Article

The Integration of Hainan's Intangible Cultural Heritage into Public Space under the Perspective of Digitalization

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Abstract: Public spaces function as essential arenas for cultural dissemination and public engagement, offering communities opportunities to interact with heritage in meaningful ways. The emergence of digital technologies has expanded the potential for Hainan's intangible cultural heritage (ICH) to move beyond traditional exhibition settings, enabling its integration into everyday public spaces and fostering more immersive experiences. This study investigates the current limitations in integrating ICH within Hainan's public spaces, which include superficial presentations, restricted opportunities for interaction, and experiences that often lack diversity and engagement. These challenges are examined in the context of the evolving needs for preserving living heritage and the multifunctional development of public spaces in the digital era. By exploring three key dimensions-digital transformation of spatial environments, intelligent interactive experiences, and collaborative cultural dissemination-this research proposes an integration framework grounded in "technological empowerment, cultural implementation, and public participation." Digital transformation emphasizes the adaptation of physical spaces to incorporate advanced technologies such as augmented reality, virtual simulations, and digital storytelling platforms, creating environments that allow ICH to be experienced in new, dynamic ways. Intelligent interactive experiences prioritize audience engagement through responsive installations, gamified learning, and participatory workshops, fostering a deeper connection between visitors and cultural content. Collaborative dissemination focuses on bridging cultural organizations, local communities, and visitors to co-create and propagate knowledge, ensuring that heritage remains vibrant and contextually relevant. The findings of this study provide actionable guidance for transitioning Hainan's ICH from static "museum preservation" models toward dynamic, participatory, and living public space dissemination. By integrating digital innovation, immersive interactions, and community collaboration, public spaces can become platforms where intangible heritage is actively experienced, appreciated, and sustained, thereby contributing to the broader cultural and social development goals of the Hainan Free Trade Port.

Keywords: digitalization; Hainan intangible cultural heritage; public space; cultural integration; living inheritance

1. Introduction

1.1. Research Background

Hainan is home to over 300 intangible cultural heritage (ICH) projects at various levels, including Li ethnic brocade weaving (Li minzu jingzhi), Lingao fishing songs (Lingao diaoyu ge), and the Nanhai maritime navigation route (Nanhai hanghai dao). These ICH resources, rooted in both maritime and ethnic cultures, form the core cultural identity of the Hainan Free Trade Port, reflecting its historical continuity and contemporary social significance. Public spaces-ranging from urban squares, transportation hubs, and commercial complexes to community centers-serve as vital

cultural connectors between urban and rural populations. These spaces offer inherent advantages, including openness, high-frequency engagement, and the potential for interactive experiences, making them ideal platforms for disseminating and revitalizing cultural heritage.

With the rapid adoption of digital technologies such as 5G networks, virtual reality (VR), augmented reality (AR), and artificial intelligence (AI), public spaces are undergoing a transformation from purely physical venues to hybrid environments that integrate digital interaction. This evolution provides unprecedented opportunities for ICH to move beyond static displays and traditional exhibitions, allowing heritage elements to be experienced in dynamic, immersive ways. In this context, understanding how digital technologies can facilitate deeper integration of Hainan's ICH into public spaces becomes a critical task. Such integration not only enhances public engagement and awareness but also strengthens the contemporary relevance of traditional cultural forms, fostering a more profound cultural identity among local residents and visitors alike [1].

1.2. Research Significance

From a theoretical perspective, this study bridges the domains of digital technology, intangible cultural heritage, and public space research, addressing current gaps in the literature. Existing studies often focus narrowly on museum-based technological applications or discuss cultural integration in abstract terms without offering practical implementation pathways. By integrating these three dimensions, this research advances the theoretical framework of "spatial dissemination," providing a structured approach for the living inheritance and dynamic transmission of intangible cultural heritage.

Practically, the study identifies specific challenges in integrating Hainan's ICH into public spaces, including limited interactivity, superficial presentation, and a lack of audience engagement. It further proposes actionable digital strategies that transform traditional heritage elements-such as the intricate patterns of Li ethnic brocade and the melodic rhythms of Danjia fishing songs-into visible, tangible, and interactive experiences. These strategies include the use of immersive installations, interactive digital storytelling, and community co-creation initiatives that collectively enhance the cultural richness of public spaces. Moreover, the implementation of these approaches supports the Hainan Free Trade Port in positioning itself as an "international cultural showcase window," promoting its unique heritage on a global stage while fostering social cohesion and cultural appreciation among local communities.

2. The Value and Foundation of Integrating Hainan's Intangible Cultural Heritage into Public Space under the Perspective of Digitalization

2.1. Core Value: Transition from "Protection" to "Living Transmission"

Traditional preservation of intangible cultural heritage (ICH) often relies on closed-off settings, such as museums, heritage workshops, or master-apprentice studios, which inherently limit public engagement and accessibility. Public spaces, by contrast, provide an open and inclusive platform that allows a wide range of audiences to experience heritage directly. Whether travelers passing through Sanya Airport, shoppers in Haikou commercial complexes, or villagers in rural squares, all can interact with ICH as part of their daily routines, expanding its social reach and contemporary relevance [2].

Digital technologies further dissolve the barriers of time and form that have historically constrained heritage engagement. For example, augmented reality (AR) applications allow visitors to scan QR codes in public squares to virtually witness the brocade-making process of the Li ethnic group. Interactive digital installations enable community members to learn and perform Lingao fishing songs in real time, transforming traditional passive observation into active participation. Virtual reality (VR) experiences and motion-sensitive interfaces can simulate historical contexts or traditional craftsmanship techniques, making ICH accessible to audiences who might otherwise lack

direct exposure. By combining open public environments with immersive digital tools, the living inheritance of Hainan's ICH is activated, allowing cultural practices to continue thriving in contemporary society.

2.2. Realistic Foundation: Triple Support of Policy, Technology, and Resources

The integration of ICH into public spaces in Hainan is underpinned by three critical support pillars: policy, technology, and resources.

Policy support is provided through strategic initiatives such as Hainan's "14th Five-Year Plan for Cultural Reform and Development," which explicitly encourages the incorporation of intangible cultural heritage into public spaces, tourist attractions, and community venues. The plan emphasizes leveraging digital technologies to enhance the dissemination and visibility of ICH, offering a clear institutional framework for implementation.

Technological readiness has been significantly enhanced by Hainan's comprehensive 5G network coverage, spanning all counties and urban districts. Cities including Haikou and Sanya have deployed interactive screens, VR devices, and other digital installations in high-traffic public spaces such as Haikou International Duty-Free City and Sanya's Tianyahaijiao Scenic Area. These initiatives establish a solid technological infrastructure that enables the seamless integration of ICH into diverse public contexts [3].

Resource availability further strengthens the foundation for digital integration. Hainan possesses rich and diverse heritage assets, encompassing both tangible items such as Li ethnic silver ornaments, hand-woven brocades, and coconut carvings, and intangible practices like fishing songs, boat songs, and maritime rituals. These elements can be transformed into multisensory digital formats, including visual, auditory, and interactive experiences, to suit different public space scenarios. By aligning policy support, technological readiness, and abundant cultural resources, Hainan is well-positioned to implement a sustainable and engaging model of ICH integration that transforms heritage from static preservation into vibrant public experiences.

3. Current Situation and Problems of Integrating Intangible Cultural Heritage in Public Space in Hainan

3.1. Superficial Integration Forms and Lack of Digital Depth

The current integration of Hainan's intangible cultural heritage (ICH) into public spaces primarily remains at the level of visual attachment, often serving as decorative embellishments rather than meaningful cultural experiences. For example, some bus stops in Haikou display patterns of the Li ethnic group's brocade, and Sanya shopping malls feature posters of Danjia fishing songs. However, these efforts largely function as static decorations and fail to utilize digital technology for content expansion or interactive engagement. Limited digital initiatives, such as the ICH promotional video at Sanya Airport, primarily rely on one-way playback without interactive elements or immersive storytelling. As a result, the public experiences only a superficial impression of these cultural forms, which quickly fades from memory, preventing the establishment of lasting cultural touchpoints and engagement [4].

3.2. Insufficient Scene Adaptation and Disconnection from Public Space Functions

Public spaces differ significantly in their functional characteristics and user needs. Airports and train stations demand fast, fragmented interactions, community spaces emphasize frequent daily engagement, and commercial complexes focus on entertainment-driven, consumer-oriented experiences. However, Hainan's current integration of ICH often neglects these contextual variations. For instance, complex VR devices installed in rural squares remain largely unused by elderly villagers who find the technology difficult to operate. Similarly, lengthy ICH documentaries broadcast at airports go unwatched by travelers on short layovers. These mismatches between

technological solutions and user behavior result in inefficient use of resources, technological waste, and minimal cultural impact.

3.3. Weak Coordination among Stakeholders and Lack of a Long-Term Mechanism

The successful integration of ICH into public spaces requires collaboration among four key stakeholder groups: heritage inheritors, public space operators, digital technology companies, and government agencies. Currently, this coordination is inadequate. Heritage inheritors often lack the digital skills needed to transform traditional weaving techniques or fishing songs into formats suitable for public space presentation. Operators tend to prioritize functional objectives-such as transportation efficiency or commercial revenue-while neglecting long-term cultural planning. Technology companies, although capable of creating advanced digital solutions, frequently lack cultural understanding, producing content that is technologically sophisticated but culturally shallow. Meanwhile, government agencies, despite providing policy guidance, do not offer sufficient coordination, resulting in most integration efforts being short-term, event-based projects-such as temporary exhibitions on ICH Day-that fail to establish sustainable mechanisms for ongoing cultural dissemination [5].

3.4. Monotonous Experience Formats and Limited Public Participation

Current digital integration primarily emphasizes visual representation, neglecting auditory, tactile, and immersive engagement that could enrich the public's experience. Critical elements-such as the tactile sensation of Li ethnic brocade weaving, the rhythmic sounds of coconut carving tools, and participatory singing of Dan ethnic fishing songs-remain largely absent. Additionally, integration with Hainan's unique maritime and ethnic heritage has been insufficient. Interactive digital installations for fishing songs in seaside plazas remain undeveloped, and augmented reality navigation systems for the South China Sea maritime routes in port areas have not been implemented. These gaps hinder public enthusiasm and engagement, limiting opportunities to create a virtuous cycle in which cultural identity fosters active participation and ongoing dissemination. Without diverse and contextually adapted experiences, the potential of public spaces as platforms for living cultural heritage remains underutilized [6].

4. The Path of Integrating Hainan's Intangible Cultural Heritage into Public Space under the Perspective of Digitalization

4.1. Scenario-Specific Customization: Developing a Space-Adaptive Digital Integration Solution

To effectively integrate intangible cultural heritage (ICH) into public spaces, it is essential to align digital initiatives with the functional characteristics and user demographics of each space, ensuring both technological appropriateness and content relevance. At transportation hubs such as Sanya Phoenix International Airport and Haikou Meilan Airport, fragmented digital experiences are designed for immediate accessibility. Interactive "ICH digital blind box" screens in terminals allow passengers to scan QR codes and access short videos of 1-3 minutes featuring Li ethnic brocade patterns or Lingao fishing songs. AR scanning stations in baggage claim areas can trigger dynamic visualizations of Nanhai maritime navigation routes, presenting animations that showcase the skills and knowledge of ancient navigators. These interventions transform otherwise idle waiting periods into immersive cultural experiences [7].

In commercial complexes such as Haikou Riyue Plaza and Sanya International Duty-Free City, the focus is on fun-driven engagement and experiential learning. Digital tapestry walls allow visitors to "weave" Li ethnic patterns on touch screens, generating personalized digital posters for sharing. In dining areas, "Danjia Fishing Song Karaoke Machines" with AI voice recognition encourage visitors to hum songs, unlocking full tracks and earning intangible cultural heritage experience certificates. A "Coconut

Carving Digital Puzzle" game enables users to redeem cultural heritage discounts upon completion, seamlessly combining interactive learning with consumer engagement.

Urban and rural communities are targeted with initiatives that integrate ICH into daily life, prioritizing frequent engagement. At the Haikou Community Activity Center and Baoting Li-Miao Village Square, touch-screen terminals offer simplified Li ethnic weaving tutorials for seniors, while young participants can watch live-streamed demonstrations by heritage bearers. Interactive "Fishing Song" audio systems in rural squares light up ethnic patterns rhythmically during community chorus performances, enhancing participation. The "Intangible Cultural Heritage Neighborhood Exchange Program" rewards digital participation with points redeemable for items such as coconut-carved ornaments and Li brocade scarves, fostering sustained community involvement.

Cultural squares, including Haikou Wanlv Garden and Sanya Civic Square, offer deeply immersive experiences. 3D projection technology displays dynamic Nanhai Navigation Routes on floors or walls, accompanied by ocean wave sounds, recreating the voyages of ancient merchant ships. The "Li Ethnic Brocade VR Experience Hall" allows visitors to virtually enter weaving workshops, operate looms, and select patterns to experience craftsmanship firsthand. Regularly organized "Digital Intangible Cultural Heritage Evenings" feature holographic projections enabling heritage bearers to perform alongside the public, bridging temporal and spatial distances [8].

4.2. Technology Empowerment: Creating a Multi-Sensory and Intelligent Integration Platform

Digital technology enables multi-sensory engagement across visual, auditory, tactile, and intelligent dimensions. Visually, AR triggers embedded in public ICH elements-such as brocade posters and coconut-carved sculptures-allow citizens to scan QR codes to access cultural narratives. For instance, scanning a dragon motif on Li ethnic brocade reveals animated legends of the "Qilin and Twin Phoenixes." Digital projections at bus stops and subway stations display seasonal ICH content, with spring depicting Li brocade farming patterns and summer showing Dan ethnic maritime fishing activities, transforming static environments into dynamic cultural showcases.

Auditory integration is achieved through interactive sound installations. "Fishing Song Wind Chimes" at Haikou's West Coast recreate traditional Lingao fishermen melodies when moved by wind. Community stairwells feature "ICH Voice Guides" playing Li ethnic proverbs and Danjia folk songs as residents ascend. AI-powered "Fishing Song Chorus" systems allow users to hum melodies, generating personalized versions aligned with traditional modes, adding engagement and enjoyment.

Tactile experiences further enhance public engagement. Interactive stations, such as the "Li Ethnic Brocade Tactile Simulator" in shopping malls and communities, replicate the feel of weaving looms, allowing users to create and save unique digital designs. Rural schools offer "Digital Coconut Carving Stations," where students sculpt virtual coconut shells using styluses, receiving real-time feedback on carving techniques. These experiences lower learning barriers and promote hands-on interaction with heritage.

Intelligent integration uses big data analytics to provide customizable and traceable experiences. The "Public Space ICH Experience Database" collects user preferences, distinguishing, for example, between young visitors favoring interactive games and seniors preferring skill-based instruction. A personalized recommendation system tailors ICH experiences based on location and interests, enhancing engagement and ensuring content relevance [9].

4.3. Collaborative Efforts: Establishing a Multi-Party Coordination Mechanism

Effective integration requires collaboration among government agencies, heritage practitioners, enterprises, and the public. Hainan's Provincial Department of Culture and Tourism has led the creation of the "Hainan Intangible Cultural Heritage Public Space Integration Task Force," issuing implementation guidelines and establishing a dedicated

fund to support AR equipment, interactive screens, and digital content development. Pilot projects in ten public spaces across Haikou, Sanya, and Baoting have tested these initiatives, with plans for province-wide expansion based on results.

Heritage bearers, including Li ethnic brocade artisans and Lingao fishing song performers, are actively involved in digital content creation. They contribute to digital pattern libraries, record folk stories in "Digital Classrooms," and establish "Digital Heritage Studios" in commercial and public spaces. Live-streaming allows them to interact with audiences and gather feedback, ensuring authenticity and continuous improvement.

Corporate partnerships provide technical and operational support. Local digital enterprises develop and maintain digital ICH products, and commercial collaborations integrate heritage experiences with consumer activities, such as offering duty-free coupons for participating in digital brocade interactions. These efforts ensure long-term sustainability and operational stability.

Public participation is encouraged through programs like the "Hainan Intangible Cultural Heritage Public Space Co-Creation Program," which invites citizens to upload heritage videos and digital designs. Exceptional works are showcased in public spaces. Recruitment campaigns for "Digital Heritage Experience Officers" and school competitions in public space design further stimulate engagement, creating a cycle of participation, dissemination, and cultural identity reinforcement.

5. Conclusions and Perspectives

Digital technology is central to integrating Hainan's intangible cultural heritage into public spaces, enabling interaction, extending accessibility, and improving dissemination efficiency. Its primary value lies in transforming heritage from niche preservation into everyday cultural engagement. While challenges persist-such as superficial integration, poor scenario adaptation, and weak stakeholder coordination-adopting a three-pronged approach of scenario-specific digital customization, multi-sensory technology empowerment, and multi-stakeholder collaboration can effectively address these issues. This approach creates mutual empowerment: public spaces gain cultural depth, and heritage elements like Li brocade and Lingao fishing songs are revitalized in daily life.

Emerging technologies, including the metaverse and digital twins, promise new avenues for ICH integration. Virtual public spaces could allow users to "step into" Li Village Square digitally, participating in traditional dances alongside global audiences. Integrating digital ICH into platforms such as the Hainan Free Trade Port International Cultural Cloud Platform enables overseas tourists to access heritage content through multilingual terminals in airports and hotels. Throughout this digital transformation, it is essential to maintain the principle that culture remains central, ensuring that technology enhances rather than overshadows the living inheritance of Hainan's intangible cultural heritage and supports the region's cultural development.

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