

The Application of TouchDesigner in Real-Time Interactive Projection for the Intangible Cultural Heritage Exhibition of Zhuhai's Sanzao Crane Dance

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Abstract

This paper explores the application of Touch Designer in real-time interactive projection to enhance the exhibition of Zhuhai's Sanzao Crane Dance, a nationally recognized intangible cultural heritage (ICH) in China. Traditional ICH exhibitions often lack interactivity and fail to engage younger audiences. Through a mixed-methods approach involving experimental design, surveys, and qualitative interviews, this study demonstrates how interactive projection enhances immersion, fosters cultural identity, and promotes active participation in cultural transmission. Findings offer strategic recommendations for applying digital tools in modern ICH exhibitions.

Keywords: Touch Designer, Interactive Projection, Intangible Cultural Heritage, Sanzao Crane Dance, Audience Engagement, Cultural Identity

Introduction

In recent decades, intangible cultural heritage (ICH) has gained increasing global attention as societies seek to preserve living cultural practices amid rapid technological and social change. Among these heritage expressions, the Sanzao Crane Dance from Zhuhai, Guangdong Province, stands as a representative example of Chinese folk dance rooted in local belief, community rituals, and the symbolic imitation of cranes.

Despite its cultural richness and symbolic significance, the traditional exhibition modes of the Sanzao Crane Dance often fail to attract younger generations. Static displays such as photos, artifacts, and textual descriptions limit audience interaction and emotional engagement. With the advent of digital media and real-time interactive technologies, however, new possibilities have emerged for revitalizing heritage practices through immersive exhibition formats.

This paper investigates the integration of Touch Designer a node-based visual programming platform widely used in new media art into the real-time interactive exhibition of the Sanzao Crane Dance. The study aims to explore how this technology can enhance the immersive experience, strengthen audience cultural identity, and foster greater engagement with heritage practices.

Research Objectives

The primary goal of this study is to explore how real-time interactive projection, facilitated by Touch Designer, can be strategically applied to enhance the exhibition of the Sanzao Crane Dance. Within this overarching aim, the study identifies three specific research objectives:

1. To enhance audience immersion and engagement through the integration of real-time interactive projection in ICH exhibitions.

2. To examine the role of interactive projection in fostering cultural identity and emotional resonance

with intangible heritage, especially among younger audiences.

3. To develop practical strategies and design guidelines

for curators and exhibition designers integrating interactive technologies in ICH contexts.

Rather than merely showcasing a technical implementation, this research emphasizes the interplay between technology and Cultural expression. It seeks not only to evaluate technological outcomes but also to address the Cultural depth and Experiential quality of Exhibitions.

Literature Review

In light of the growing urgency to modernize the presentation of intangible cultural heritage, existing scholarship offers valuable insights across three major domains: traditional challenges of ICH exhibition, immersive experience theory, and digital interaction technologies in cultural contexts. This section selectively reviews representative works to build a theoretical foundation for the present study.

First, conventional ICH exhibitions are widely critiqued for their static, text-heavy formats. According to Liu (2022), such approaches often fail to convey the dynamic, living essence of heritage, particularly in performing arts like dance. Ren (2023) highlights the disconnect between object-based displays and the emotional or ritualistic contexts that give heritage its cultural depth.

Second, the concept of immersive experience has evolved from entertainment to educational and cultural settings. Drawing on Csíkszentmihályi's (1975) Flow Theory, Wang and Liu (2018) argue that multisensory immersion increases retention and emotional resonance. Dai and Peng (2023) extend this idea by showing that user-centered immersive designs can foster ethnic identity in heritage-based interfaces.

Finally, recent research has examined the application of interactive digital technologies like AR, VR, and real-time rendering in heritage spaces. Su (2020) emphasizes that TouchDesigner's modular environment lowers the technical threshold for artistic expression, enabling real-time feedback and audience interaction. In case studies like Digital Dunhuang and TeamLab Borderless, immersive projection is shown to bridge sensory engagement with historical depth (Han, 2022).

In sum, this literature reveals a critical shift from passive display to participatory interaction in heritage exhibitions. Yet, few studies explicitly link the technical affordances of Touch Designer with the cultural storytelling needed in ICH contexts. This gap justifies the present research.

Research Methodology

This study adopts a mixed-methods research design to explore how real-time interactive projection, specifically via Touch Designer, can improve audience experience and cultural engagement in ICH exhibitions. The methodology integrates qualitative and quantitative tools to ensure a robust and multifaceted understanding.

1. Experimental Setup

A controlled experimental environment was developed featuring two exhibition designs one using traditional static display methods and the other utilizing Touch Designer-based interactive projection. Both versions were built around the Sanzao Crane Dance narrative, with the interactive version enabling gesture-triggered visuals and audio responses.

2. Participants and Sampling

A total of 80 participants were recruited, including university students, local residents, and tourists. Participants were randomly assigned to either the control (traditional) or experimental (interactive) group, ensuring demographic diversity and minimizing selection bias.

3. Data Collection Methods

Three primary tools were employed Pre- and post-experience surveys measured changes in audience perception of cultural identity, emotional resonance, and exhibit effectiveness.

Observation checklists recorded behaviors such as dwell time, gesture frequency, and audience flow patterns.

Semi-structured interviews with 15 participants provided qualitative depth on emotional experience and cultural interpretation.

4. Analytical Framework

Quantitative data were processed using SPSS for t-tests and correlation analysis. Qualitative interviews were analyzed using NVivo software to identify recurring themes related to identity, immersion, and participation. A triangulation strategy was applied to cross-validate results.

This methodological framework Ensures a balance between Empirical rigor and experiential depth, suitable for studying the complex intersection of technology, audience behavior, and cultural storytelling.

Research Scope

This study focuses on the conceptual and experiential intersection of three domains:

1. **Digital media technology** (TouchDesigner) as a creative platform,
2. **Intangible cultural heritage** (Sanzao Crane Dance) as subject matter, and
3. **Audience interaction and cultural immersion** as behavioral outcomes.

The conceptual framework developed for this study is illustrated as a **three-tier model**

1. Input Layer – Cultural and Technical Resources

Incorporates the symbolic narratives, ritual gestures, and visual motifs of the Sanzao Crane Dance, along with TouchDesigner's node-based real-time rendering capabilities.

2. Interaction Layer – System and Experience Design

This layer defines how sensors, visuals, and sound are structured to respond to audience movement and participation. The choreography of interaction aligns with the logic of the dance.

3. Output Layer – Cultural Resonance and Reflective Engagement

This final layer evaluates the outcomes: audience immersion, identity construction, and emotional involvement, reflecting the effectiveness of the system.

By structuring the framework in this layered fashion, the study ensures alignment between cultural intention, technical implementation, and experiential outcome.

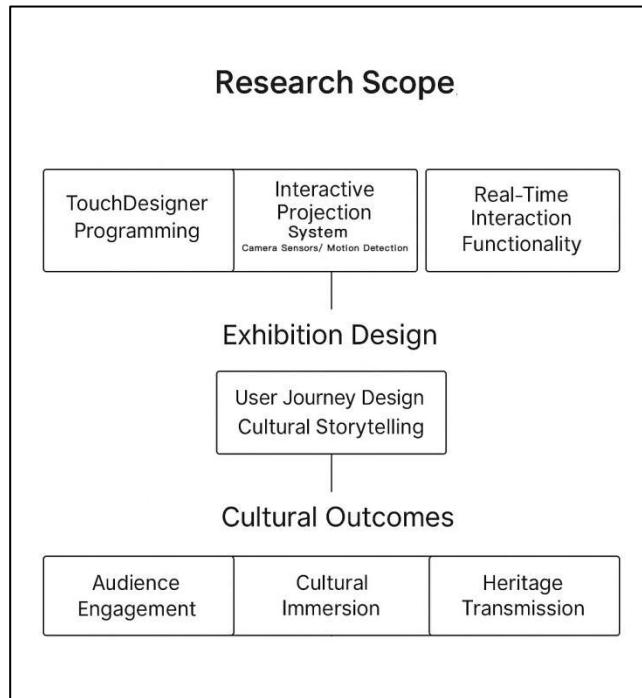


Figure 1. Conceptual framework illustrating the research scope for applying TouchDesigner in the interactive exhibition of Zhuhai's Sanzao Crane Dance.

Research Results

The results of this study provide compelling evidence for the impact of interactive projection using Touch Designer on the effectiveness of intangible cultural heritage exhibitions. Findings are organized across three key thematic domains aligned with the research objectives.

1. Enhanced Immersion and Engagement

Participants in the interactive exhibition group reported significantly higher levels of immersion compared to the control group ($M = 4.5$ vs. 3.2 on a 5-point Likert scale, $p < 0.01$). Observational data showed longer dwell times, more spontaneous gestures, and frequent emotional expressions (e.g., laughter, verbal interaction) within the TouchDesigner environment.

2. Cultural Identity and Emotional Resonance

Post-experience survey responses indicated a deeper emotional connection to the Sanzao Crane Dance and local culture. 85% of participants in the interactive group agreed with the statement: “This exhibition deepened my sense of connection to intangible heritage.” Interviewees frequently used words such as “proud,” “curious,” and “moved.” Notably, younger participants (aged 18–25) demonstrated the strongest emotional engagement, suggesting that digital interactivity bridges generational gaps in cultural understanding.

3. Participatory Transmission and Learning Potential

The interviews revealed an emerging theme: participants viewed themselves not just as spectators, but as co-performers and culture bearers. Several participants expressed interest in sharing the experience with peers or applying it in educational contexts.

These findings affirm that interactive projection does more than display culture it enables people to enact it. The Sanzao Crane Dance is no longer just observed, but felt and reimagined.

Discussion

The results of this study support the hypothesis that real-time interactive projection using TouchDesigner can significantly enhance audience experience and deepen cultural connection within intangible heritage exhibitions. In this section, we critically reflect on these findings by comparing them with prior literature and identifying implications for future exhibition design.

1. From Passive Spectatorship to Active Participation

Traditional heritage exhibitions often struggle to move beyond static display formats. This study confirms prior critiques (e.g., Liu 2022; Ren 2023) that such modes lack emotional depth. The interactive approach presented here breaks that limitation by enabling audiences to become embodied participants in the narrative. This reflects recent discourse on performative heritage, where culture is not only remembered but reenacted.

2. Technology as a Cultural Interface

While TouchDesigner is often framed as a visual effects tool in new media art, this research extends its role to a cultural interface a conduit for symbolic gestures, community memory, and identity transmission. Unlike VR headsets or AR devices that isolate users, TouchDesigner supports shared spatial experiences, aligning with the collective nature of traditional performances.

3. Balancing Authenticity and Innovation

One challenge in applying digital technology to ICH is the risk of “spectacularization,” where aesthetics may overshadow cultural meaning. Some interviewees expressed concern that the dance’s ritual significance might be diluted in overly gamified settings. This underscores the need for curators and designers to establish a balance between fidelity to tradition and audience-centered innovation.

4. Generational Bridging and Informal Education

The strong response among younger participants reinforces the potential of interactive exhibitions as tools for informal education. Unlike textbook-based approaches, these experiences stimulate curiosity and emotional learning. The implication is clear: digital exhibitions are not merely supplementary, but may become primary pathways for ICH transmission among digital natives.

Overall, this discussion highlights how Touch Designer-based exhibitions may redefine the boundaries of cultural display transforming passive remembrance into active co-creation, and shifting from information transfer to experience-driven engagement.

Conclusion

This study explored the integration of TouchDesigner into the real-time interactive exhibition of Zhuhai’s Sanzao Crane Dance and evaluated its impact on cultural experience and audience participation. Through a mixed-methods approach involving experimental design, surveys, and interviews, the research revealed clear benefits of digital interactivity in enhancing immersion, fostering emotional connection, and stimulating participatory learning.

Key contributions of this research include the development of a conceptual framework that maps the interaction between technology, heritage content, and audience engagement, and the empirical demonstration that such a model can support new forms of cultural transmission.

Importantly, this study positions Touch Designer not merely as a digital tool, but as a **cultural medium** that can interpret, embody, and renew traditional practices in meaningful ways. The Sanzao Crane Dance long rooted in ritual and community is reimagined here as a participatory narrative system capable of resonating across generations.

While limitations remain such as scalability and the risk of superficial engagement he findings strongly suggest that interactive projection represents a valuable strategy for rethinking how intangible heritage is exhibited, experienced, and passed on in the digital age.

Recommendations

Based on the research findings and reflections discussed, several recommendations can be made for future applications of interactive projection in intangible cultural heritage (ICH) exhibitions. These suggestions are divided into practical implementation strategies and theoretical research directions.

Practical Recommendations for Designers and Curators

1. Integrate modular interaction systems

that allow for real-time adjustments to audience movement and emotional responses.

2. Incorporate traditional experts in co-design

to preserve authenticity while exploring innovative formats.

3. Design spatial storytelling paths

that lead users through emotional and symbolic arcs, not just information points.

4. Develop evaluation tools

that measure not only engagement time, but affective impact and knowledge retention.

Theoretical and Strategic Recommendations

5. Frame interactive exhibitions as cultural ecosystems

where technology, ritual, narrative, and audience behavior are co-dependent.

6. Encourage cross-disciplinary collaboration

between heritage scholars, interaction designers, and data scientists.

7. Reframe digital heritage not as a substitution, but as a transformation

an evolution of embodied storytelling in the algorithmic age.

Together, these recommendations aim to ensure that future ICH exhibitions not only embrace technological innovation but do so in a way that honors the depth, meaning, and continuity of cultural practices.

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