a triangular

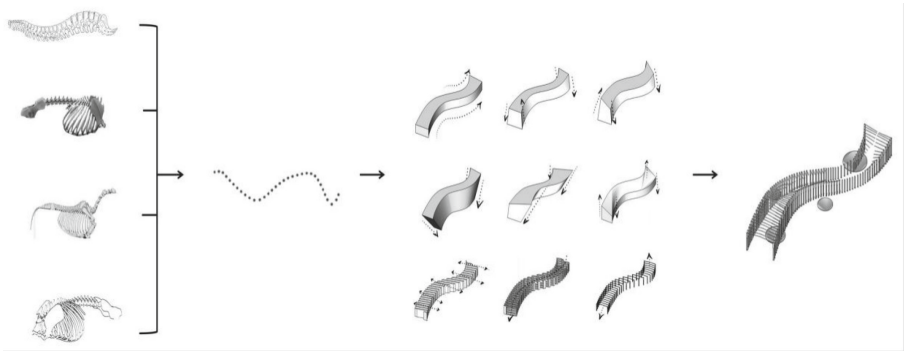

Fig. 5. Abstraction, Simplification and Derivative Molding

arrangement. The beams are articulated with rectangular square tubes, which are arranged in a triangular shape to form a solid enclosure. Architectural device entrances and exits reserved structural openings, up and down customized barge parts hinged fixed, device monolithic maximum 3.9 m, where a single arrangement of frame beams and columns in the combination of part of the choice of mortise and tenon inlay structure, the beams and columns embedded in the assembly. The beam tube is divided into two parts, the front beam tube is solid, smaller than the rear beam tube, which can be indented into the rear beam tube, and the rear beam tube is hollow. This project arranges 65 single units in a path array in the center of the lake island. The whole main device is made of rich materials, no interactive columns of brushed stainless steel, interactive columns and beams of galvanized sheet metal, beams inside the retractable inner tube is made of hose, wrapped in mirror material is able to reflect the surrounding things. When the mirror on the main device maps the surrounding landscape, from the appearance of more like nature as a coat for the package, into the surrounding natural landscape, to achieve harmony between nature and artificially created objects, to create an environment that allows the audience to immersive experience.

The interactive mode of this device selects stepping as the main, the workflow is shown in Fig. 7, and the interactive mode is shown in Fig. 8. 4 irregularly sized circular load-bearing sensing devices are placed under the main device, the built-in load cell is connected to the arduino sensing device, and the maximum weighing limit of 240 kg ($\approx$ 4 adult weights) is set up in advance, when the load-bearing capacity of the circular load-bearing device reaches the limit, the load-bearing information is transferred to the sensing device. When the load-bearing capacity of the circular load-bearing device reaches its limit, the load-bearing information will be transmitted to the inductor, and the inductor will receive the information so that the beams of the main device above will start to fall down and shrink the inner tube, and when the weight is less than the

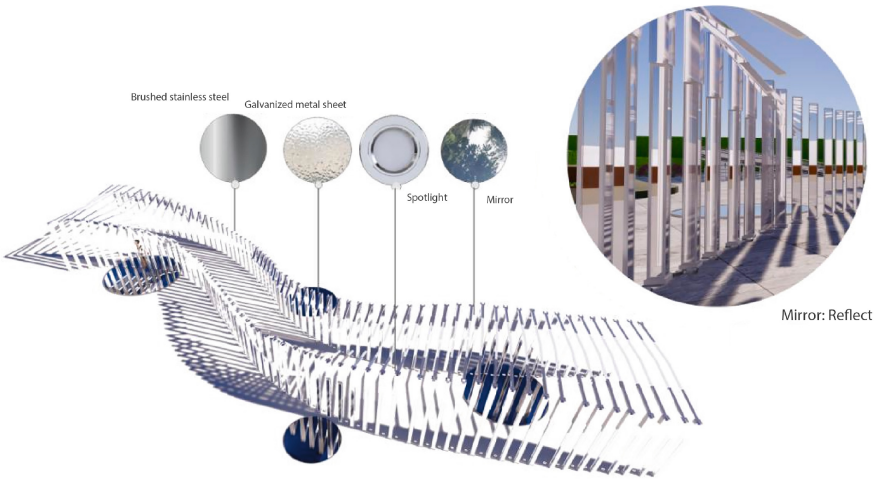

Fig. 6. Material Selection

maximum weighing limit of the load-bearing device, the deformed main device will restore the original, and the beams and tubes will rise up and extend outward. The deformation pattern of the whole device is a metaphor for the way man and nature get along with each other, when human behavior is excessive, nature will begin to lose its original balance. When human behavior is moderate, nature will maintain the balance, at the same time, the falling beam tube will produce a certain degree of visual oppression, the broken device to "prick" visual stimulation to stimulate people to the "pain" of the tactile sensory experience, to complete the visual experience to the tactile experience of the visual experience to the tactile experience is completed, and the most basic sensory transfer is achieved. At the same time, the combination of the visual stimulation of sharp "thorns" and the tactile stimulation of "pain" triggers the audience's further association and cognition - that is, the instinctive fear and repulsion of human beings towards sharp objects, so as to obtain a multi-sensory experience. The combination of visual stimulation and tactile stimulation triggers further associations and perceptions - the instinctive fear and rejection of sharp objects, thus obtaining a multi-sensory overlay. The realization of the two experiences and the combination with the entire landscape environment to achieve the highest level of empathetic experience - imagery interoperability, by the joint role of the device and the surrounding landscape will be implanted into the audience's heart the concept of symbiosis between man and nature, to achieve emotional resonance. The final effect is shown in Fig. 9.

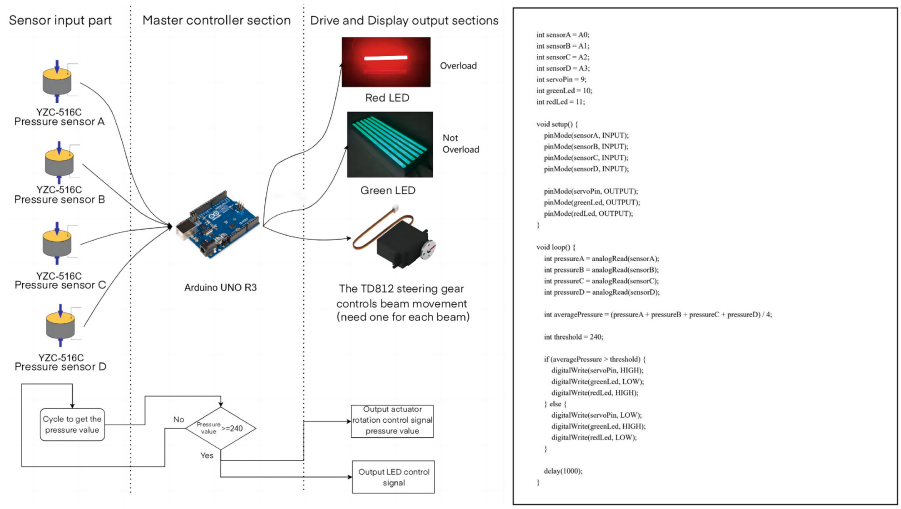

Fig. 7. Workflow and part of the running code

4.4 Design Effectiveness Verification

In order to verify whether the interactive installation "Or Symbiosis, or Imbalance" meets the audience's perceptual experience, the project presents the artwork to the audience by means of a scale questionnaire, and uses 100 audience members as the sample to measure their satisfaction with the installation.

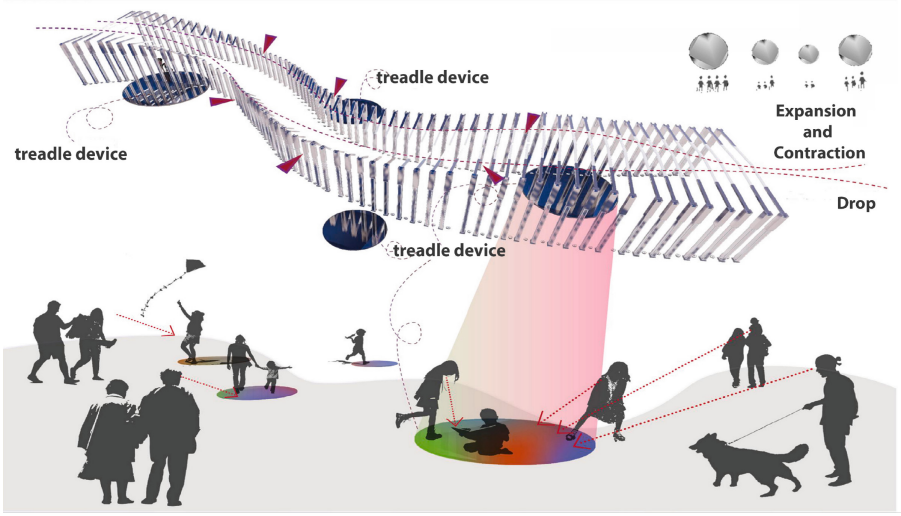

Fig. 8. Specific Display of Interaction Mode

Fig. 9. Final rendering

The questionnaire consists of 10 questions, including 3 questions on appearance impression, 2 questions on interactive experience and 5 questions on emotional resonance, which can effectively measure the audience's immediate satisfaction with the work and their willingness to experience the installation. The questionnaire adopts a 5-level scale, and the respondents need to evaluate the device from very dissatisfied to very satisfied according to their feelings after watching the demo animation, which is a complete linear evaluation process for the device, and can be a good way to assess whether the interactive device meets the audience's preferences from the appearance of the interactive device, or whether the interactive mode makes the audience associate with the device. Whether the mode of interaction creates an associative response from the audience, and whether the entire installation inspires a deeper emotional resonance from the audience, will ultimately determine the success of this design practice.

Table 1. Cronbach's reliability analysis

Questionnaire	Correction term total correlation (CITC)	Deleted α coefficients for item	Cronbach's α coefficient
From the looks of it I would love and want to experience the "or symbiosis, or imbalance" interactive installation	0.622	0.874	0.886
I think the use of materials and the design of the shape of this interactive installation make it look harmonious with its surroundings	0.625	0.874	
I think the "or symbiosis, or imbalance" interactive installations are designed to meet my daily park needs	0.655	0.887	
Watching the demo animation, I could clearly understand the operation mechanism of the interactive installation	0.554	0.892	
While watching the demo animation, I was very satisfied with the interactive experience of the interactive installation	0.728	0.866	
While watching the animation of the deformation of the device triggered by the interactive location, from the visual perception, I felt nervous and uneasy about the shape of the device that deformed after triggering the interaction	0.599	0.876	
While watching the interactive location-triggered device morphing animation, the descending and retracting metal tube triggers a response in my tactile senses (e.g., pain, etc.)	0.611	0.875	
When I watched the demo animation, the device that restored the original state at the end of the interaction gave me a feeling of ease in my heart	0.54	0.88	
When watching the animated presentation, I can understand the theme that this installation is trying to convey about the relationship between human beings and nature	0.609	0.875	
After watching the presentation animation, I was thinking seriously about the current unbalanced relationship between man and nature (e.g., I feel that current human behavior is destroying the natural environment while also destroying itself)	0.637	0.873	

The Cronbach's coefficient is used to evaluate the internal consistency and stability of multiple items in the questionnaire, and the formula for calculating the coefficient is as follows:

$$\alpha = \frac{K}{K-1}\left(1 - \frac{\sum_{i=1}^{K} \sigma_{Y_i}^2}{\sigma_x^2}\right) \tag{1}$$

Table 2. Cronbach's reliability analysis

KMO and Bartlett's test	
KMO value	0.899
Bartlett Sphericity Check approximate chi-square (math.)	393.737
df	45
p-value	0.000

In the formula, K is the number of test questions, represents the variance of the total test results, and represents the variance of the test of the current observation sample. The Cronbach's alpha coefficient test was performed on the scales in the questionnaire using SPSS statistical analysis software. From the test table, it can be seen that the Cronbach's coefficient is 0.886, which is greater than 0.8; the KMO value of the questionnaire is 0.899, which is greater than 0.8; and the P-value of the Bartlett's sphericity test is much less than 0.05, as shown in Table 1 and Table 2. Combining the above two indicators, it can be seen that this questionnaire has good reliability and validity. After organizing and analyzing, the audience's satisfaction with the appearance impression of this interactive installation work is 78%, the interactive experience is 76%, and the emotional resonance is 73%. The results show that the audience has a good overall satisfaction with the interactive installation "Coexistence or Imbalance".

5 Conclusions

This project is based on the development trend of the relationship between humans and nature, using synesthesia theory as the basis, and interactive installation art as the carrier, simplifying the complex interrelationships in the entire natural world, and proposing a possibility for the future of mankind - human beings' evil deeds against nature will eventually backlash on themselves. Through the consideration, application and practice of design methods, interactive installation art design based on synesthesia experience can not only bring more diverse interactive experience modes to the audience, but also strengthen the emotional connection between the installation and the audience, enabling designers to more effectively convey their design concepts to others. It also obtains a design thinking model that combines synesthesia theory with emotional design, providing new ideas for future interactive installation art design. However, this article has insufficient experience in the combination of thinking and methods, and the design practice is not perfect. In the future, we need to continue to explore better ways to combine synesthesia theory with emotional design, optimize it, and find more effective and reasonable design methods.

References

1. Zhang, B., Chen, X., Han, D.: Sound scene interaction design based on synesthesia theory of Meidai Zhao. Packag. Eng. **44**(S1), 15–23 (2023). https://doi.org/10.19554/j.cnki.1001-3563.2023.S1.003
2. Merleau-Ponty, M.: The World of Perception. Routledge, London (2004)
3. Qian, Z.-S.: Seven Patches [M]. Beijing: Life · Reading · New Knowledge Joint Publishing Company (2019)
4. Chen, Y.-D.: Spiritual Insight and Wonderful Realization - Art Synesthesia Theory. Anhui Education Press, Hefei (2005)
5. Norman, D.A.: Emotional Design [M]. Q.-F. Fu and J.-S. Cheng, Trans. Beijing: Electronic Industry Press (2005)

6. Song, X., Gu, Y.: Research on art design of digital media interactive installation based on green design. In: International Symposium on Robotics, Artificial Intelligence, and Information Engineering (RAIIE 2022). SPIE, vol. 12454, pp. 15–20 (2022)
7. Zhou, L., Xie, F.: Welcome to Heshan: an installation to create immersive and entertaining experiences with local art through interactive media technologies. In: Rau, P.L.P. (ed.) HCII 2022. LNCS, vol. 13312, pp. 304–317. Springer, Cham (2022). https://doi.org/10.1007/978-3-031-06047-2_22
8. Zhong, M., He, R., Zhao, D., et al.: Design of interactive devices based on synaesthesia experience. Packag. Eng. **42**(4), 109–114 (2021). https://doi.org/10.19554/j.cnki.1001-3563.2021.04.014
9. Liu, J.: Science popularization-oriented art design of interactive installation based on the protection of endangered marine life-the blue whale. In: Journal of Physics: Conference Series. IOP Publishing, vol. 1827, no. 1, p. 012116 (2021)
10. Liu, W., Li, Z., Guo, Q., et al.: Research on cultural and creative product design based on the emotional needs of generation Z. Packag. Eng. 1-17 (2023) [Online]