

The Reconstruction of Emotional Resonance and Cultural Memory: Cross-Media Design Research on Embodied Interaction and Human-Computer Interaction in Guangdong Intangible Cultural Heritage

Abstract

This study explores the application of cross-media technology and emotional design in disseminating intangible cultural heritage (ICH). Taking Guangdong ICH as a case study, this paper proposes an "emotion-driven cultural memory model", combining semiotics, emotional design and embodied cognition theory to analyze how cultural symbols can stimulate emotional resonance and reconstruct cultural memory through multi-sensory interaction. The study proposes four design principles: symbol accuracy, emotional immersion, multi-sensory integration and participatory interaction, which verifies the potential of cross-media narrative and immersive experience in enhancing cultural communication. At the same time, from an interdisciplinary perspective, it integrates cultural studies, psychology and technological design, provides theoretical support and practical paths for disseminating ICH, balances technological innovation and cultural sustainability, and stimulates the interest and recognition of traditional culture among the younger generation.

Keywords: Intangible Cultural Heritage, Emotional Design, Transmedia Storytelling, Cultural Memory, Guangdong

1. Introduction

1.1 Research Background and Problem Statement

Guangdong's intangible cultural heritage (such as Cantonese opera, paper-cutting, and lion dance) is an important part of Chinese culture, reflecting the uniqueness of regional cultures. However, the emotional bond in the intergenerational transmission of these cultural forms is gradually weakening. The younger generation's interest in traditional cultural forms is steadily declining, with many perceiving them as "too old-fashioned" or "out of style," and lacking a connection to modern lifestyles. Meanwhile, the traditional culture from family and school is disappearing bit by bit to limit the opportunities that young people would be deeply influenced by it. This phenomenon reflects a generational gap in identity, particularly as young people's understanding and recognition of intangible cultural heritage (ICH) become increasingly diluted (Taylor, 2019).

The methods of heritage dissemination also face significant limitations. Currently, most ICH displays rely on static exhibitions or festival activities, lacking interactive experiences in everyday life, and fail to meet the demand for dynamic and immersive experiences in the digital age. For young people, there are barriers to understanding ICH. Traditional cultural transmission mainly relies on apprenticeship or family heritage, but this single model is difficult to adapt to the diversified cultural needs of modern society.

1.2 Challenges in Combining Technology with Heritage Dissemination

The rapid development of digital technology has allowed intangible cultural heritage to be presented in more intuitive and vivid ways, providing users with multisensory experiences. However, these technological applications also face several challenges.

Some designs overly focus on visual effects, resulting in superficial content. For example, some ICH digital projects demonstrate dynamic effects but fail to explore the cultural connotations and historical backgrounds in depth. Many digital interactive forms are limited to "view-click" shallow interactions, lacking deep emotional engagement and memory connections. For instance, the AR experience of lion dance focuses on the dynamic movements of the dance, neglecting the importance of teamwork and the ritual context.

Additionally, technology-driven cultural dissemination may lead to the phenomenon of cultural "fast food." Users on short video platforms experience brief visual shocks through seconds-long highlights but struggle to gain a deep understanding of cultural meaning. This weakens the narrative and emotional resonance of ICH content.

1.3 Necessity of Transdisciplinary Research

The dissemination of intangible cultural heritage involves a complex combination of technology, emotion, and culture, and a single-disciplinary research approach cannot

fully address this complexity (Repko et al., 2020). For example, anthropology focuses on cultural contexts and symbol interpretation, psychology emphasizes emotional responses in user experiences, and technology is dedicated to innovating interactive methods. While these disciplines have made progress within their respective fields, they lack integrated solutions.

Transdisciplinary research integrates cultural studies, psychology, and technological design to provide systematic pathways for heritage dissemination. Cultural studies can decode the symbolic meanings of ICH, providing deep content for technological design; psychology analyzes user emotional needs to optimize interaction experiences; and technology facilitates immersive experiences through embodied interaction and human-computer interaction. This integrated research approach helps improve the effectiveness of ICH dissemination and promotes the sustainability of intergenerational transmission.

Specifically, transdisciplinary research has the potential to:

- **Integrate Multiple Perspectives:** Combining semiotics and psychology to reveal emotional resonance mechanisms in multisensory experiences, offering theoretical foundations for technological design.
- **Promote the Integration of Technology and Culture:** By using technology to delve deeper into the cultural meanings of ICH, making them adaptable to modern society's needs. Digitalizing cultural symbols allows them to be flexibly disseminated across media platforms, enriching user participation and enhancing cultural content dissemination efficiency and modern adaptability.
- **Build Systematic Dissemination Paths:** From cultural content excavation to technology implementation and user feedback, designing complete dissemination models to support ICH protection and innovation.

1.4 Objectives and Significance of the Research

Theoretical Significance

- To deepen the research on emotional resonance and cultural memory in ICH dissemination, providing a new theoretical framework for cultural communication in the digital age.
- To explore the application of embodied interaction and human-computer interaction technologies in the cultural field, promoting the collaborative development of ICH dissemination and technological design.

Practical Significance

- To explore immersive VR/AR experiences and digital educational tools, innovating methods for ICH dissemination.
- To provide an interaction-based dissemination model to enhance the effectiveness and attractiveness of Guangdong's ICH projects.

Social Significance

- To strengthen the younger generation's sense of identity and participation in ICH, bridging the gap in cultural memory between generations.
- To offer strategic support for the international dissemination of ICH, promoting the sustainable development of Guangdong's ICH in a global context.

2. Literature Review

2.1 Cultural Memory and Emotional Resonance

2.1.1 Cultural Memory Theory

Jan Assmann's framework of cultural memory emphasizes that cultural memory is a form of social memory constructed through symbols and media such as rituals, texts, and material cultural forms (Assmann, 1995). Unlike individual memory, cultural memory operates through a process of symbolization, transforming individual experiences into shared social memories (Chandler, 2017). For example, the vocal style of Cantonese opera and the patterns of Guang embroidery are not only artistic expressions but also symbolic carriers of local cultural memory, ensuring the long-term preservation and intergenerational transmission of culture.

Cultural symbols are closely related to emotions by the means of rituals and festivals, which enhance the transmission of cultural memory and emotional identity. More importantly, multimedia narrative technologies enable this intergenerational transmission of cultural symbolism (Convery et al., 2012). For example, during the Spring Festival, the lion dance performance is not only an artistic practice, but also enhances regional culture identity and people's relationships within their communities, as emotional experiences are entwined in practices of symbolic processing (Halbwachs, 1992).

This theoretical framework suggests that the dissemination of symbols may overcome time and space, thus enabling cultural memory to persist while promoting cultural identity and emotional connections (Barsalou, 2008).

2.1.2 Emotional Resonance Theory

Emotional resonance is a key factor in cultural dissemination. Don Norman's emotional design theory asserts that successful design should transcend functional requirements and trigger emotional responses in users through multisensory interaction (Norman, 2004).

- **Sensory Experience and Emotional Connection:**

Familiar emotional clues, such as the melody of Cantonese opera and the color of Guang embroidery, will evoke the emotional memory of users, so that they can provide a more profound interpretation of cultural contents and their effective dissemination.

- **Emotional Potential of Cross-Media Narratives:**

Jenkins proposes that cross-media narratives integrating auditory, visual, and tactile elements can enhance emotional resonance (Jenkins, 2006). For example, the Cantonese paper-cutting project, combining audio commentary and dynamic visuals, stimulates users' cultural interest and emotional connection through multisensory narrative design. These theories show that emotional engagement can make cultural symbols a deep experience, connecting the communication between the traditional and modern audience.

2.2 Embodied Interaction and Human-Computer Interaction

2.2.1 Embodied Cognition Theory

Embodied cognition theory suggests that the generation of memory and emotions is closely linked to bodily movements and environmental interactions (Dourish, 2001).

- **Physical Participation and Emotional Enhancement:**

Virtual reality enables users to act out movements either from Cantonese opera or lion dance choreography and thus creates cultural practices that deepen the understanding of artistic expressions and strengthen emotional memory.

- **Cultural Value of Hands-On Practice:**

Traditional craftsmanship-participation in such activities as embroidery or pottery making-allows the users to understand better the sophistication of the techniques and develop an emotional attachment to the spirit of the craft. This participatory approach reinforces cultural memory and skills transmission.

2.2.2 Emotional Design in Human-Computer Interaction

Human-computer interaction (HCI) technologies enhance users' emotional experiences through emotional computing and immersive interaction.

- **The Role of Emotional Computing:**

HCI systems capture users' emotional states (such as facial expressions or voice) through sensors and provide real-time feedback. For example, the AR-based lion dance experience can dynamically adjust visual effects and interaction content, helping users better understand the cultural significance of the ritual.

- **Practical Applications:**

AR technology seamlessly integrates cultural elements, such as Cantonese paper-cutting, into the user's environment, providing personalized experiences, like designing custom paper-cutting patterns. This interactive approach broadens cultural participation and strengthens personalized experiences.

2.3 Cross-Media Design and Technological Adaptation

2.3.1 Cross-Media Narrative

Cross-media narratives create immersive cultural dissemination experiences by integrating visual, auditory, and tactile elements (Jenkins, 2006).

- **Enhancing Immersive Dissemination:**

Audio commentary and dynamic visuals vividly present the history and artistry of Cantonese opera. For instance, a mobile application allows users to appreciate classic scenes while exploring character backstories, expanding the accessibility and reach of cultural dissemination.

- **Value of Multimedia Integration:**

Combining 3D modeling and audio commentary vividly presents the intricate textures and historical significance of Guang embroidery. This approach allows users to experience cultural works through both visual and narrative dimensions.

- **Dynamic Narratives and Emotional Connection:**

By combining dynamic scenes with narrative elements (such as immersive VR environments), users can explore the deeper meanings of cultural symbols. For example, interactive narratives around Guang patterns enhance cultural interest and participation.

2.3.2 Technological Adaptation Strategies

Effective dissemination calls for technical solutions appropriate for the characteristics of the intangible cultural heritage forms.

Dynamic ICH: Theatrical performances, dances, and folk rituals would include newer technologies such as motion capture, virtual reality, and augmented reality. As such, ICH would be perfectly suited to a combination of motion capture with VR that rebuilds the scene of the ICH or AR with superimposing dynamic performances, increasing immersion and interactivity.

Static ICH can be best dealt with by technologies related to visual and symbolic information, such as 3D modeling, virtual museums, and image recognition-for example, traditional crafts, calligraphy, and painting.

2.4 Interdisciplinary Innovative Perspectives in Heritage Dissemination

2.4.1 Interdisciplinary Perspectives

Interdisciplinary theories integrate cultural studies, psychology, semiotics, and technological design, providing innovative solutions for ICH dissemination.

- **Contribution of Cultural Studies:**

In-depth analysis of ICH symbols and cultural contexts avoids superficial technological designs. For example, studying the performance structure of Cantonese opera helps design meaningful virtual environments.

- **Support from Psychology:**

Research shows that multisensory stimulation can significantly enhance users' immersion and memory. Emotional design combining auditory and visual elements strengthens cultural memory and user engagement.

- **Potential of Technological Innovation:**

Motion capture and VR technologies allow users to immerse themselves in cultural experiences, such as exploring the artistic appeal and emotional depth of Cantonese opera performances.

2.4.2 Collaborative Innovation of Technology and Culture

Interdisciplinary research combines cultural studies and technological practices to address issues such as technological lag and emotional disconnection:

- **AI-Generated Cultural Narratives:**

AI technology can generate cultural background stories, helping users better understand cultural symbols.

- **Interactive Platforms and Cultural Dissemination:**

Interactive platforms encourage users to share cultural experiences and create personalized content, forming a dynamic digital heritage dissemination network.

3. Theoretical Framework

3.1 Emotion-Driven Cultural Memory Model

Symbol → Sensory Experience → Emotional Resonance → Cultural Memory Reconstruction

This model emphasises that the generation and transmission of cultural memory are inseparable from emotional experiences. Through symbolic transmission, sensory experiences, and emotional resonance, cultural memory is dynamically reconstructed.

a. Symbol:

Symbols are the core carriers of cultural memory. They convey historical significance and emotional connotations through visual, auditory, and material forms. For instance, the floral and bird patterns in Cantonese embroidery are not only aesthetically valuable but also carry deep regional cultural memories.

- **Semantic, Pragmatic, and Syntactic Levels of Symbols:**

Charles Morris's semiotic theory asserts that the semantics (meaning), pragmatics (application), and syntax (form) of symbols collectively determine their dissemination effect (Morris, 1938, pp. 23–25). Through cross-media translation of symbols, the limitations of traditional media can be overcome, allowing for the widespread dissemination of ICH.

- **The Historical and Emotional Aspects of Symbols:**

ICH symbols contain rich historical stories and emotional associations. By delving deeper into the cultural values behind these symbols, their depth and emotional resonance in dissemination can be enhanced.

- **Innovative Application of Symbols:**

Literature suggests that AI technology can automatically generate visual designs for ICH culture through symbolic analysis, improving the efficiency and diversity of cultural dissemination (Giordano et al., 2024, pp. 15–27).

b. Sensory Experience:

Sensory experience is an important pathway for stimulating emotional responses. Through visual, auditory, tactile, and even olfactory designs, users can more profoundly perceive the essence of ICH.

- **Multi-Sensory Interaction:**

With the support of augmented reality (AR) technology, users can "touch" the textures of traditional crafts, such as simulating the stitch details of embroidery. Research indicates that multi-sensory stimulation can significantly deepen users' memory of cultural content.

- **Audio and Emotional Connection:**

The melodies of traditional instruments can evoke users' cultural memories and emotional resonance. By combining modern audio technologies, traditional music can blend with contemporary elements, enhancing the auditory experience for users.

- **Dynamic Sensory Design:**

Literature indicates that immersive audio and dynamic lighting can further enhance emotional connections, allowing the audience to experience emotional resonance through both auditory and visual stimuli (Doukianou et al., 2020, pp. 35–42).

c. **Emotional Resonance:**

Emotional resonance is key to transforming cultural memory into personalized identity.

- **Emotional Design:**

Don Norman's emotional design theory emphasizes that triggering emotional resonance through design can enhance the appeal of products or content. In ICH dissemination, for example, using VR technology to immerse users in traditional festival settings deepens their sense of belonging and identification with cultural symbols.

- **Personalised Emotional Connection:**

Dynamic data collection technology can personalize ICH content based on users' behaviors and preferences, such as generating patterns related to users' family histories in a digital embroidery experience, hence strengthening the binding of cultural memory with individual emotions.

- **Innovative Applications of Affective Computing:**

Facial expression recognition technologies can be integrated with the haptic display device to change the display of ICH content in real time. For example, interactive experiences might alter content based on user reaction to enhance the depth of emotional connection.

d. **Cultural Memory Reconstruction:**

Reconstruction of cultural memory is not only about preserving traditional culture but also innovatively reshaping it in light of contemporary contexts.

- **The Dynamics of Reconstruction:**

Reconstruction does not mean reproduction but a kind of innovation, rooted in advanced modern technology and meeting the needs of society. For example, it gives new aesthetic value to cultural signs: reworking traditional Cantonese embroidery into contemporary designs for jewelry and at the same time opens up a larger space for use.

- **The Role of Digital Technologies:**

Through digital archiving and 3D printing technologies, traditional cultural symbols can be disseminated across generations and cultures, supporting their sustainable development in a global context.

- **Integration of Education and Social Interaction:**

Within the framework of social-emotional learning (SEL), educational interactive scenarios (such as virtual workshops) can enhance user participation in cultural memory (Sethi & Jain, 2024, pp. 220–223).

3.2 Transdisciplinary Integration Model

3.2.1 Psychology and Technological Sciences: The Integration of User Psychological Needs and Human-Computer Interaction (HCI):

- **Integration of User Psychological Needs and HCI:**

Psychological theories suggest that emotion is a key driver in enhancing memory (Schacter, 1996, pp. 56–58). HCI technologies, through affective computing, capture users' emotional states and provide dynamic adjustments for ICH experience design. For example, facial expression recognition technology can adjust the presentation of ICH scenes in real-time, making the experience more personalised.

- **Tactile Feedback and Emotional Deepening:**

Using tactile feedback devices (such as vibrations or simulated textures), users can "touch" the textures of traditional crafts, enhancing their perception of ICH culture. For example, in an interactive embroidery experience, users can feel the subtle differences in stitching techniques through hand sensations.

3.2.2 Culture and Design: Modern Expressions of ICH Symbols:

- **Modern Expression of ICH Symbols:**

The use of ICH symbols in contemporary design has to balance modern esthetics with their cultural connotations (Eco, 1976). In this case, the translation of traditional Cantonese embroidery patterns into minimalist styles in modern fashion design maintains traditional values while meeting aesthetic preferences among today's consumers.

- **Cultural Adaptation in Cross-Media Design:**

Semiotic theory emphasises that symbols' pragmatics determine their adaptability in cross-media expressions (Morris, 1938). For example, dynamic visuals and interactive animations can breathe new visual life into traditional symbols, while 3D printing technologies can restore their tactile qualities.

- **Audio Expression of Cultural Content:**

By combining traditional tonal characteristics with modern music production techniques, ICH audio content with cross-cultural appeal can be created. For example, integrating Cantonese opera's gong and drum beats with popular electronic music can attract a younger audience.

3.2.3 Technology and Culture: Innovative Pathways for Integrated Development

The transdisciplinary integration model provides sustainable paths for the dissemination and preservation of ICH by promoting bidirectional innovation between technology and culture. For example, AI can be used to create dynamic ICH content, such as automatically generated Cantonese opera scripts or Cantonese embroidery patterns, injecting new vitality into cultural creation. Besides, through interactive design on multimedia platforms, ICH culture can be extended from a single form to multiple expressions. By using geolocation technology in AR scenes, the contextual relevance of ICH symbols can be further enhanced (Convery et al., 2012, pp. 12–19). Moreover, the integration of AI and AR in cultural heritage applications showcases their potential in the complex reconstruction of cultural symbols. These technologies can improve the visualisation and dissemination efficiency of ICH content in virtual environments (Russo et al., 2024).

4. Case Studies

4.1 Analysis of Successful Cases

a. Dunhuang Digitization

Through 3D modelling and Virtual Reality (VR) technology, the Dunhuang digitization project recreates the murals and sculptures of the Mogao Caves, combining dynamic

narrative and cross-media dissemination to offer global audiences the opportunity to experience millennia-old art.

- **Academic Value and Everyday Life Link**

- **Academic Level:** The project provides an innovative template for the digital preservation of cultural heritage.
- **Everyday Level:** Digital resources are widely used in online courses and virtual exhibitions, enhancing global users' cultural understanding and engagement.



Figure 1 Screenshot of website-Dunhuang Digitization, (captured by Huang. Jiaying, 2025)

b. Alsace Museum and Community Engagement

Through Augmented Reality (AR) technology and community services, the Alsace Museum demonstrates how dynamic narratives and traditional cultural dissemination can be integrated.

- **Academic Value and Everyday Life Link**

- **Academic Research:** This project demonstrates the importance of community participation for the sustainable development of ICH.
- **Everyday Application:** Handicraft designs are incorporated into modern home décor, creating a positive cycle of cultural revival.

c. Musée d'Orsay: Paris 1874 - The Birth of Impressionism Exhibition

- **Background and Technology Application:**

This exhibition focuses on the first Impressionist exhibition and uses multimedia and immersive technologies to showcase the origin and development of Impressionist art, deeply analyzing its significance in cultural memory and artistic innovation.

- **Academic Value and Everyday Life Link**
 - **Academic Level:** The exhibition attracted global art researchers and became an important academic case for discussing artistic innovation and cultural memory.
 - **Everyday Life:** The online virtual exhibition extended the reach of the exhibition, integrating Impressionist art into the daily cultural experience of more people, serving as a model for education and art dissemination.



Figure 2 Screenshot of website - Musée d'Orsay: Paris 1874 - The Birth of Impressionism Exhibition
(captured by Huang. Jiaying, 2025)

4.2 Case Study: Guangdong Intangible Cultural Heritage

Guangdong Pavilion Digital Intangible Heritage Display

The Guangdong Pavilion uses modern technology to showcase ICH, combining immersive experiences and interactive design, focusing on the core elements of Lingnan culture.

- **Technology and Dissemination**
 - **Holographic Projection Interactive Exhibition:** Holographic projection technology dynamically displays the processes of Cantonese embroidery, Cantonese opera performances, and wood carving, allowing audiences to observe the details of traditional craftsmanship in real-time from a 360-degree view.
 - **Virtual Reality (VR) Experience Center:** Audiences can immerse themselves in the cultural background and creation process of Cantonese embroidery and Cantonese opera through VR devices.
- **Academic Value and Everyday Life Link**

- **Academic Research:** The project provides a new model for the protection and dissemination of Lingnan ICH, offering a template for museum and educational institutions' digital ICH research.
- **Everyday Life Application:** Cultural products integrate traditional craftsmanship into modern homes, forming a complete chain from exhibition to practice, allowing more people to engage with Lingnan's ICH.

4.3 Interdisciplinary Perspectives in Case Comparison

Summary of Commonalities in Successful Cases

- **Interdisciplinary Integration of Science, Art, and Culture**
 - Cases such as Dunhuang Digitization and the Alsace Museum demonstrate the role of technology in supporting cultural dissemination, especially in the combination of dynamic narrative and immersive experiences.
 - The Guangdong Pavilion case illustrates how digital technology integrates ICH into modern life through cultural products, shifting cultural dissemination from a one-way output to a two-way interaction.
 - The Musée d'Orsay highlights the blending of artistic innovation and historical narrative in cultural dissemination, enhancing the effectiveness of culture transmission through VR technology and dynamic interpretation.
- **Design of Emotional Resonance**
 - Successful cases universally enhance users' cultural identity and emotional resonance through the combination of technology and narrative design.
 - The Lingnan cultural exhibition at the Guangdong Pavilion exemplifies this, attracting a wide audience through multilingual interactive designs and dynamic displays.

Shortcomings and Improvements

- **Balancing Symbolization of Technology and Cultural Connotation**
 - Some projects overly focus on technological display, neglecting the depth of cultural connotation. For example, some virtual exhibitions fail to provide sufficient cultural context, leading to superficial user experiences. Future designs should enhance cultural expression through deeper narrative design.
- **Strengthening Community Participation and User Needs**
 - While community participation is mentioned in some cases, the involvement of local residents is still limited in certain practices. Future projects should adopt a user-centered design approach, such as introducing customized experiences and allowing community members

to directly participate in the production and dissemination of digital content.

- **Sustainability and Openness of Data**

- The sustainability of digital resources remains a challenge. It is recommended to establish open cultural data platforms to broaden the application of resources in education and research, enhancing the long-term impact of cultural dissemination.
- Additionally, improving collaboration between technology and culture teams is crucial to ensure that technological development aligns with cultural dissemination needs.

- **Incorporation of an International Perspective**

- The depth of international collaboration in interdisciplinary cases still requires strengthening. Future studies could explore the adaptability of technology in different cultural contexts through more international cultural project comparisons, achieving a balance between global and local dissemination of ICH.

5. Design Practice

5.1 Design Objectives and Principles

Design Objectives:

- **Achieving a Bidirectional Connection Between Emotion and Culture:** By using embodied interaction and human-computer interaction (HCI) technologies, enhance the depth of users' experience of Guangdong's intangible cultural heritage (ICH), allowing them to both participate and create, thus constructing a bidirectional bridge for the transmission of emotion and culture.
- **Strengthening Cultural Memory:** Through the integration of narrative and multisensory technologies, reshape the cultural scenes of Guangdong's ICH, creating deep cultural memories and a sense of identification among younger users.

Design Principles:

1. **Accuracy of Symbols and Cultural Context Representation:** Accurately present cultural symbols and their relevant contexts in digital media, such as showcasing the historical significance of costume designs and lines in Cantonese opera characters through narrative animation, enhancing the depth of cultural transmission.
2. **Emotion-Driven Immersive Design:** By introducing virtual characters in which the audience gradually transforms into a performer, users can experience the emotional layers of the narrative background.

3. **Cross-Media and Multisensory Integration:** Combine visual, auditory, and tactile elements to design dynamic scenes, providing users with a fully interactive experience.
4. **Participatory and Personalized:** Utilize AI technology to generate personalized ICH learning paths based on users' interests and encourage users to create their own cultural expressions through interactive design.
5. **Social and Community Connection:** Provide a virtual community platform where users can share their creations, forming a digital ICH dissemination network.

5.2 Case Results and User Feedback Summary

5.2.1 Immersive Exhibition Design

Case Results:

- **Digital Exhibition Space:** Using VR/AR technologies to recreate the lion dance performance scene, users can experience collaboration as a member of a lion dance team in a virtual environment.
- **Interactive Experience Area:** By utilizing haptic feedback technology and motion-sensing devices, users can simulate the embroidery process of Guangxiu or participate in the detailed carving of Chaozhou wood carving, enhancing their sense of involvement in ICH craftsmanship.

User Feedback:

- **Immersion and Resonance:** Most users reported that dynamic scenes and multisensory design enhanced their sense of participation and immersion.
- **Learning and Identification:** Some teenagers mentioned that through immersive Cantonese opera experiences, they not only remembered classic segments but also understood the ethical values expressed in the performances.

5.2.2 Narrative Cultural Creative Product Design

Case Results:

- **Cultural Narrative-Themed Games:** Designed a lion dance-themed narrative experience in which users progress the story by completing team tasks.
- **Narrative-Driven Cultural Products:** Designed dynamic narrative cultural products such as AR postcards; through scanning, animations related to ICH stories pop up.

User Feedback:

- **Story Immersion:** The users felt that the narrative design helped in understanding the deeper meaning of cultural signs.
- **Interactivity and Creativity:** Teen users were very interested in AR's interactive products. They said designing their own Guang patterns made them feel the connection between ICH culture and per

5.3 Insights from Interdisciplinary Design Practice

Practical Application of Symbols and Emotional Design:

- **From Culture to Symbols to Personalized Design:** Combine users' personalized needs to generate embroidery designs based on different emotional themes, such as creating exclusive patterns based on family stories.
- **Multisensory Narrative Design:** Use dynamic sound effects and narrative animation to help users more deeply understand the emotional tension between characters.

Technology-Driven User Experience Optimization:

- **Refinement of Real-Time Interactive Technologies:** HCI technology combined with user behavior data enables dynamic scene adjustments.
- **Application of Generative AI in Creative Design:** AI optimizes details based on user feedback, enhancing user participation and satisfaction.

Cross-Cultural and Educational Community Building:

- **Innovative Models for Virtual Community Platforms:** Apply the virtual platform so that users of different cultural backgrounds can work with each other for the design related to Guang Embroidery.
- **Extension of Educational Functions:** Allow virtual workshops to include educational functions so that students can practice ICH crafts and understand their cultural values; further stimulate participation by enabling online sharing.

6. Discussion

6.1 The Long-term Impact of Human-Computer Interaction on Cultural Memory

6.1.1 Potential Changes to Cultural Memory through Human-Computer Interaction

Digitalisation and Continuity of Cultural Memory

Human-Computer Interaction technologies are opening completely new dimensions for the conservation and dissemination of cultural memory. These technologies allow users

to experience virtually in real-time and in-depth emotions and values included in traditional culture. On the other hand, this digitization faces some challenges:

- **Weakening of Authenticity:**

While digital content showcases intricate details, it cannot fully replace the historical weight and tactile experience of physical objects.

- **Dilution of Cultural Significance:**

In dynamic displays, traditional culture may lose its deep historical context and meaning due to the tendency towards entertainment (Guzman, 2018).

Changes in Emotional Expression

More recently, with the use of technology, emotional expression has turned into a vital interactional feature in HCI: for instance, technologies of affective computing capture users' facial expressions and emotions and give immediate feedback in order to enhance the emotional bond between cultural content and users. However, excessive reliance on technology may weaken the authenticity of natural emotions and even reduce users' autonomy in expressing their emotions. The key to addressing this issue lies in transparent design and giving users control over their emotional data (Liu & Sundar, 2018).

6.1.2 Reshaping Forms of Cultural Memory through Human-Computer Interaction

From Static to Dynamic Transformation

Traditional cultural memory is usually presented in static forms, such as artefacts or books. HCI technologies, through dynamic presentations, allow users to transform from passive observers to active participants in culture. For example, by recreating the lion dance in virtual reality, users not only observe but also experience its artistic charm.

Challenges and Solutions in Dynamic Presentation

- **Blurring Boundaries of Authenticity:**

Dynamic technologies may redefine the meaning of cultural symbols, making it difficult for users to distinguish between traditional and modern interpretations.

- **Fragmentation of Cultural Memory:**

Fragmented dynamic content may lead to an incomplete understanding of the overall cultural context (Bickmore & Picard, 2005).

The solution is to combine dynamic interaction with static displays, ensuring the coherence and depth of cultural memory in digital experiences of ICH, such as Cantonese embroidery.

6.2 Pathways for Balancing Technology and Humanities

6.2.1 Enhancing Emotional Transmission

Immersive Emotional Experience:

Place users in virtual environments where narrative and interactive design trigger deeper emotional resonance.

Participation in Emotional Design:

Users can experience cultural rituals and teamwork while completing tasks through team collaboration or personalised interactive design. At the same time, affective computing technology adjusts task difficulty based on user actions, supporting personalised experiences.

6.2.2 Core Pathways for Balancing Technology and Humanities

Promoting Social Interaction:

Technology design should integrate social elements to enhance interaction between users(Matsumoto, 2020). For example, a virtual Cantonese opera platform allows users to share experiences and participate in discussions, fostering the collective transmission of emotional memory (Ta et al., 2020).

Clarifying the Boundaries of Cultural Digitalisation:

In the process of cultural digitization, clear boundaries need to be maintained so that the virtual contents do not get confused with reality. For example, in the case of demonstrating Cantonese embroidery digitally, presentation should go beyond mere visual effects to embody interpretations of culture and craftsmanship; otherwise, an over-entertaining mode may lead to the loss of cultural meaning.

7. Conclusion and Outlook

7.1 Research Summary

7.1.1 The Value of Human-Computer Interaction and Interdisciplinary Approaches in ICH Dissemination

The Empowering Role of Technology

These HCI technologies bring a new presenting way to intangible cultural heritage, especially with the support of AR, VR, and other similar technologies. Such innovations can make traditional cultural symbols show highly interactive and immersive forms. This approach attracts not only the interest of the young but also allows for the possibility of global dissemination. As shown in the online Cantonese opera platforms, for example, viewers can watch not only performances but also communicate with characters for better interpretation of the situation. Moreover, through HCI technologies, the limitations imposed on the dissemination of traditional culture by time and space can be torn down, enabling people in remote areas or cross-cultural contexts to understand and experience the richness of ICH.

Innovative Value of Interdisciplinary Approaches

The integration of interdisciplinary approaches further enriches the depth and breadth of ICH dissemination. By combining cultural studies, psychology, semiotics, and technology design, cultural dissemination has shifted from a one-way output to a two-way interaction. This integration facilitates the reconstruction of cultural memory through user participation (Bruner, 1990). The application of affective computing technology, which captures and provides real-time feedback on users' emotions, has strengthened users' cultural engagement and sense of identity (Liu & Sundar, 2018). These methodological breakthroughs have transformed ICH dissemination from static symbol displays to dynamic user experiences that embed emotional value and cultural depth.

7.1.2 Limitations of Human-Computer Interaction and Interdisciplinary Approaches

Risks of Technology Misuse

While technology can enhance the effectiveness of ICH dissemination, over-reliance on it may lead to the “fast-foodification” of cultural content. For example, some ICH interactive projects focus more on the visual impact of technology rather than the deep historical meaning behind the culture. This phenomenon can weaken the emotional depth of the culture and potentially reduce it to commodified, short-term entertainment (Guzman, 2018).

Additionally, the misuse of technology may cause users to neglect authentic cultural experiences. As users access cultural memories through virtual platforms, their interest in physical heritage or offline cultural activities might diminish.

Challenges of Interdisciplinary Collaboration

Interdisciplinary approaches require the integration of knowledge and methods from different fields, but differences in language, thought processes, and objectives across disciplines can lead to inefficiencies in collaboration. For example, technical experts

may prioritize algorithms and system optimization, while cultural scholars focus on the authenticity and completeness of cultural content.

In this context, balancing commercial demands with cultural preservation responsibilities becomes an important issue. For instance, if the development of digital cultural products is market-driven, it may weaken the reflection of cultural essence.

7.2 Future Directions

7.2.1 How Interdisciplinary Collaboration Can Further Promote the Deep Integration of Culture and Technology

Deepening Interdisciplinary Collaboration Mechanisms

Establish interdisciplinary teams consisting of cultural scholars, technology experts, designers, and sociologists to collaboratively advance research in ICH dissemination. For example, joint labs or interdisciplinary research platforms can be created to promote resource sharing and innovative communication. In this framework, cultural experts can offer deep insights into semiotics and contextual analysis, while technologists can use AI and HCI technologies to create innovative displays (Kolomaznik et al., 2024).

Collaborative Innovation Between Technology and Cultural Research

- **AI-Driven ICH Content Generation:**

By using natural language processing to extract semantic information from traditional texts, AI can help users understand the cultural background and symbolic meaning of ICH (Liu & Sundar, 2018).

- **Digital Restoration Technologies:**

AI and 3D modelling technologies can be used for digital restoration of cultural heritage, while also recording the restoration process to enhance authenticity.

Future research should continue exploring more advanced technological applications and emphasize the long-term sustainability of cultural content. Additionally, technological development should prioritize the longevity and sustainability of digital archives to ensure that cultural symbols do not lose their meaning due to technological updates.

7.2.2 Expanding the Audience and Application Scenarios of ICH Dissemination

Coverage of Diverse Audience Groups

To cater to different cultural backgrounds, age groups, and interests, adaptive dissemination methods should be developed. Social media platforms can be used to

promote short videos on ICH to attract younger users. Immersive exhibitions should integrate multilingual commentary and interactive features to reach international audiences (Bruner, 1990).

Expanding the Educational Function of ICH Dissemination

ICH dissemination is not only a kind of entertainment but also an important educational tool. For example, the integration of HCI technology into classroom-based interactive teaching tools allows students to learn about history and artistic values of ICH with simulations. Traditional crafts restoration by AR tools enables students to create Cantonese embroidery patterns in a virtual environment, which may increase learning interest and cultural memory.

7.2.3 Establishing a Balance Between Technological Ethics and Cultural Preservation

Strengthening the Legal Protection of Digital Culture

By establishing laws for digital cultural dissemination, the authenticity of cultural content and copyright protection can be regulated. For example, blockchain technology can be used to record the digital copyrights of ICH, ensuring the legality and traceability of cultural heritage in digital environments (Floridi & Cows, 2019).

Emphasizing Emotional and Human-Centered Design

Technology development should place more focus on users' emotional experiences and cultural identity. For example:

- Incorporate narrative design in virtual experiences to enhance the emotional impact of cultural content.
- Avoid the coldness caused by pure technical displays, ensuring users can feel the warmth and emotional resonance of culture (Kolomaznik et al., 2024).

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