

Research on Intelligent Interactive Product Design in Cruise Ship Public Spaces

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Abstract:

Aiming at the problems of homogenization, simplification of experience and lack of connection between functions in the design of intelligent interactive products in the cruise public space, this paper discusses the design logic and specific implementation path of intelligent interactive products in the cruise public space, and around the emotional interactive experience, multi-sensory experience design, function integration and optimization methods, proposes an intelligent interactive design strategy that integrates aesthetic value, emotional level and practical functions, so as to promote the transformation of cruise public space from a place that simply meets the functional needs to a space rich in emotional value, and explains it through design practice, so as to provide reference for the cruise industry.

Keywords:

Cruise Ship Public Space, Intelligent Interactive Design, Emotional Design, Multi-Sensory Experience

1. Introduction

With the transformation of cruise from transportation to “mobile living space”, the emotional interactive experience function of cruise public space is single, sensory dimension is missing, and technology and art are disconnected. This paper aims to build an emotional bridge between people and products, people and space by accurately connecting user needs and technology empowerment, enrich experience dimensions with the help of multi sensory integration, and improve use efficiency through functional integration and optimization.

Through functional integration, experience premium and industrial empowerment, this study is ultimately committed to building an intelligent interactive product design system that meets the characteristics of cruise scenes and passenger needs. Break the bottleneck of homogenization of interactive experience in cruise public space, and solve the problems of overlapping functions, single forms and similarities of interactive products in the current smart cruise construction through systematic innovation of design strategies. At the same time, with the help of function integration

logic, simplify operation, significantly improve the efficiency of public service circulation and optimize service energy efficiency while reducing passengers' cognitive load. This study not only focuses on the pleasure of individual interaction, but also aims to provide forward-looking design path and theoretical support for the transformation of the cruise industry from “traditional shipping” to “smart cultural tourism”, and reshape the value boundary of interactive experience in the public space of cruise tourism. This will enhance the experiential value and service efficiency of spatial interaction, providing an innovative design path for the high-quality development of the cruise industry. The paper’s framework is shown in Table 1.

Table 1. *Paper’s framework.*

Chapter Level	Core Section	Key Content Points
Part One	Problem Analysis	Homogenization of interaction, lack of multi-sensory experience, disconnect between function and context
Part Two	Theoretical Framework	Emotional interaction, multi-sensory experience , functional integration and optimization
Part Three	Design Strategy	Integration of brand culture and emotion, immersive multi-sensory collaborative strategy
Part Four	Practical Cases	“Ocean Symbiosis” interactive wall, “Blue Relax” intelligent leisure cabin

2. Analysis of Problems in Intelligent Interactive Product Design for Cruise Ship Public Spaces

2.1. Interaction Design Faces a Serious Problem of Homogenization

At present, the intelligent interactive products on cruise ships generally value function and despise personality. Most of them provide basic functions such as information query and light adjustment, and are highly similar in design. From a design perspective, there’s a lack of deep integration with brand culture and the ocean theme. In terms of interaction methods, they primarily rely on traditional touch and button methods, failing to incorporate intelligent forms such as sensors, voice, and gestures. From the visual performance point of view, the interface style, color matching and shape design are easy to cause visual fatigue and lack of artistic presentation. This similar design idea is difficult to meet the personalized needs and weakens the market competitiveness of the product.

2.1.1. The Disconnect Between Functional Orientation and Brand Narrative

At present, the development of cruise intelligent interactive products shows an obvious tendency of emphasizing function implementation and ignoring cultural expression, which leads to a serious dilemma of homogenization in design. The interactive terminals of existing cruise ships are mostly limited to basic one-way information retrieval, basic environmental control, such as lighting, temperature control and other instrumental categories, and the design logic is highly similar. Most products fail to deeply reconstruct and organically integrate the cultural core of the cruise brand and the marine theme visual gene, making interactive products become standardized industrial plug-ins, lacking unique scene recognition, and difficult to convey the value proposition and cultural temperature of a specific cruise brand through interactive media.

2.1.2. Lagging Interaction Modalities and Lack of Dimensions

In terms of the construction of interaction logic, the existing products are still in the path dependent stage of traditional physical media. Although it is in the transformation period of smart cruise, its practical application is still highly limited by the single dimensional operation modes such as two-dimensional screen touch and physical keys, lacking the exploration and integration of multimodal interaction system. The lack of cutting-edge intelligent interaction paradigms such as inductive recognition, voice control and gesture tracking makes the human-computer interaction process appear stiff and inflexible. This low dimensional interaction mode not only can not meet the expectations of users for natural interaction in the high seas navigation environment, but also limits the energy efficiency of intelligent technology in the cruise public space scene.

2.1.3. Visual Paradigm Fatigue and Lack of Artistry

The similarity of visual expression dimension is the most intuitive representation of homogenization phenomenon. At present, there are many problems in the interactive interface design of cruise public space, such as flat style, lack of color logic and mechanized contour. The homogenized UI interface with a large number of highlights and high saturation is sharply separated from the exquisite space aesthetics inside the cruise ship, which is very easy to lead to users' visual perception overload and aesthetic fatigue. The industrial appearance design without artistic consideration reduces the aesthetic added value of the cruise ship as a high-end cultural and tourism carrier. This lack of personalized and artistic design thinking not only makes it difficult to cope with the increasing aesthetic expectations of passengers under the background of consumption upgrading, but also fundamentally weakens the market core competitiveness of products in the intelligent transformation.

2.2. Lack of Multi-Sensory Experience

In the past, the focus of interactive product design was on vision and touch, ignoring the synergy of hearing and smell, resulting in incomplete experience. Visual design excessively pursued a technological feel while ignoring aesthetic harmony. Tactile design failed to adequately consider material selection, leading to unpleasant tactile sensations. When the auditory and olfactory design is obviously insufficient, the sound effect is monotonous, and the olfactory elements are relatively few. The interaction of a single dimension is difficult to drive the participation of multiple senses, unable to form three-dimensional perception, and reduces the interaction willingness and emotional connection.

2.2.1. Imbalance and Fragmentation of Sensory Dimension

At present, the design of interactive products in cruise ship public spaces exhibits a clear preference for sensory experiences. Traditional design logic often relies too much on visual guidance and tactile feedback as the core carrier of information transmission, but inadvertently ignores the synergy of hearing and smell. This disconnection of sensory design leads to users' inability to obtain a logical and immersive interactive experience in the complex cruise environment, which makes the original all-round intelligent service dimensionality reduction into a single dimension of screen interactive experience.

2.2.2. Misconceptions About Vision and Touch

When pursuing the visual expression of "smart cruise", designers often blindly chase a technological feel. A large number of electronic media with high brightness and cool colors have been coercively implanted into the public space. Although the

instantaneous amount of information has been increased, the overall coordination with the cruise interior aesthetics has been ignored. This kind of visual design that overemphasizes functional features easily causes visual fatigue and weakens the warmth and artistic depth of cruise vacation. On the other hand, the existing intelligent terminal lacks meticulous consideration in tactile design. The design focuses on the smoothness of the touch screen, while ignoring the combination of physical materials of interactive components and ergonomics. Because of insufficient research on the temperature and humidity changes of materials in the maritime environment and their impact on touch psychology, the product feels stiff and cheap, making it difficult to convey the high-end quality of cruise products through touch.

2.2.3. Lack of Perception of Environmental Atmosphere

Auditory experience, as an important means of building a three-dimensional sense of space, is extremely monotonous in the current design. The voice feedback in the interaction process is often limited to the mechanical prompt tone, lacking brand recognition and emotional fluctuation. In noisy cruise ship public areas, such as lobbies and restaurants, monotonous music fails to blend with the background noise. How to better integrate the auditory experience into the design of interactive products in cruise ship public space while combining the brand culture and narrative theme needs to be further considered.

Smell is the most pathway to triggering human emotional memory, but it is almost isolated in the design and development of intelligent interactive products. The role of odor in relieving the depression of confined space, especially the inner cabin area, and enhancing interactive memory points is ignored, which makes the interactive experience less vivid and interesting.

2.2.4. Impact of Multi-Sensory Collaboration Failure

This single dimension interaction mode reduces the user's willingness to interact, and it is difficult to stimulate the user's desire for active exploration. Smart interactive products are no longer a "housekeeper" full of temperature, but a cold "machine". Users cannot generate a sense of belonging and pleasure through interaction. Vague brand recognition and lack of consistent design across senses make it difficult for the differentiated characteristics of cruise brands to leave a deep impression on users.

2.3. Disconnect Between Functional Configuration and Scenario

The previous product design showed the characteristics of "discretization", each functional module was independent of each other, and the lack of adaptation to specific use scenarios made the product functions redundant and insufficient, and the system integration was insufficient. For example, the interactive equipment on the deck has no weather information push, and the terminal of the restaurant cannot provide one-stop service. Data and functions of products in different areas are not connected and integrated. The lighting adjustment of the entertainment hall cannot be linked with the activity content. The fitness data fails to give catering suggestions, resulting in a lack of coherence in the overall experience.

2.3.1. The "Discretization" of Functional Modules and Inefficient System Integration

At present, the configuration logic of cruise intelligent interactive products shows an obvious "discrete" feature, and the design of functional modules is often isolated from the specific physical field and behavior, lacking overall planning at the system

level. Some interactive terminals integrate a large number of low-frequency and unnecessary redundant functions, resulting in cumbersome interaction levels and waste of software and hardware resources. On the other hand, under the specific core scenario, the product also shows the absence of key service efficiency. The lack of system integration makes it difficult for interactive products to form a joint force and build an intelligent matrix of collaborative operation in the complex cruise ecosystem.

2.3.2. Discontinuous Interactive Experience

The cruise environment has strong dynamics and scene diversity, but the existing interactive products lag behind in the scene perception dimension. For example, the interactive media in the open deck area often lack real-time response logic to the meteorological environment, and fail to translate environmental parameters such as dynamic wind, ultraviolet intensity or precipitation warning into interactive suggestions. The interactive terminals in the catering area mostly stay in the static menu display, unable to provide cross module one-stop service. The dislocation between interactive experience and actual needs brought about by this functional configuration is essentially due to the failure to accurately build the psychological expectations of passengers at specific time and space nodes in the early stage of design, resulting in the failure of natural migration of interactive behavior with the scene conversion.

2.3.3. Fragmentation of Interactive Experience Due to Information Silos

The data gap between different interaction dimensions in the cruise public space is the key to the lack of continuity of experience. Due to the serious data barriers between the service experience of entertainment, fitness, catering and other functional areas, the interactive behavior presents a clear fragmented state. For example, the intelligent lighting system of the leisure and entertainment space cannot be synchronized with the performance content in real time, resulting in the limited sense of immersion of the space atmosphere. The exercise physiological index data collected by the fitness module could not be closed-loop fed back to the catering system to generate personalized nutrition suggestions. The failure of this interactive function experience collaboration hinders passengers' emotional and entertainment experience in cruise life, making intelligent interaction unable to improve the integrity of the experience, but reducing passengers' trust and dependence on the interactive experience of smart space due to the fault of the operation process.

3. Design Framework for Intelligent Interactive Products in Cruise Ship Public Spaces

3.1. Emotional Interaction Design to Build Emotional Connection Between People and Space

In the public space of cruise ships, the design of emotional intelligent interactive products should fully fit the scene characteristics of cruise travel. Donald A. Norman, an American cognitive psychologist, clearly proposed in his book emotional design that users' emotional experience can be divided into three levels from bottom to top: instinct level, behavior level and reflection level [1]. Passengers are in a relaxed psychological state and have a strong demand for emotional comfort, social identity and freshness [2]. The design thinking path of intelligent interactive products in cruise public space is shown in Figure 1. For example, in the design of intelligent interactive facilities on the cruise deck, it is not only necessary to meet the basic functions such

as shading and rest, but also to create an atmosphere of “coast under the starry sky” through the linkage of inductive lighting and wave sound. In the parent-child interaction space, intelligent interactive toys with emotional feedback are designed to respond to children’s interactive behavior through voice encouragement and light and shadow changes, so as to enhance the emotional communication between parents and children. Emotional intelligent interaction design makes the cruise public space no longer a simple collection of functions, but an “emotional carrier” that can perceive users’ emotions and respond to users’ needs, so as to improve users’ emotional experience and brand loyalty [3].

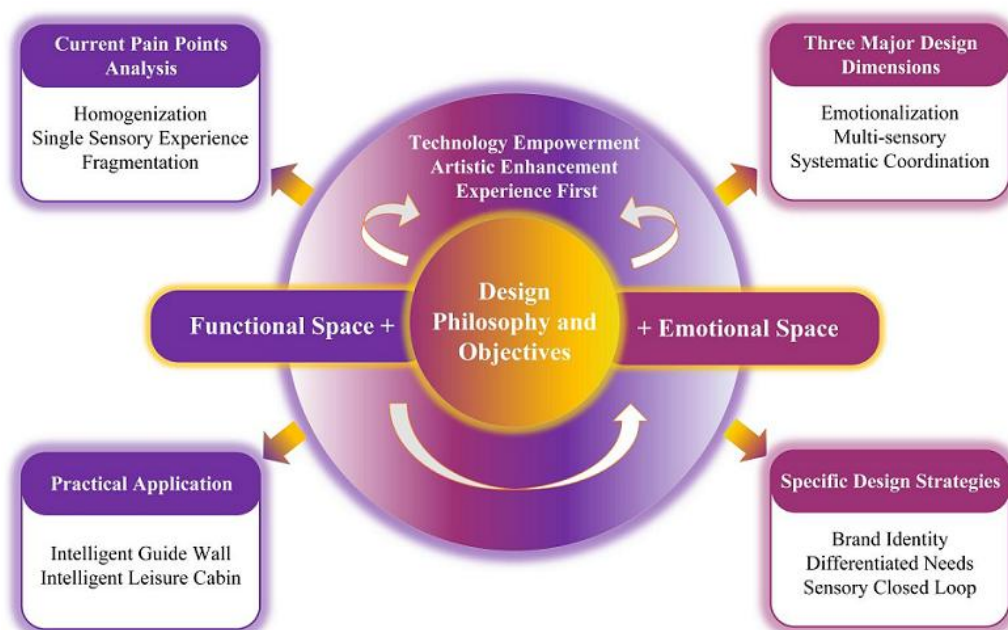


Figure 1. Design Thinking Path for Intelligent Interactive Products in Cruise Ship Public Spaces.

3.2. Multi-Sensory Experience Design to Enrich the Dimension and Depth of Product Interaction

The multi-sensory intelligent interactive design of cruise ship public space has a natural advantage in contextual resources. The constantly changing wind and waves in the marine environment, the light and shadow and starry sky landscape formed by the alternation of day and night, and the unique structure and material touch in the cruise ship space together constitute a highly immersive and dynamically changing interactive context, providing rich sensory input conditions for the construction of multi-sensory interactive system. In response to the three levels of artistic synesthesia, when viewers experience interactive installations, they also experience three levels of experience, namely sensory experience, exploration experience, and thought experience [4]. On this basis, multi-sensory intelligent interactive design integrates sensory channels such as vision, hearing and touch, and incorporates user behavior, environmental feedback and system response into a unified interactive framework to achieve two-way communication between people and space. For example, in the fitness center scene, the user’s exercise rhythm and intensity data can be collected by sensors and mapped to output elements such as light brightness, color change and music beat, so that the interactive feedback and user behavior form a real-time linkage relationship, thereby enhancing the user’s sense of control and participation in the exercise process.

3.3. System Synergistic Design Based on Scenario Needs to Optimize Product Functions

The core of product function integration design is to take the scene demand as the organization center and the user behavior as the design direction. Through the systematic disassembly of the use situation and the in-depth analysis of the user behavior path, the rationalization of function configuration and the efficiency of system linkage are realized [5]. In a more complex public space, it can significantly improve the convenience of operation and optimize the experience. For example, the intelligent interactive products of the cruise comprehensive entertainment hall can preset a variety of operation schemes for different scenes such as conferences, performances and gatherings, and complete the simultaneous adjustment of several subsystems such as lighting, sound and video with the help of one operation, so that the spatial functions can quickly adapt to the scene changes and switch smoothly. Relying on function integration and operation process optimization, intelligent interactive products can not only improve system operating efficiency, but also accurately match actual usage scenarios and user needs, thereby bringing users a natural and efficient interactive process.

4. Design Strategies for Intelligent Interactive Products in Cruise Ship Public Spaces

4.1. Emotional and Brand Integration Design Strategy

With emotional design at its core, and combining cruise brand culture with ocean theme characteristics, we will build a smart interactive product system with unique recognizability, realize the value unity of “function + emotion + brand”, and further realize the construction of a highly recognizable smart interactive experience system through the integration of emotional and brand design strategies.

Explore the cultural connotations and ocean imagery carried by cruise brands and integrate them into the appearance design, interface design and interaction logic of intelligent interactive products, so as to have clear brand expression, emotional orientation and functional needs. In terms of emotional expression, take into account the differentiated emotional needs of different user groups. For family users, design parent-child interactive intelligent interactive products, such as intelligent seats with marine life voice interaction and digital graffiti walls completed by parents and children to enhance family cohesion; for young users, develop intelligent interactive products with strong social attributes, such as interactive projection games on the deck and social matching terminals based on geographical location to meet their social needs. Through the deep integration of emotionalization and branding, make intelligent interactive products a carrier of cruise brand culture and a medium for emotional transmission, break the homogenization dilemma, and improve brand recognition and user loyalty [6].

4.2. Multi-Sensory Collaborative Design Strategy

An immersive interactive experience scenario for public spaces on cruise ships is constructed using a multi-sensory collaborative design strategy. Traditional interactive design often remains at the 2D level of “visual + auditory”. Linstrom pointed out that 75% of human emotions are caused by smell, while touch is the foundation for human trust. Multi-sensory design is not simply the superposition of senses, but rather the reinforcement of specific memories through synergy. When the information conveyed

by multiple senses is consistent, the immersive experience will be greatly enhanced [7]. For example, in the cruise ship scenario, intelligent interactive products should not just be cold screens, but should be olfactory with the scent of the ocean, tactile with the texture of waves, and auditory with the rhythm of the tides.

Based on the unique characteristics of public spaces on cruise ships, this system integrates multiple sensory channels, including sight, hearing, touch, and smell, to create a complete and immersive intelligent interactive experience, enhancing user engagement and lasting impression.

In the visual and auditory presentation, it emphasizes the combination of “beauty in appearance” and “beauty in artistic conception”. The interface layout adheres to simple and direct requirements, and the color combination is consistent with the overall atmosphere of the cruise public space. For example, warm and soft colors are used in the dining area, lively colors are used in the fitness venue, and the shape design focuses on the characteristics of the space to reduce the stiff feeling, and the interactive terminal is made into wavy, shell like and other marine related forms. Strengthen the overall aesthetic effect of the space, increase the visual feeling with the help of light intensity changes, add inductive lighting in the deck interaction device, bring light and shadow flow changes with the user’s walking, and enhance the interest of interaction with the help of sound feedback. After the user completes the interactive operation, a happy celebration sound effect interaction will sound.

4.3. Innovative Design New Paradigm

A new paradigm for intelligent interactive product design in cruise ship public spaces is constructed, characterized by “technology empowerment, artistic enhancement, and experience supremacy”, as shown in Figure 2.

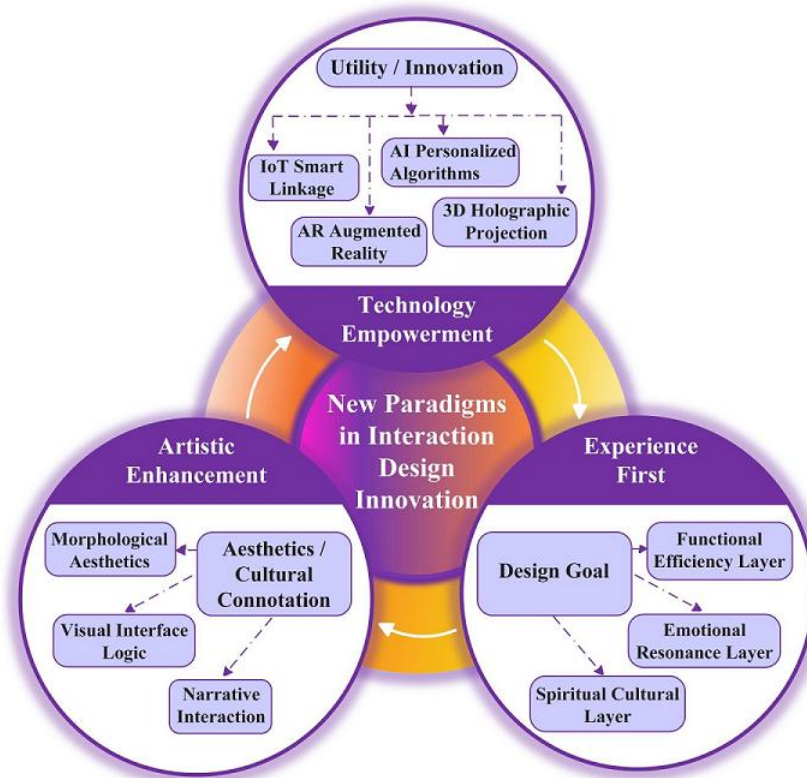


Figure 2. Innovative Design New Paradigm.

In terms of technological practice, technological elements are the key to transforming intelligent concepts into intelligent products. The ultimate goal of intelligent product interaction design is to improve the user experience, including efficiency improvement and emotional satisfaction [8]. Therefore, the new paradigm of intelligent product interaction design can be represented by a hierarchical model consisting of a technology layer, an art layer, and an experience layer. The technology layer focuses on technology empowerment, emphasizes the balance between innovation and practicality, combines the special characteristics of cruise ship scenarios with advanced technologies, and enhances the intelligence and fun of intelligent interactive products, including IoT intelligent linkage, AR augmented reality, AI personalized algorithms, and 3D holographic projection. For example, 3D holographic projection technology can be used to create virtual ocean-themed performances in various public spaces on cruise ships, while interacting with tourists to enhance the artistic atmosphere of the space. By applying AR technology to develop intelligent interactive products for ocean culture popularization, one can see virtual marine life and maritime history scenes, and use artificial intelligence technology to realize personalized service recommendations, and push suitable activities, catering, and entertainment projects according to the user's consumption habits and interests.

In terms of art integration, the unity of aesthetic expression and cultural connotation is achieved. Art design is integrated into the entire life cycle of the product, and attention is paid to integrating artistic elements and cultural connotations from appearance form to interaction logic, from visual interface to user experience. This includes appearance form aesthetics, visual interface logic, and narrative interaction. When designing and applying brand cultural elements, four methods can be adopted: reverse design; directional design; biomimetic design; and combining various designs. At the same time, it is necessary to attach great importance to the extraction of brand cultural elements, appropriately add some modern elements to the brand cultural elements, and do a good job in appearance design, model construction and process research, etc. [9]. For example, in visual interface design, the design language of ocean elements such as curves and gradients is adopted, while using simple and smooth visual language, color matching echoes the ocean theme, and the icon design is artistic and recognizable. In terms of interaction logic, narrative design is integrated, and interactive storylines are built around the themes of "ocean exploration" and "round-the-world voyage", so that users can obtain emotional resonance and cultural experience in the process of using the product.

From the perspective of experience design, cruise ship experience design is a hierarchical system that progresses from the material foundation to the spiritual height. Based on the functional layer, through the industrial coordination of complex spatial flow and intelligent services, the anxiety caused by the closed environment at sea is eliminated, and basic trust and satisfaction are established. Emotional resonance is the core of experience design, focusing on the interactive experience between people and space, and between people. By using five senses design and immersive interactive experience scenarios, the physical space is transformed into an "emotional container" that carries pleasure and surprise, thereby building a deep stickiness of users to the brand. Finally, it is sublimated into the spiritual and cultural layer, which is the ultimate pursuit of experience design, focusing on the transmission of values and self-realization. By exploring the cultural depth of the route and the aesthetic value of life, the cruise ship is not only a moving carrier, but also a spiritual field that transmits

specific values and lifestyles, allowing tourists to achieve a leap from sensory enjoyment to self-discovery and spiritual sublimation at the end of the journey [10].

5. Practical Design Cases

5.1. “Ocean Symbiosis” Intelligent Guided Interactive Wall

The “Ocean Symbiosis” intelligent guided interactive facility is located in key public spaces such as the main deck and atrium of the cruise ship. It is a large intelligent interactive device integrating information services, emotional transmission and participation experience. It uses an ultra-wide transparent OLED display screen. The interactive wall presents the virtual marine ecological landscape generated in real time by AI algorithm in the default state. With the help of cutting-edge technologies such as machine vision recognition, motion sensing and surrounding environment perception, it can bring a smooth and generative public service scene for passengers and create a core of emotional communication in the cruise public area.

Show the tropical fish and coral reef landscape in the daytime, and turn into the visual theme of deep-sea luminous creatures under the moonlight at night to enhance the immersive experience. The system can update the display content in real time according to the actual navigation area of the ship, present the typical biological community and ecological characteristics of the water area, promote the deep combination of information presentation and spatial atmosphere, and enhance the communication effect of marine culture and brand emotion, as shown in Figure 3.



Figure 3. “Ocean Symbiosis” Intelligent Guided Interactive Wall.

5.2. “Blue Relax” Intelligent Leisure Cabin

“Blue relax” intelligent leisure cabin is a semi private intelligent leisure interactive product located in the cruise deck scenic spot. It is designed for middle-aged and elderly passengers, lovers, business passengers and high-end user groups to create a “relaxation and exclusive space” between public space and private rooms. The product integrates the functions of leisure, entertainment services, environmental regulation and health management, and can accommodate 2-5 people. It adopts streamlined organic modeling design and becomes an artistic landscape in the deck space.

The leisure cabin realizes the coordinated adjustment of temperature, light, noise and odor through environmental sensors and intelligent algorithms, creating a comfortable, relaxed and pleasant microenvironment experience. The adaptive seat

integrates the health monitoring function to realize massage relaxation, posture adjustment and basic health data collection and feedback. The cabin is equipped with a hidden touch screen, which provides a variety of use scenarios such as video entertainment, virtual viewing, mobile office and meditation guidance, and provides services such as food and beverage ordering, information consultation and emergency call through voice interaction. It provides high-quality and emotional intelligent leisure and relaxation solutions for cruise public space, as shown in Figure 4.



Figure 4. “Blue Relax” Intelligent Leisure Cabin.

6. Conclusions

From the perspective of theoretical exploration and practical application, the study Based on the dual path of theoretical exploration and practical application, this study conducted a comprehensive and systematic analysis on the intelligent interactive design of cruise public space, aiming to provide a new logical paradigm for reshaping the cruise intelligent interactive service experience. Through the theoretical method of Scene-driven, this paper deeply analyzes the synergy of interactive products in the aspects of design logic implementation, space environment construction and user multi-dimensional perception, and assists the artificial intelligence software to build the design practice scene, which visually presents the application form of intelligent interactive product design in cruise public space. Interaction design is no longer just a stack of interfaces, but a link between cutting-edge technology and humanized narrative. It is the core driving force to improve the homogeneity of current cruise products and enhance the depth of spatial narrative.

In view of the bottlenecks faced by the current cruise industry, such as the lack of sensory experience dimension, the single interaction paradigm and the lack of product innovation power, this study constructed a new paradigm design system for intelligent interactive product design in cruise public space. This achievement not only helps to improve the overall perceived quality of cruise tourism, but also provides theoretical support and innovation path for the transformation of cruise industry to high-end digital cultural tourism through the intervention of Digital Aesthetics and emotional interaction.

Looking forward to the future, the intelligent interactive product design of cruise public space will enter a deep stage of interdisciplinary and collaborative innovation. The research expects to continuously inject innovative vitality into the cruise interactive experience ecology by strengthening the interdisciplinary integration and collaborative innovation of interaction design, engineering technology and art design.

Future design achievements will produce more design paradigms with high-tech added value, deep emotional ties and artistic expression.

Conflicts of Interest

The author declares that there is no conflict of interest regarding the publication of this article.

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