



Study on Interactive Imaging Device Based on Sympathy Theory

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Abstract. This paper discusses the experience of interactive image device based on synesthesia theory, analyzes the basic concept and application of synesthesia theory, and puts forward an effective interactive experience design strategy. The theory of synesthesia provides a new perspective for the design of interactive image installations, which can enhance the audience's immersion and emotional resonance through multi-sensory fusion and interaction. Finally, this paper analyzes the future development trend of interactive imaging device design, emphasizing the deep integration of technological innovation and sensory fusion.

Keywords: Sympathetic theory; Interactive imaging devices; Experiential design; Sensory integration; Immersion

1 Introduction

With the development of science and technology, interactive image installations have been widely used in art exhibitions, public space, advertising communication and other fields. Interactive imaging device is not only a visual presentation medium, but also a multi-sensory interaction system. From the perspective of synesthesia theory, this paper studies the design strategy and user experience of interactive imaging devices, and discusses how to enhance the user's immersive experience and emotional response through sensory interaction.

1.1 Basic Concepts of Synesthesia Theory

Synesthesia is a cross-sensory perception phenomenon, that is, the fusion and overlap of different senses. In daily life or reading, we can often hear or see such words: "this smell is very cold", "you smile really sweet", "cold, warm color" and so on; Or have some feelings, such as seeing a particularly dense array of food, will feel a tingling skin, see the picture of chocolate cake, will feel as if they smell sweet taste. This is a more abstract and special phenomenon, this phenomenon acts on the consciousness system in our brain, but in fact we do not really touch the cold taste, taste the sweetness of the smile, touch the cold and warm color, but still can understand the meaning

of its expression, this is the reason of synesthesia. ¹Traditionally, the senses have been regarded as separate sensory systems, but in synesthesia, the senses such as human vision, hearing, and smell are linked. For example, when a certain color is presented, it may be associated with a certain sound or taste. This phenomenon offers new possibilities for artistic creation and design.

1.2 Definition and Characteristics of Interactive Imaging Devices

Interactive image installations are interactions of visual images with other senses to present dynamically changing works of art or technology. Unlike traditional still images, interactive image installations emphasize audience engagement and interaction. Audience movements, emotions, sounds, etc. can affect the output of the device, resulting in immediate feedback effects. The core features of the interactive imaging device include:

Participation: The behavior of the audience is the driving factor of image performance, which enhances the audience's sense of participation and interaction. The interactivity of multimedia interactive art is mainly reflected in the subjective initiative of the audience. Different from the traditional exhibition in which the audience passively accepts the information transmission, multimedia interactive art enables the audience to actively participate in the display of the work, play a role, and even change the way the art is presented. Therefore, the transmission of information becomes a two-way communication between people and the work. ²

Immersiveness: Provide a more immersive experience through a multi-sensory fusion design.

Immediate feedback: The device generates real-time feedback based on the behavior of the audience, forming an interactive closed loop.

2 Experiential Design Effect and Experiential Design Carrier for Interactive Imaging Devices

2.1 Core Objectives of Interactive Experience Design

The experience design of interactive imaging devices is not only a technical implementation, but also more importantly, it enhances the user's sense of engagement, immersion and emotional resonance through design. Designers need to consider how the combination of image, sound, touch and other elements, so that the audience's perception beyond a single sense, into a state of multi-sensory interaction, enhance emotional identity and cognitive response to the work.

2.2 Selection of Design Carriers

The design carrier of interactive image device mainly includes screen, projector, sensor, sound equipment and so on. As technology advances, designers can combine through more diverse carriers to create richer multi-sensory experiences. For example,

spatial sensors are used to detect the movement trajectory of the viewer, thereby controlling changes in the image; or to extend the image experience to the viewer's physical perception through a tactile feedback device.

2.3 Evaluation Criteria for Design Effectiveness

The design effects of interactive imaging devices need to be evaluated from multiple dimensions, including visual effects, interaction effects, and emotional transmission effects. Designers can evaluate the effectiveness of the device through indicators such as user feedback, behavioral data, and emotional responses. At the same time, studying audience engagement, immersion, and cognitive response is also an important criterion for evaluating design effectiveness.

3 Cases Analysis

3.1 Case 1: Sound of the Meadow

Background and Design Concept.

Sound of the Meadow is an interactive video installation created by a team of artists in 2018 at a digital art exhibition in Tokyo. Combining visual, sound and tactile feedback, the device aims to convey sensory experiences in close contact with nature through reproduction of sounds and images from nature. The theme of the work is the relationship between nature and human senses, which aims to evoke the audience's concern and perception of the ecological environment.

Design and Interaction.

Viewers interact with images and sounds by walking and touching the virtual grass in front of the device. When the audience touches the grass, the device emits sounds of different frequencies, and the image changes according to the audience's movements. For example, touching a piece of grass makes the color of the grass more vivid in the image, while sounds such as wind, insects, and birdsong are heard from the surrounding speakers, forming an immersive natural environment.

Application of Sympathetic Theory.

The design of this work fully reflects the application of synesthesia theory, especially in the integration of senses. The interaction between sight and hearing creates a multidimensional experience. The addition of touch allows the viewer to make a direct connection with the environment through limb perception. The changes in the sound and visual images of the grass in the work are driven in real time by the behavior of the audience, making the experience unique to each audience. From the perspective of hearing, people gradually have visual fatigue because of different expression of vision in design art, it is easy to deal with this problem by sound. People can easily get into the space made by the installation, through the layout of the sound field and the connectivity and interaction of sound, the rendering and promotion of narra-

tion can be constructed. From the background rendering, in terms of hearing, the audience will step into a new space different from the real world with the ingenious arrangement of background music and white noise, analyzed by the brain's subconscious to help the audience think and connect continuously when they are experiencing the installation. From the plot promotion, it can make the audience experience the interaction in the specific way set by the designers through the guidance of language and the progressive design of the sound field. The programming language can also locate the different position of audience to change the pitch, timbre and loudness, interacting with the audience in various way.⁴

3.2 Case 2: Light Symphony

Background and Design Concept.

Light Symphony is an interactive light and shadow installation created by an internationally renowned team of media artists and exhibited at the Museum of Digital Art in Paris. Installation art is one of the most important and provocative developments in the visual arts during the last half century and has become a key focus of artists and of contemporary museums. It is also seen as particularly challenging or even disliked by many viewers, and—due to its unique in situ, immersive setting—is equally regarded as difficult or even beyond the grasp of present methods in empirical aesthetic psychology.⁵ Combining video projection, spatial sound and tactile feedback, the device is designed to interact with the audience through music, light and present a harmonious aesthetic of sight and hearing. Through this cross-sensory expression, the work hopes to immerse the audience in the artistic creation at the same time, feel the emotional communication between music and light and shadow.

Design and Interaction.

The device captures the audience's position and movement in space through multiple sensors, adjusting the intensity of light and sound in real time according to the audience's movements. The action of the audience not only changes the light and shadow effect in the space, but also produces a specific musical melody, forming a kind of visual and auditory resonance. For example, when the audience waves their arms, the light around them changes accordingly, and the music changes according to the rhythm of the movement, creating a synchronized sensory experience.

Application of Sympathetic Theory.

In this case, the multi-sensory interaction design using synesthesia theory breaks down the boundaries between the senses by interacting visual and auditory perception with the audience's movements in real time. Each action triggers not only visual changes, but also auditory adjustments, creating an experience of "sensory interaction." For example, a quick arm swing can trigger bright light and exciting music, while a slow motion brings soft light and a gentle melody. This type of interaction not only enhances the audience's sense of engagement, but also brings emotional immersion and pleasure.

4 Interactive Imaging Device Experience Design Strategy

4.1 Design Strategies Based on Sympathy Theory

Sensory Fusion.

Sensory fusion is one of the most basic and common approaches in synesthesia design. In interactive imaging installations, designers can create a cross-sensory immersive experience by cleverly blending sensory elements such as vision, hearing, and touch. For example, a combination of sight and hearing can help the viewer better understand the emotion or atmosphere behind the image, while the addition of touch can enhance the presence of the visual and auditory experience.

Multisensory Interaction.

Multi-sensory interactions are designed based on real-time audience behavior feedback. The interaction of different sensory modes enables the organism to perceive the environment more comprehensively and accurately and make more appropriate responses. For example, when crossing the road, people will simultaneously rely on visual observation of traffic conditions, auditory listening to vehicle sounds, and tactile feeling of ground vibration to ensure safe passage.⁶For example, sensor technology is used to sense the audience's movements, emotions, or physiological responses, and to adjust images, sounds, and tactile feedback in real time. Perceptual systems, in contrast to the senses as channels of sensation, are whole body activities devoted to actively extracting, isolating, or clarifying informative structure in the world.⁸Through this dynamic change, each action of the audience can cause a different sensory experience, making each interactive experience unique. The accuracy of sensor technology must be ensured in the design to ensure smoothness and timeliness of interaction. Any delay breaks the viewer's immersive experience and affects the transmission of emotions. Different audiences react differently to the interaction, and the design should consider how to adjust sensory feedback through the system so that each audience can feel a personalized interactive experience. For example, the system can dynamically adjust the image and sound effects based on the audience's pace or gesture width.

Emotional Transmission.

The application of synesthesia theory is not only the fusion of senses, but more importantly the transmission of emotions through sensory interaction. In interactive image installations, designers can convey specific emotions through the careful combination of color, tone, rhythm and other elements. For example, warm tones and soft music can convey tranquility and comfort, while cold tones and intense sound create a tense and turbulent atmosphere.

4.2 User-centric Design Strategy

The design of the interactive image device needs to fully consider the perceptual habits and needs of the audience, so the design should focus on the concept of user-centered. The design should be adapted and optimized according to the behavioral habits, cultural background and psychological needs of different audiences to ensure the best experience for each audience. The emerging field of interaction design reflects not only how people interact with machine interfaces, but also how people interact with each other in environments where interaction is ubiquitous. It elevates previously utilitarian digital design concerns to a cultural level, incorporating concepts such as premise, appropriateness, and appreciation.⁷

Adaptive Design.

In response to the needs of different user groups, designers should consider the adaptability of interactive design. For example, for users of different ages and cultures, the intensity, rhythm and complexity of sensory stimuli may vary. These differences should be fully considered when designing, optimizing the experience with adjustable parameters and personalized settings. For example, in an exhibition of interactive video installations, the design can provide different modes of interaction for children and the elderly. For children, simpler interactions can be set up, such as simple touch or press operations, while for adults, more complex interactions can be provided, such as multi-dimensional interactions through motion sensors.

Cross-cultural Adaptation.

The design needs to take into account the different responses of audiences from different cultural backgrounds to sensory stimuli. For example, bright red is often used in Western cultures to express passion, while in some Asian cultures, red may represent joy and good luck. The design should be based on the cultural background of the exhibition venue and the audience, and the appropriate sensory stimulation program should be selected. When designing interactive imaging installations for the global tour, design details may need to be adapted to the cultural characteristics of different countries and regions. For example, milder tones and quieter sounds may be used when exhibiting in Japan, while stronger colors and fast-paced music may be used when exhibiting in the United States to suit the cultural preferences of different audiences.

4.3 Combination of Technology and Art

Interactive image installation is not only the presentation of technology, but also the way of artistic expression. Designers should enhance the artistic quality of the work and the emotional resonance of the audience through the combination of technology and art. Create an immersive art experience with high-quality images, sounds and interactive design.

5 Conclusions

This paper discusses the experience design of interactive image device based on synesthesia theory, and analyzes its design effect and strategy from theory to practice. In the future, with the continuous advancement of technology, interactive imaging devices will be more intelligent, personalized and multi-sensory. Interactive imaging device design based on synesthesia theory offers a rich possibility of sensory experience and emotional expression. With the continuous development of technology and the deepening of artistic creation, interactive image installations will continue to develop towards more intelligent, personalized, multi-sensory and cross-border integration. In the 5G era, the accelerated development of science and technology has brought infinite possibilities to the creation of interactive video installation art. Facing the mobile Internet and the Internet of Things, 5G has the technical characteristics of ultra-narrowband, ultra-broadband, massive connection, high reliability and low delay, and its performance goals are high data rate, reduce delay, save energy, reduce costs, improve system capacity and large-scale device connection, and broaden the road for data transmission.³ In the future, designers should pay more attention to the cross-border integration of senses, pay more attention to the emotional transmission and personalization of the audience, and pay more attention to sustainable development and environmental protection.

References

1. Fan, Shunan. Research on the Experience Design of Interactive Video Installation Based on Synesthesia Theory [D]. Changchun University of Technology, 2024. DOI:10.27805/d.cnki.gccgy.2024.000304.
2. Xuan, Yixiao. Research on Immersive Multimedia Interactive Art Installations Based on Synesthesia and Synaesthesia [D]. Xi'an University of Technology, 2023. DOI:10.27398/d.cnki.gxalu.2023.000338.
3. Jiang, Wei & Zhao, Lu. The Development Trend of Interactive Video Installation Art in the 5G Era [J]. New Art Field, 2022, (05): 82-84.
4. On the In-application Value of Emotional Intelligence Interaction Based on Interactive Art Installation[J]. Zhou Xinyu.Journal of Physics: Conference Series.2021
5. Capturing Aesthetic Experiences With Installation Art: An Empirical Assessment of Emotion, Evaluations, and Mobile Eye Tracking in Olafur Eliasson's "Baroque, Baroque!"[J]. Pelowski Matthew;;Leder Helmut;;Mitschke Vanessa;;Specker Eva;;Gerger Gernot;;Tinio Pablo P L;;Vaporova Elena;;Bieg Till;;Husslein-Arco Agnes.Frontiers in psychology.2018
6. Hölscher, C., & Hölscher, T. (2015). "The Interaction of Sensory Modalities in Interactive Systems." *Interacting with Computers*, 27(5), 547-558.
7. McCullough, M. (2013). *Digital Ground: Architecture, Pervasive Computing, and Environmental Knowing*. MIT Press.
8. Gibson, J. J. (1979). *The Ecological Approach to Visual Perception*. Houghton Mifflin.

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