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*Original Paper*

# Communicating Food Heritage in the Digital Age: A Study on the Multisensory and Participatory Design of the Guangxi Rice Noodles Museum

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***Abstract***

*Based on the critical underrepresentation of regional food heritage in conventional museum practices, this study proposes the design and theoretical underpinnings of the Guangxi Rice Noodles Museum, a hybrid digital-physical exhibition. The project aims to preserve and communicate the cultural significance of Guangxi rice noodles as both tangible and intangible heritage, fostering intergenerational transmission and critical reflection on its commercial value. Drawing on participatory museology and sensory studies, the methodology integrates immersive technologies—including markerless AR, VR cooking simulations, multilingual voice interaction, and motion-triggered scent devices—with community-driven content collection and inclusive design principles. The research results in a detailed, implementable framework comprising a structured content data model, user journey mapping, and functional specifications for interactive systems. It is concluded that this multisensory and participatory approach effectively transforms everyday food culture into an engaging heritage experience, bridging the gap between local knowledge and global audiences. The museum model demonstrates how digital curation can serve as a platform for cultural democratization, inclusivity, and sustainable heritage practice, positioning regional culinary traditions within broader discourses of identity and memory.*

***Keywords***

*guangxi rice noodles museum, hybrid exhibition, multisensory experience, participatory design, digital heritage*

## 1. Introduction

This study proposes an integrated physical and digital exhibition—the Guangxi Rice Noodles Museum—which explores how regional food heritage can be communicated through inclusive, multisensory curatorial strategies. Combining traditional displays with AR, audio-visual storytelling, tactile installations and oral histories, the project aims to engage diverse audiences in cultural participation. This hybrid exhibition addresses the underrepresentation of local culinary knowledge and sensory experience in conventional food heritage practices.

Rice noodles are not just regional treats; they are cultural artefacts linked to memory, labor, identity, and mobility. The project aims to highlight Guangxi rice noodles as tangible and intangible heritage, showing stories of community resilience, intergenerational transfer, and place-based identity. Inspired by Raymond Williams' (1989) understanding of everyday culture, the exhibition highlights how food can anchor emotions, memories, and belonging.

The cultural foundation of this project stems from the broader challenges of heritage representation. Whether in China or globally, much of the existing exhibition work related to food remains overly commercial and visual (Sandell, 2007). While tourism and viral media shape regional identities and strive to benefit communities, the situation of heritage cultural development can become extremely complex (Su & Teo, 2009). The sensory richness of daily labor, voices, and food culture is often erased. In Guangxi, it involves marginalizing rural noodle shop artisans, elderly women producers, and ethnic minority traditions. So, this exhibition promotes curatorial justice by including unheard voices and decentering the dominant narrative.

In terms of methodology, the exhibition is based on the design of participatory museums and draws on Nina Simon's (2010) participatory museum model, as well as the research on accessibility by Vikmane et al. (2024)—Stimulating emotions, memories, and imaginations can significantly enhance the overall museum experience for all visitors and facilitate the development of interactive technologies and co-created content. The olfactory display and VR cooking simulation not only make the space accessible to different users (including children, the elderly, and disabled visitors), but also enhance the cultural immersion by connecting physical sensations with historical knowledge (Howes & Classen, 2013).

Moreover, the exhibition responds to critiques by Bell and Valentine (1997) and LeBesco and Naccarato (2012), who argue that food heritage spaces often obscure structural inequalities and commodify culture for mainstream consumption. Through participatory design and embodied interpretation, this project seeks to counter such tendencies. It challenges the viewer not just to consume, but to feel, reflect, and act.

To capture these dynamics, the project engages in comparative research across regional and international food exhibitions, identifying representational gaps and conceptual weaknesses in existing

practices. It also draws on Walter Benjamin's (2008) notion of aura to critique the disconnection between mass-reproduced food images and the intimate, sensorial processes of food making and sharing. By repositioning rice noodles as daily sustenance and mobile cultural memory, the project aims to create a new museum practice that is ethical, embodied, affective, and inclusive.

Ultimately, the Guangxi Rice Noodles Museum contributes to discourses on heritage studies, cultural democratization, and digital curatorship. It asks how underrepresented food cultures can be reimagined for dialogue and transformation, with multisensory experience as a means for cultural justice and community empowerment.

## 2. Aims and Objectives

The aims and objectives outlined below form the strategic foundation of the exhibition at the Guangxi Rice Noodles Museum. This exhibition encompasses both digital and physical dimensions and aims to redefine rice noodles not merely as a commercialized regional symbol but also as a carrier of memories, traditions, and identities. Through the integration of immersive technologies, oral history, and participatory design, the exhibition presents a multi-voiced, community-centered cultural narrative mode rather than a simplistic heritage narrative. It aims to reflect the best practices in digital heritage, sensory museology, and mobile technology curation (Parry, 2007; Lynch, 2013; Economou & Meintani, 2011).

**Aim 1**: To preserve and communicate the regional diversity and cultural significance of Guangxi rice noodles through immersive, multi-sensory curatorial practice.

This aim positions the exhibition not merely as an information display, but as an experiential intervention into how local food traditions are remembered, shared, and valued. It challenges dominant narratives that often reduce food heritage to a visual spectacle or tourist branding tool. Instead, it seeks to recover and reframe rice noodles as living heritage embedded in social relations, sensory memory, and geographic diversity.

**Objectives:**

1) To create six regionally themed exhibition halls by Month 6, each representing a key rice noodle tradition within Guangxi (e.g., Guilin, Liuzhou, Nanning), and showcasing 57 varieties of rice noodles through spatial, visual, and material design.

Justification: By curating rice noodles by locality, the exhibition resists homogenized representations and instead visualizes geographic specificity and culinary nuance. This directly supports the aim of promoting cultural complexity and region-specific knowledge. As Scarpato (2001) argues, local culinary expressions are crucial markers of identity and social cohesion.

2) To integrate AR/VR and interactive technologies by Month 8 that simulate rice noodle production processes, enabling deeper sensory and procedural understanding.

Justification: Digital interaction expands the scope of sensory interpretation curatorial tools. It allows visitors to experience food-making practices and connect intellectually and emotionally with other overlooked knowledge systems. Following Cameron (2011), immersive technologies can break passive viewing, transcend the limitations of the venue, and encourage concrete engagement with cultural content. This is in line with the shift in digital museology towards more equitable access.

3) To provide a multi-sensory interpretive strategy including soundscapes of noodle markets, scent diffusers mimicking broth aromas, and tactile replicas of tools and ingredients.

Justification: Sensory design deepens emotional and cognitive responses, enhancing memory and empathy. This method supports the exhibition's communicative goal by activating taste memory and sensory recognition.

4) To build a sustainable digital archive platform by Month 12 that stores regional typologies, oral histories, visitor inputs, and multimedia content for long-term access by educators, curators, and the public.

Justification: A digital archive ensures long-term cultural preservation and positions the exhibition within an open-access, educational framework. Harrison et al. (2020) highlight the importance of archiving community-driven heritage within collaborative, participatory systems.

**Aim 2**: To foster intergenerational transmission, community participation, and critical reflection on the cultural and commercial value of Guangxi rice noodles.

This aim centers the social life of heritage—how food knowledge circulates, who participates in it, and how communities negotiate cultural continuity. It also attends to the tensions between heritage preservation and commodification. Through oral history, workshops, and participatory design, the project positions the museum as a dialogic space, not just a display site. The goal is to facilitate an ongoing cultural conversation, responsive to local voices and shifting identities.

**Objectives:**

1) To collect and digitally present oral histories from local elders, noodle artisans, small vendors, and tourists, using audio booths and video installations in the exhibition space.

Justification: Oral storytelling sustains cultural memory and democratizes authority by foregrounding lived experiences. This fulfills the aim by ensuring intergenerational and grassroots knowledge becomes central to the exhibit.

2) To set up community-oriented workshops and interactive storytelling zones, where visitors (particularly students and families) can learn noodle-making, engage in taste memory activities, and contribute personal stories.

Justification: These workshops animate heritage as lived and ongoing. By making space for experiential learning and user-generated narratives, the exhibition becomes a platform for cultural transmission and civic participation. This approach advocates for co-creative museum models that

recognize visitors as contributors.

3) To curate a cultural-creative display zone for local rice noodle brands, paired with a feedback mechanism (questionnaire) that gathers visitor reflections and opinions on commercialization, tradition, and authenticity.

Justification: Presenting commercial branding alongside critical reflection surfaces the cultural contradictions inherent in heritage commodification. It supports the aim by provoking thought about how food heritage is shaped in markets and media.

4) To analyze visitor responses and publish a post-exhibition evaluation report that assesses user engagement, cultural impact, and public perception of commercial vs traditional heritage expressions.

Justification: This supports institutional learning and transparency, feeding back into heritage research and future curatorial practice. Participatory exhibition models should build in evaluative tools to remain accountable to diverse stakeholders.

**Why These Aims and Objectives Matter**

Together, the two aims reflect a dual commitment: first, to present Guangxi rice noodles as rich, multi-dimensional cultural heritage; and second, to activate this heritage as a living and shared experience. These aims are intentionally broad yet conceptually grounded. Each objective is a concrete action toward realizing these intentions through curatorial design, technological integration, and social engagement.

The selected methods—regional exhibition zoning, AR/VR simulation, oral history collection, community workshops, and brand feedback—support these aims by fostering sensory immersion, social inclusion, and critical reflection.

## 3. Context

### *3.1 Cultural Background and Content*

Understanding the cultural context of Guangxi rice noodles is not just a culinary interest but crucial for recognizing the cultural necessity and academic value of their exhibition. This resonates with Raymond Williams's (1989) critique that culture is not confined to elite expressions but deeply embedded in everyday practices, including food. Pine and Gilmore's (1999) theory of the 'experience economy' also suggests that cultural consumption is increasingly tied to emotion and memory, underscoring the need to foreground such foodways in curatorial practice. By situating Guangxi rice noodles within these theoretical frameworks, we underscore the compelling reasons why their conservation and interpretation within the museum context are not merely pressing but also hold profound significance.

Although rice noodles are popular in China, Guangxi's versions are a unique cultural practice little explored in museums and academia. This section contends that Guangxi rice noodles are more than food; they symbolize ecological adaptation, cultural resilience, and social cohesion. Despite being

common, their cultural significance is overlooked or just used for tourism. The following analysis highlights the need to present, interpret, and critically examine this history.

Guangxi rice noodles have a history of over two thousand years, influenced by the region's unique geographical, agricultural, and ethnic conditions. Abundant rainfall and mountainous terrain make it suitable for rice cultivation, different from the wheat-dominated north. Guangxi's rice noodle culture developed from ecological needs and local wisdom, challenging the common top-down, Han-centric view of food heritage.

Archaeological findings and texts like in the Book of Han show long rice-based food consumption in Lingnan. Early records stress the sophistication and social value of rice food processing. The traditional method (soaking, grinding, steaming, cutting) is still used, maintaining knowledge and authenticity. Previous studies show it is essential to document these in a museum; otherwise, modernization may erase this knowledge.

Guangxi rice noodles are more than a single tradition. They are a mix of regional types influenced by trade, ethnic relations, and local tastes. Guilin's noodles show Cantonese braising influence; Liuzhou's snail noodles use local fermentation and snail resources; Nanning's old friend noodles, from Zhuang cuisine, have medicinal and communal meanings. These differences oppose the one-sided view of 'Chinese food' and encourage a more diverse understanding of regional identity.

Yet these histories are not easily accessible to the public. Digital platforms and packaged goods (like instant snail rice noodles) have separated rice noodles from their cultural background. Social media can increase visibility but often sacrifices depth, strengthening stereotypes and commercial aesthetics. After 1978, urbanization and mass production helped cross-regional exchange but also made regional differences less distinct.

In this context, curating a Guangxi rice noodles exhibition is not just about nostalgia or celebration; it is an urgent cultural preservation and interpretation act. The exhibition corrects mainstream narratives that neglect or commodify local culinary knowledge. It invites audiences to see rice noodles not as snacks or souvenirs, but as artefacts of migration, memory, and meaning. By tracing their history, diversity, and social function, we show their relevance to identity, mobility, and belonging in contemporary China. It is the basis for a key claim: Guangxi rice noodles are intangible heritage needing attention, curation, and public engagement. Without this, the cultural meanings in this food may be lost due to convenience and consumption.

*3.2 The Socio-Cultural Environment*

In recent decades, Guangxi rice noodles have changed from a common daily staple to a symbol of regional pride and cultural capital. Understanding this change is crucial to show why the museum's intervention is needed. Once mainly eaten by laborers, students, and rural people, rice noodles now play a big role in food festivals, social media marketing, and TV documentaries as icons of China's

diverse cuisine. This phenomenon illustrates how food traditions are re-framed as consumable heritage (Tellström, Gustafsson, & Mossberg, 2006), creating both opportunities for visibility and risks of distortion.

As Bourdieu (1984) noted, cultural practices like food are not just acts of consumption but also expressions of symbolic capital. The change of rice noodles from necessity to nostalgia, and from marginal snack to trendy item shows this. In this process, their original socioeconomic background and meaning may be erased or changed to suit the middle class and tourists. Such changes highlight the need for a critical, museum-based approach to preserve original meanings and context.

This shift also reflects the broader trend of cultural commodification in contemporary China, where local traditions are often commercialized to support domestic tourism and soft power campaigns (Nyíri, 2006). Events like Liuzhou River Snail Rice Noodle Food Festival or Xing'an Guilin Rice Noodle Festival show how cultural policy and market dynamics intersect to promote food as heritage and economic driver. However, as Watson (2006) has shown in his work of McDonald's in East Asia, localization of food products can also reproduce dominant narratives while silencing subaltern voices. This increases the urgency for a museum to show the marginalized and overlooked parts of noodle heritage.

Furthermore, the museum emerges as China's young generation, especially post-2000 digital users, is increasingly detached from traditional foodways. Surveys and interviews with Guangxi university students indicate many know little about the production, variety, or history of daily-consumed rice noodles. For them, rice noodles are often experienced digitally: ordered via apps and reviewed through influencer videos. As Benjamin (2008) said, mechanical reproduction can remove the "aura" of cultural artefacts. Here, the Guangxi Rice Noodles Museum aims to reconnect food to its roots. Thus, the museum is necessary both as a knowledge repository and a generational bridge.

Rural rice noodle-making by older women without digital storytelling platforms is often excluded from urban-centered narratives. Feminist food scholars have emphasized the invisibility of women's culinary labor in heritage discourse (Avakian & Haber, 2005). These silences marginalize elder knowledge and homogenize Guangxi's noodle traditions. Focusing only on successful forms like Liuzhou snail rice noodles, public discourse may flatten local differences for marketable stereotypes.

Furthermore, heritage politics dynamics often privilege certain geography narratives and exclude humanity culture value (Smith, 2006). The museum aims to intervene by creating a platform for multiple voices, especially those excluded from mainstream branding like rural producers, minority communities, and women elders.

The socio-cultural environment for this museum's development is shaped by tensions like commodification vs preservation, globalization vs localization, digital vs physical. The Guangxi Rice Noodles Museum aims to expose rather than resolve these tensions, following Tunbridge and

Ashworth's (1996) dissonant heritage concept. It must carefully handle these tensions and be open to public reflection. By curating contested narratives critically, it promotes a more inclusive heritage practice, preserving cultural heritage while maintaining its contested and pluralistic nature.

*3.3 Exhibition Practices and Critical Comparisons*

Current food-related exhibitions, both in China and globally, reveal why this project is urgently needed. Such as the Liuzhou Snail Rice Noodles Museum, the Guilin Rice Noodle Cultural Experience Hall, or various local-brand showrooms. While they contribute to regional branding and food tourism, these exhibitions tend to prioritize visual aesthetics and marketability over historical depth or cultural reflexivity. They often present as commodified versions of food culture, reducing multifaceted local traditions to consumable places for tourists.

This tendency is not limited to China. Globally, exhibitions such as the Dubai Coffee Museum or the Smithsonian's "Food: Transforming the American Table" face similar criticisms. Scholars like Heldke (2003) have noted that food exhibitions often reproduce dominant culinary narratives while marginalizing subaltern voices and everyday foodways. They may romanticize tradition, depoliticize food systems, or overlook the labor, gender, and ethnic relations embedded in culinary heritage.

Critiques from critical museology also emphasize that many food heritage exhibitions fall short of engaging local communities in curatorial processes. Instead, curatorial authority tends to remain centralized, limiting the diversity of perspectives represented (Simon, 2010). Simon's participatory museum model is particularly relevant here—it advocates for the shift from audiences as passive viewers to active participants in shaping cultural narratives. Likewise, multisensory design—essential for fully conveying food's material and emotional significance—is underutilized or poorly integrated (Edwards et al., 2006). This aligns with Juhani Pallasmaa's (2005) critique of ocularcentrism in spatial environments, calling instead for multisensory and embodied modes of interpretation.

In the Chinese context, food exhibitions are often shaped by government and commercial agendas. Heritage is selectively framed to support narratives of national unity, economic growth, or regional distinctiveness (Oakes, 2013). This instrumentalization can flatten cultural differences and silence more complex or contested aspects of local identity. In the case of present Guangxi rice noodles, exhibitions usually highlight Liuzhou river snails rice noodles' recent popularity while neglecting lesser-known varieties, the voices of rural producers, or the social practices around production and sharing.

Therefore, the absence of exhibitions that critically explore food heritage in multisensory, participatory, and locally grounded ways points to a significant cultural gap. The analysis of existing exhibitions reveals a recurring pattern of surface-level storytelling, economic instrumentalism, and aesthetic formalism. This critique provides the basis for arguing that more reflexive, inclusive, and community-informed approaches are urgently needed in food museology. Only by addressing these limitations can future exhibitions meaningfully reflect the complexity and cultural significance of food

as lived heritage.

*3.4 Inclusivity and Accessibility Design*

Institutional mission statements often mention inclusivity, but it is unevenly applied in cultural exhibitions, especially food museums. Many exhibitions are visually dominant, assuming a typical visitor (sighted, mobile, tech-literate), leaving disabled and neurodivergent audiences underserved (Sandell, 2015). This is not just a design oversight; it is epistemological exclusion. Bouffard (2025) says curatorial care is an "art of attention" that reconstructs an exhibition's meaning and value through physical and sensory experiences.

The Guangxi Rice Noodles Museum emerges in this context of exclusion. It views accessibility not as a regulatory box to tick but as a critique of current exhibition norms and a proposal for different museological futures. Scholars in disability studies and inclusive design say access should be seen as a cultural justice issue, not just about convenience (Sandell, Dodd, & Garland-Thomson, 2010). Museums should actively break down sensory hierarchies that favor vision and text over touch, sound, and smell. Contemporary food exhibitions often neglect this need. Recent studies on B&VI access to cultural spaces show that even inclusive-claimed exhibitions rarely enable independent and immersive engagement. Instead, they rely on aids like verbal descriptions or tours, widening the gap between disabled and 'normal' audiences. Few offer multisensory content or co-create with disabled communities. Eardley et al. (2022) say such approaches only compensate for vision loss and lack true inclusion.

In response, the Guangxi Rice Noodles Museum advocates a radical rethinking of inclusion, drawing on universal design principles and multi-sensory curation, stimulating emotions, memories and imagination, can significantly enhance the overall museum experience for all visitors—whether visually impaired or not (Vikmane et al., 2024). Its approach incorporates tactile replicas, audio narratives in multiple dialects, ambient soundscapes, and scent-infused zones to recreate the spatial, sonic, and olfactory context of rice noodle culture. This strategy builds on the work of Pallasmaa (2005), who challenges ocularcentrism in architectural and museum design, and aligns with participatory approaches that see access as co-production. Digital inclusion is equally important. AR and VR in exhibitions often widen the digital divide, leaving out those unfamiliar with devices or using assistive technologies. Inclusive AR/VR can be exclusionary without simplified or adaptive interfaces. Creed et al. (2024) note immersive technologies have accessibility barriers unless inclusive design is prioritized. The museum's tech strategy tackles this with simplified interfaces, voice commands, high-contrast options, and accessible AR overlays.

Inclusive design is inseparable from the museum's subject. Guangxi rice noodles are everyday food for all. An inclusive approach is both ethically and culturally essential. The museum says if rice noodles are shown as living heritage, all who live it should fully experience it. This turns accessibility into a

curatorial method and political stance, expanding culture and cultural subjects. In this sense, the Guangxi Rice Noodles Museum is part of a critical museology movement. It views access as key to cultural engagement. It says heritage should be more than visible; it must be touchable, audible, smellable, and co-authored. By questioning and changing dominant sensory norms, the museum makes food culture accessible to the excluded and reshapes the public's idea of cultural inclusion.

*3.5 Audience, Purpose and Impact*

The Guangxi Rice Noodles Museum is designed for a diverse audience. Its main audience are local residents in Guangxi, especially those familiar with rice noodles. The museum is like a mirror, affirming their culture, boosting community pride, and helping the young reconnect with culinary traditions.

Youth, especially students, are a key audience, both as learners and potential inheritors of the region's intangible heritage. The museum aims to bridge generational gaps by creating accessible, interactive content appealing to digital natives with historical and social depth. School tours, community workshops and university collaborations will integrate the museum into local education. By using rice noodles to explore history, identity, ecology and economy, the museum goes beyond a food showcase and becomes an educational platform.

For domestic and international tourists, the museum acts as both an attraction and an educator. In the context of China's booming cultural tourism industry, visitors increasingly seek authentic, localized experiences. The museum responds by offering not just tastings or performances, but knowledge: stories of people, places, processes, and meanings. For international audiences unfamiliar with Chinese regional cuisine beyond dim sum or Sichuan hotpot, the museum introduces a lesser-known but richly layered food culture, positioning Guangxi as a unique cultural geography within China's broader landscape.

Cultural researchers, anthropologists, food historians, and curators are also key stakeholders. By providing meticulously curated exhibits and an open-access digital archive of oral histories, historical materials, and ethnographic data, the museum contributes to scholarly conversations around food studies, heritage theory, and participatory curation. The space also welcomes critical dialogue—hosting roundtables, exhibitions-in-progress, and public reviews that invite critique and co-creation. In doing so, the museum does not merely transmit knowledge but generates it.

From an industry perspective, the museum holds value as a hub for gastronomic innovation, entrepreneurship, and brand storytelling. It provides an arena where small-scale producers, chefs, designers, and culinary startups can interact, test ideas, and reach new markets. Through partnerships with local governments, cultural agencies, and businesses, it becomes a nexus where heritage meets opportunity.

The broader educational and social outcomes of the project are far-reaching. Culturally, it restores dignity and visibility to everyday knowledge and labour, particularly that of women, elders, and rural communities. Socially, it builds platforms for inclusion and participation, aligning with UNESCO's emphasis on safeguarding intangible cultural heritage through education and dialogue. Emotionally, it fosters a sense of belonging, nostalgia, and curiosity, inviting people to reconsider what they thought they knew about food and culture.

In essence, the Guangxi Rice Noodles Museum is not just for cultural elites or food enthusiasts—it is for everyone who has ever shared a bowl of noodles, learned a recipe from a parent, or walked past a street vendor and caught a whiff of something familiar. It offers not only a celebration of rice noodles but a deeper reflection on who we are, how we remember, and why the ordinary deserves to be extraordinary.

## 4. Technology and Data

The Guangxi Rice Noodles Museum combines digital innovation with tangible heritage for a hybrid exhibition. Its tech infrastructure has a multi-layered architecture (presentation, business logic etc.) for an immersive system. This section details the technologies, data standards, and strategies, with reasons for use and analysis of pros and cons.

### *4.1 Hybrid Exhibition Architecture: Bridging Physical and Digital*

#### 4.1.1 AR/VR Integration and Exhibition Impact

The Guangxi Rice Noodles Museum employs a hybrid architecture that deliberately combines physical artefacts with AR and VR, reflecting the idea that digital media should extend, not replace, heritage experiences (Biedermann, 2021). This choice responds to a core problem: visitors cannot usually handle fragile artefacts or access their sensory environments (Wojciechowski et al., 2004). By embedding AR overlays, such as showing how a rice noodle pot was once used in Liuzhou kitchens, the exhibition provides cultural depth without compromising conservation.

The decision to adopt markerless AR via Vuforia and 8thWall was based on usability and aesthetics. Marker-based systems may be more stable but introduce visual clutter that undermines curatorial design. Similarly, overlay-based AR was justified because it creates embodied engagement by reconstructing noodle stalls in situ, which static signage could never achieve. Unity3D and WebGL were selected not for graphic superiority but for inclusivity: they enable browser-based 3D rendering across both high- and low-spec devices, removing the need for downloads. Here, accessibility outweighs maximal visual fidelity.

VR experiences on Meta Quest 2 were integrated because they provide immersive kitchens and markets that no physical gallery could replicate. While headsets introduce barriers, fallback browser-based VR mitigates exclusion. This two-tier approach demonstrates a commitment to both immersion and

equity—prioritising cultural understanding over technological spectacle.

Drupal was adopted as the CMS because it facilitates co-creation and educational layering, unlike WordPress, which lacks flexibility for multi-modal cultural content. This reflects a broader design logic: technologies are chosen not for novelty but for their ability to support participatory museology and iterative adaptation.

There are technical challenges—such as AR instability in poor lighting or WebGL lag on older devices—but these are acceptable compromises. What matters is that the hybrid system creates multiple interpretive paths, fosters accessibility, and embeds Guangxi's noodle heritage into global cultural discourse. AR and VR thus function not as decorative add-ons but as critical interpretive strategies that align directly with the project's mission of inclusivity and cultural continuity.

4.1.2 Scent Devices and Multisensory Curation

The Guangxi Rice Noodles Museum uses scent technology, following sensory museology principles to expand cultural engagement beyond sight and sound. Scent-emitting devices reproduce key ingredient aromas like pickled cowpea and snail broth, placed in thematic zones. These scents are essential to the rice noodle narrative. Pairing olfactory cues with visual and textual content helps visitors connect with heritage more affectively and bodily than written panels or images alone.

The decision to use micro-nebulizer scent dispensers with motion sensors was made after evaluating alternatives. Passive methods were dismissed due to lack of dosage control and freshness assurance, and manual activation would disrupt the visitor journey. Automated, sensor-triggered release ensures precision and immersion, meeting the museum's goal of low-friction interactions.

Precedents like The Scents of Ancient Egypt at the Egyptian Museum have shown scents' potential to deepen cultural immersion. However, they focus on ritual atmospheres while the Guangxi project emphasizes everyday culinary culture. This is intentional: it views rice noodles as a living tradition, not static artefacts. Also, adding scent increases inclusivity as it involves visually impaired visitors, giving them a different sensory way into the exhibition's stories. The choice of this technology recognizes its challenges like frequent cartridge refills and cross - contamination risk. Ventilation and zoning were added to the design for airflow management. Despite complexities, the advantages of olfactory storytelling are greater as scent is crucial for food heritage.

The Tate Sensorium (2015) showed the power of integrating smell, touch, and sound into art exhibitions, but was criticized for limiting user agency as sensory triggers were pre-designed. This led the museum to embed interactive games, feedback systems, and user-generated content platforms, making visitors co-creators of meaning instead of passive recipients. Similarly, Touching the Prado (2015) offered a pioneering accessibility model. It let visually impaired visitors explore tactile 3D painting reproductions with Braille and audio guides. Its value was showing how physical reproduction could democratize access. But its tactile-first way was very object-centered and less into contextual

storytelling. The Guangxi project adapts this by combining tactile replicas with voice interaction and AR overlays, achieving inclusivity without losing narrative depth.

4.1.3 Voice Interaction System

The integration of a voice interaction system in the Guangxi Rice Noodles Museum is not just a tech embellishment. It is a response to inclusivity and cultural preservation. Traditional touchscreens, though common, marginalize the elderly or visually impaired. Speech-based interaction is more natural and intuitive, letting visitors query the exhibition and get real-time responses.

The system is built on speech recognition APIs like Google Cloud Speech-to-Text and CMU Sphinx, along with NLP tools that match visitor queries to pre-scripted answers or trigger multimedia segments. This architecture was chosen over options like QR-code-triggered audio guides or static listening devices, which offer only linear paths. Voice interaction enables conversational flexibility and personal choice, letting visitors follow narratives based on their curiosity.

Multilingual capability is crucial for the system's cultural mission. Supporting Mandarin, Zhuang, and English, the platform respects local linguistic diversity and international visitors, providing a more inclusive experience than single-language audio guides. Significantly, it preserves intangible heritage: oral stories, dialect recordings, etc. can be activated by spoken prompts. For example, when a visitor says, "Tell me about Liuzhou Snail Rice Noodles", the system plays local vendors' narratives with archival photos. This storytelling way maintains local voices' authenticity and creates emotional connections that static text labels can not.

Accessibility is enhanced with features like whisper-sensitive microphones (for private queries in quiet zones) and simple navigational voice commands (e.g., "Next station", "Play video again"). These functions reduce barriers and mirror daily conversation, making the technology less intimidating for new users.

There are challenges. Accurate transcription needs a high signal-to-noise ratio, and a limited response set may cause mismatches without continuous updates from user input logs. But benefits outweigh these issues. Different from conventional audio guides, the voice system turns visitor interaction from passive listening into a dynamic dialogue, enabling audiences to shape their interpretive journey.

4.1.4 Digital Interactive Games

The decision to embed digital interactive games in the Guangxi Rice Noodles Museum comes from the understanding that play can be a strong medium for cultural learning. Traditional displays usually fail to attract younger audiences or hold their attention. Interactive games turn passive viewing into active participation. By letting visitors simulate, guess, and reconstruct aspects of rice noodle culture, these games help people learn both how noodles are made and the social settings where they are consumed.

The games are developed in Unity3D and deployed on mobile AR platforms and touchscreen kiosks. Unity3D was chosen over options like HTML5-based mini-games due to its richer 3D environments,

smoother cross-platform performance, and compatibility with existing VR/AR infrastructure, ensuring design consistency in the hybrid exhibition.

"Rice Noodles VR making" immerses visitors in noodle-making, reinforcing the process and highlighting regional differences. Passive video demonstrations can convey the same info but lack kinaesthetic engagement and decision-making. "Guess the Tool" uses 3D-scanned artefacts for recognition and contextual learning. It is favored over static labelling as it stimulates curiosity and memory through trial and error, effective for school-aged learners. Gamification's benefits go beyond engagement. Games boost repeat play, competition, and knowledge retention, expanding the exhibition's reach. But integration needs safeguards. Balancing entertainment and education is crucial to prevent trivializing heritage. Localized versions in Mandarin, Zhuang, and English are needed for accessibility. Also, data from scores or user content must meet privacy standards like GDPR to avoid unregulated data collection pitfalls in commercial gaming.

Digital games are not just added for novelty. They are chosen over less interactive options as they create low-barrier, affective entry points for audiences unfamiliar with Guangxi food culture, while keeping the experience rooted in tangible heritage. By combining playfulness with historical accuracy, the games act as bridges between cultural tradition and contemporary digital engagement.

4.1.5 Questionnaire Platforms and Visitor Feedback Systems

The Guangxi Rice Noodles Museum features an iterative design relying on continuous audience dialogue. Thus, an integrated questionnaire and feedback system was favored over traditional comment books or sporadic interviews. Analogue methods offer anecdotal insights but lack the scale, immediacy, and data richness for real-time adaptation in a hybrid digital exhibition. Digital platforms enable the museum to quickly collect, visualize, and act on visitor responses, ensuring the exhibition evolves to meet user needs.

Technologies like SurveyMonkey and Typeform were chosen for cross-platform compatibility and easy deployment. Bespoke in-house tools were considered but rejected due to high costs and limited question-design flexibility. The selected platforms have built-in analytics. With Firebase/Google Sheets integration, they enable lightweight and scalable real-time data capture. Tableau was used for backend visualisation as it presents complex datasets in accessible dashboards for curators and stakeholders. Unlike Excel, it supports interactive pattern exploration, crucial for curatorial decisions.

The rationale for this system goes beyond operational efficiency. By embedding questionnaires at multiple touchpoints (touchscreen kiosks, QR codes, post-visit app notifications), the museum ensures inclusivity for different visitor preferences and literacy levels. A multi-channel approach was chosen instead of just post-visit emails (which have low response rates). Integrating feedback into the digital layer allows for participatory curation as visitors can share personal stories, photos, and memories of Guangxi noodles. This turns the feedback mechanism from a passive evaluation tool into an active

co-creation process, enriching the museum's cultural archive.

However, choosing digital-first questionnaires brings challenges. User consent and GDPR compliance must be strictly followed, especially when dealing with personal stories or behavioural data. Also, while urban and younger visitors usually have high digital literacy, rural and elderly audiences may have difficulty with touchscreen surveys. Thus, paper-based options are kept as a backup to ensure inclusivity.

Ultimately, the adoption of this feedback infrastructure is justified by its ability to close the design-experience loop. By enabling evidence-based iteration, the museum avoids static curatorial models and fosters a responsive ecosystem where community voices shape the exhibition's evolution. This aligns with the project's inclusivity and co-creation aims, showing why digital questionnaires are essential to its cultural mission.

*4.2 Cultural Content Digitisation*

Digitising Guangxi rice noodles' tangible and intangible heritage is key to turning local cultural practices into accessible, shareable and sustainable digital assets. The business logic layer is crucial as it manages content capture, processing, standardisation and delivery for interaction. This goes beyond static documentation to support dynamic storytelling and participation.

The project uses photogrammetry (Agisoft Metashape, RealityCapture) and 3D scanning (Artec Eva, iPad Pro LiDAR) to capture high-fidelity replicas. Manual 3D modelling was considered but rejected due to distorting authenticity and needing much input. Photogrammetry and scanning ensure accuracy, crucial for heritage integrity and AR/VR experiences.

For intangible heritage like dialect stories and food prep rituals, portable audio-visual suites (Zoom H6, DJI Osmo) were picked instead of smartphone-only recording. Smartphones are convenient but sacrifice sound quality and spatial fidelity, which are vital for oral heritage preservation. The project invests in better equipment to ensure archival-quality recordings that can be adapted into narrative-driven apps with little quality loss.

Editing and narrative tools such as Adobe Premiere, Audacity, and Klynt were chosen for their cross-media interoperability and ability to layer sound, image, and text into coherent storylines. Simpler, single-purpose tools were considered but rejected due to lack of flexibility for creating multisensory narratives. This toolset choice reflects the project's dedication to multisensory museology, where cultural content is re-contextualised for experiential learning, not just stored.

Adopting open technical standards is a strategic choice. Lightweight formats like .glb/.gltf allow smooth WebXR deployment across devices. Audio is stored in .wav for preservation and .mp3 for streaming. Metadata follows the Dublin Core schema for international interoperability, ensuring digitised noodle heritage can be discovered and reused. Nevertheless, digitisation brings practical challenges. Photogrammetry needs controlled settings for consistent lighting, and dialect recordings

need much subtitling and metadata. High-resolution 3D models and video have large file sizes, causing bandwidth and hosting issues. But these trade-offs were accepted as precision and authenticity were prioritised over convenience, ensuring the museum's digital resources are credible, accessible, and sustainable long-term.

In sum, the digitisation strategy is not only a technical but also a cultural choice. The business logic layer, by emphasizing accuracy, interoperability, and narrative flexibility, ensures Guangxi's noodle heritage is preserved authentically and can be innovatively reinterpreted in digital and hybrid settings.

*4.3 Data Architecture and Management*

The success of the Guangxi Rice Noodles Museum depends on digitising content and how it is stored, managed, and delivered sustainably and ethically. The project adopts a data architecture to balance archival stability for long-term preservation and dynamic interaction for user engagement. By designing a flexible model, the museum ensures digital heritage assets are credible and adaptable to future needs.

The architecture manages multiple data types like text, visuals, audio, and behavioural data. The content diversity required a relational database, so MySQL was chosen for metadata management. Although NoSQL options like MongoDB are more flexible, MySQL offers a stable and well-supported framework for structured heritage metadata, ensuring long-term interoperability with repositories.

For content delivery, lightweight formats like JSON and XML were chosen as they enable modular presentation across devices and platforms. This was deliberately over heavier or proprietary options that could restrict reuse and integration. Multimedia files are encrypted and stored on Google Cloud for scalability and security, crucial due to high bandwidth needs of 3D models and video. Local servers can cut costs but have hardware fragility and limited scalability, so cloud hosting was adopted for reliability and global access.

User engagement tracking is supported by Matomo Analytics, chosen for its GDPR-compliance and anonymized data collection. This is a conscious choice to avoid dominant platforms like Google Analytics, which may raise ethical data concerns. Prioritizing an open-source, privacy-focused solution aligns the project's tech infrastructure with its ethical framework. The ethical aspect of data architecture is a guiding principle, not an afterthought. User contributions are governed by Creative Commons licenses for ownership and reuse clarity. GDPR compliance is ensured through anonymisation and data minimisation, safeguarding visitor trust in this heritage project with user-generated content in the archive.

The design draws on precedents. For example, the Cartoon Movement API and Newspaper/Blog REST APIs inspired using lightweight protocols instead of rigid SOAP standards, showing adaptability. Also, the Google Drive strategy for multimedia organization informed the museum's cloud storage model. By weighing alternatives carefully and considering ethics, the data architecture does more than offer

technical infrastructure; it supports the museum's cultural mission. It ensures Guangxi's rice noodle heritage is preserved intact and remains accessible, useful, and meaningful across different situations and generations.

*4.4 Participation and User-Generated Content*

The Guangxi Rice Noodles Museum aims to present heritage as a living, co-created resource, not a static one. To do this, the integration layer has a participation platform in Drupal CMS for community members to upload personal stories, photos or AR triggers. This design follows Simon's (2010) "participatory museums" framework, where audiences are active cultural memory contributors, not passive consumers.

The choice of technologies was guided by flexibility, multilingual access, and structured moderation needs. Twine + H5P was selected for branching narrative paths, letting user contributions be part of interactive storylines. Simpler options like static comment boards were considered but risked making contributions unstructured and underused. The interactive approach was chosen as it integrates personal memories into dynamic storytelling, making community input part of the exhibition.

Similarly, ElasticSearch was chosen for fast and multilingual content retrieval. Traditional SQL full-text search might work for small-scale databases, but it can not support the various dialects and languages (Mandarin, Zhuang, English) the museum wants to cover. Thus, ElasticSearch was prioritized for its scalability and inclusive search capabilities.

Drupal's modular participation tools were chosen over basic CMS options (like WordPress plugins) due to their strong content moderation workflows. This ensures the museum can accept participatory content while maintaining curatorial quality and safety. For instance, when a visitor uploads a childhood photo of a Liuzhou noodle stall, the system tags it by region and date and links it to relevant archives. Once approved, it can show up as an AR object at the exhibition, creating a feedback loop turning personal memory into shared heritage. Technical safeguards are in this participatory framework. A moderation layer filters bad submissions, and server-side security with OAuth2 authentication protects user accounts. These measures, though adding administrative work, are essential for balancing openness with data protection and ethics.

By embedding users' contributions into the exhibition's interactive structure, the community knowledge content base expands continuously, proving the museum's future and creating an evolving archive with the audience. Thus, user-generated content strengthens museums as cultural institutions and participation platforms.

## 5. Practical Work

### *5.1 Content Data Model*

To support the hybrid exhibition experience, a structured and scalable content database is essential for managing the cultural materials related to Guangxi rice noodles. The data model is designed to allow seamless integration between physical artefacts, digital storytelling, and user interaction modules (AR/VR interfaces, multilingual guides, and scent systems). Below is a breakdown of the core components of the cultural content database:

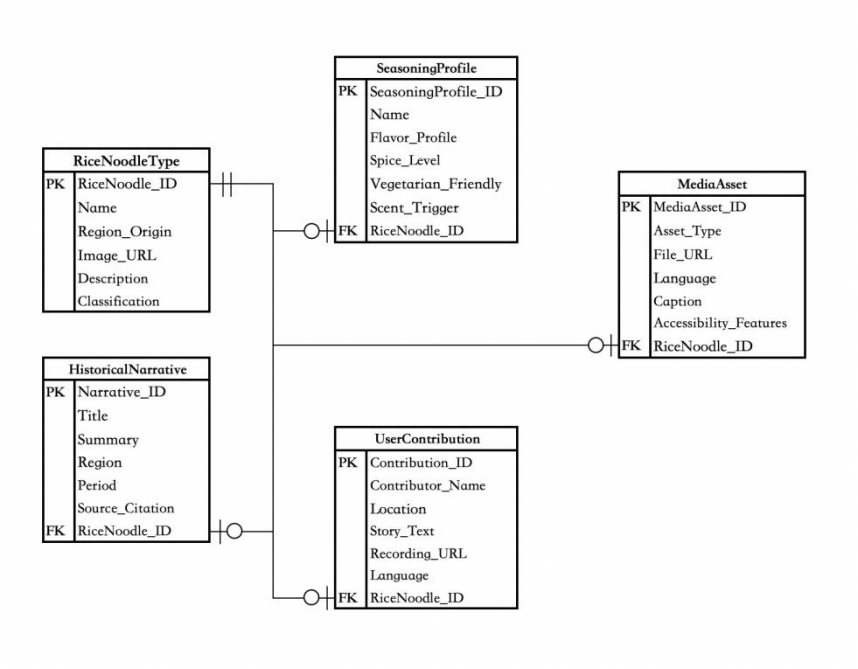


**Figure 1. Content Data Model for Guangxi rice noodles Management System**

This table archives visitor-submitted stories (via web or in-museum kiosk), allowing users to attach personal rice noodle memories or recipes, recorded in multiple languages and linked to relevant noodle types.

These entities are interlinked via foreign keys, enabling curated data display depending on user journey. For example, when a visitor scans a QR code on a Guilin Mi Fen bowl, the system can display historical facts, AR-enhanced media, and nearby user-submitted stories, all drawn dynamically from this content model. This structure is flexible enough to accommodate future entries or regional noodle variants, ensuring long-term sustainability of the digital archive.

Rice Noodle Type serves as the core basic table. Other tables (Seasoning Profile, Historical Narrative, Media Asset, User Contribution) establish associations with it through the foreign key FK_Rice Noodle_ID (or fields with similar names, with the unified logic of being associated with the primary

key of Rice Noodle Type), reflecting the relationship of "one type of rice noodle corresponding to multiple seasoning configurations, historical narratives, digital media assets, and user contributions". For example, stories submitted by different users regarding "Guilin rice noodles" are all associated with the Rice Noodle_ID corresponding to Guilin rice noodles in Rice Noodle Type.

In this way, when a certain interaction related to rice noodles is triggered (such as scanning the model of Guilin rice noodle bowl), the system can query the corresponding seasoning information (Seasoning Profile), historical stories (Historical Narrative), digital media (Media Asset), user contributions (User Contribution) etc. through the Rice Noodle_ID association, realizing the dynamic retrieval of content mentioned in the text and supporting the hybrid exhibition experience.

*5.2 Exhibition Data Model*

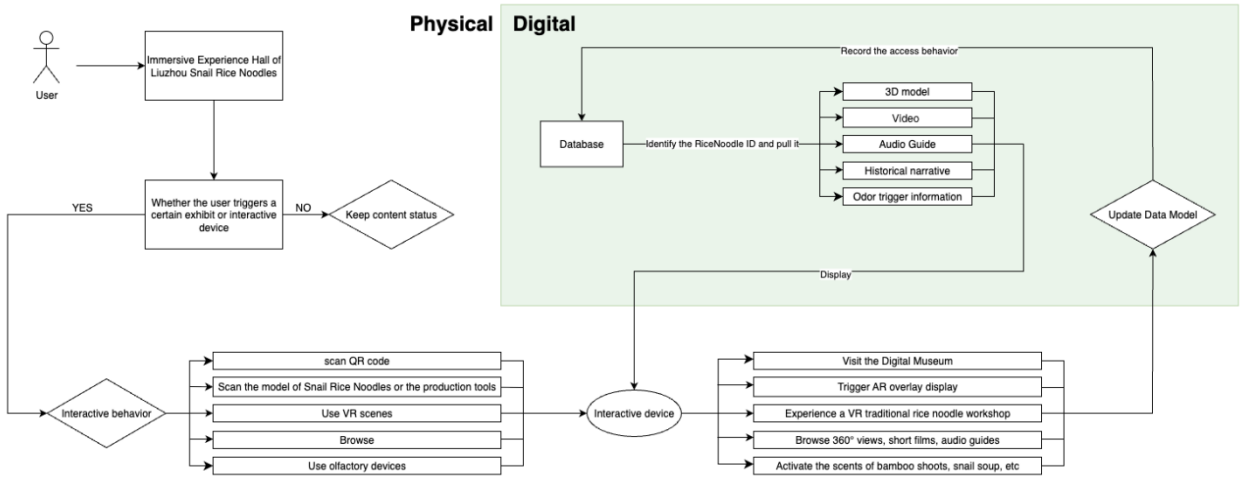


**Figure 2. Exhibition Data Model of Immersive Experience Hall of Liuzhou Snail Rice Noodles**

The exhibition data model demonstrates the integration method of physical exhibits and digital interactive content in the Liuzhou snail rice noodles immersive experience hall, as well as the interaction process between users and the system.

**User Interaction Process**

After visitors enter the immersive experience hall, they will first pass through the physical exhibition area, which includes the display of finished rice noodles, production tools, raw materials, etc. The system will make a judgment based on whether the user triggers a certain exhibit or interactive device: if not triggered, the system will maintain the original content state; if triggered (such as scanning a QR code, identifying a rice noodle model, using VR/olfactory equipment etc.), the system will identify the corresponding RiceNoodle ID and enter the data call link.

**Digital Content**

After the event is triggered, the system retrieves multi-modal content related to the RiceNoodle ID from the database, including 3D models, videos, audio guides, historical narratives, and smell-triggering information. All content is presented in real time according to the exhibit location and user operations. For example, AR overlay display, VR experience of traditional rice noodle workshops, playing of 360 °short films and audio guides, simulation of smells such as bamboo shoots and pickled bamboo shoots etc.

**Data Feedback and Update**

While providing content, the system records the user's access behavior and interaction path. These data are used to update the exhibition data model to optimize subsequent content push and user experience. For example, if a certain exhibit is accessed frequently, the system can increase the proportion of its digital extended content or optimize the display method in the future.

**The Integration of Physics and Digital Technology**

The model visually reflects the two-way connection between physical exhibits and digital content. This ensures that when users experience the culture of Liuzhou snail rice noodles, they can not only obtain an intuitive physical perception but also deeply explore the historical and cultural stories behind it through digital technology, thus achieving an immersive and personalized visiting experience.

*5.3 User Requirements*

**Target Groups:**

Domestic tourists (especially those from other provinces, who are interested in the food culture of Guangxi)

Local young residents (aged 18 to 35, who enjoy immersive experiences and interactions)

**Questionnaire**

1) Which of the following do you think can best enhance your overall experience in the immersive experience hall of Liuzhou Snail Rice noodles? (Multiple choices are available

A) Introduction to the historical and cultural background of rice noodle soup with snails and its ingredients

B) On-site demonstration or digital reproduction of the production process

C) Interactive display of rice noodle soup with snails and local culture of Guangxi

D) Immersive experiences through AR/VR technology

E) Others: _____

Purpose: Identify the core content direction that users value most and determine the main highlights of the exhibition.

2) Which way do you prefer to obtain exhibition information? (Multiple choices are available

A) Display boards and physical description boards

B) Interactive videos and short films

C) Audio Guide (with multilingual support)

D) Mobile App

E) Others: _____

Purpose: Prioritize the medium for information presentation and optimize the display and guidance methods.

3) If there is an official App, would you use it during your visit to get more interaction and information?

A) Yes

B) No (You can directly jump to Question 7)

C) Uncertain

Purpose: To predict App usage rates and provide references for investment in digital functions.

4) How interested are you in the following numerical functions? (Multiple choices are available

A) AR navigation map (for locating exhibition hall routes)

B) Virtual Rice Noodle Making Workshop (VR Scene)

C) 360 °display of details of rice noodles and tools

D) Exhibition Timeline (Historical Evolution)

E) Personalized visiting route recommendations

F) Others: _____

Purpose: To identify users' interest in specific functions for prioritized development.

5) How much do you think the following functions have helped your experience?

Scent interaction (pickled bamboo shoots, spices, soup bases etc.)

A) It is very helpful

B) It is of some help

C) General

D) No help

Purpose: To assess the practical value of olfactory interaction and determine the direction of investment and optimization.

6) What do you hope to gain from the immersive experience hall of Liuzhou Snail Rice Noodles? (Multiple choices are available

A) Learn more about the culture and history of rice noodle soup with snails

B) Experience the production process

C) Gain a thorough understanding of ingredients, seasonings and regional differences

D) Gain interactive entertainment experiences

E) Others: _____

Purpose: Clearly define the core gain goals of the visit and match the educational and entertainment values of the exhibition.

7) What do you think is the most attractive way to showcase the evolution of rice noodle soup with snails?

For example, timelines, the combination of physical objects and digital elements, immersive storytelling etc.

Purpose: To collect suggestions on innovative display forms for optimizing exhibition design.

8) What extended content do you hope to obtain after the exhibition ends? (Multiple choices are available

A) Electronic recipes

B) Download of historical and cultural materials

C) Exhibition review video

D) Purchase link for exhibition theme souvenirs

E) Others: _____

Purpose: Explore the demand for digital extensions and derivatives to enhance user engagement.

This questionnaire adopts a user-centred design approach and is specifically targeted at domestic tourists interested in Guangxi cuisine and young local residents seeking immersive cultural experiences. Its purpose is to understand visitors' expectations for the Liuzhou Snail Rice Noodles Immersive Experience Hall, particularly regarding interactive content, sensory engagement, and digital tools such as AR/VR navigation, virtual workshops, and 360° object displays. The results will inform the functional design of both the physical exhibition and its accompanying app, ensuring that content presentation, navigation flow, and personalisation options align with audience needs. Furthermore, the survey explores potential barriers to technology use and gathers opinions on post-visit engagement, enabling the team to refine features for accessibility, cultural authenticity, and sustained user interest. The final open-ended questions encourage participants to contribute creative suggestions, fostering a sense of co-creation in the exhibition's development.

*5.4 User Interface*

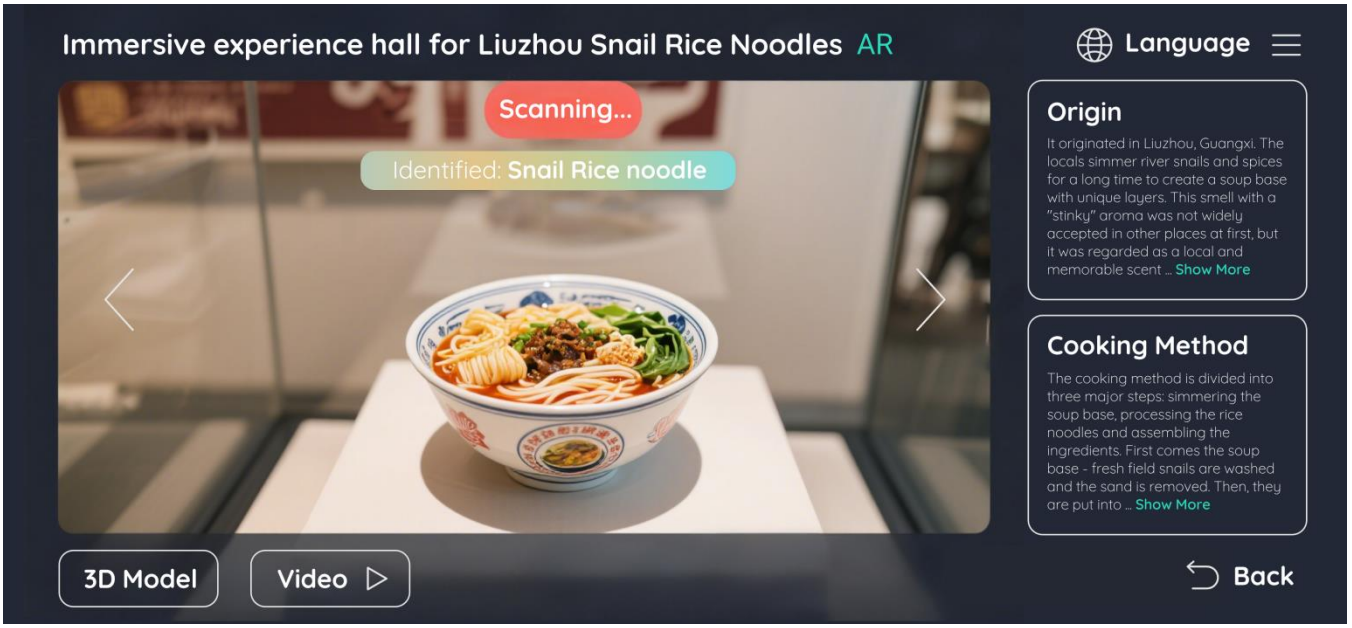


**Figure 3. AR Scanning Interactive Interface (Doubao, "Liuzhou Snail Rice Noodle Exhibition Hall", 2025), Further Edited in JS Design**

This diagram shows the AR scanning interactive interface of the "Liuzhou Snail Rice Noodles Immersive Experience Hall". It is mainly used for visitors in the exhibition hall to conduct real-time scanning and information acquisition through mobile devices or tablets equipped in the hall when visiting physical exhibits. At the top of the interface, the scanning status (Scanning…) and the recognition result (such as "Snail Rice Noodle") are displayed. The middle part presents a high-definition real-scene image of the scanned object to ensure that users can intuitively confirm the scanning object. The information panel on the right is divided into two core modules—Origin and Cooking Method. They summarize the historical background and production process in concise text and provide a "Show More" button to support users to expand and view more details. At the bottom, there are two core interactive buttons, 3D Model and Video, which are used to view the rotatable 3D model and play short videos respectively, enhancing the immersive and visual experience. In addition, the interface is also equipped with a language switch button and a return button to ensure multi-language adaptation and usability. The overall design highlights immediacy, interactivity, and multimedia integration, enabling users to obtain in-depth digital information supplementation while visiting the physical exhibition.


**Figure 4. VR Making Interface (Doubao, "Guangxi rural kitchen, VR game style", 2025), Further Edited in JS Design**

This diagram showcases the "Liuzhou Snail Rice Noodles VR Interactive Production Interface", which is used in the digital experience area to allow audiences to learn and simulate the production process of snail rice noodles in an immersive virtual environment. The background of the interface replicates the scene of a traditional rice noodle workshop, including elements such as bamboo racks for drying rice noodles and firewood stoves, enhancing the cultural atmosphere and sense of authenticity. The Steps module on the left clearly displays the progress of the production steps. For example, "Select Rice" (completed) and "Rice Milling" (in progress), helping users proceed with tasks in an orderly manner. The ingredient bar in the upper right shows the key available ingredients (rice noodles, pickled bamboo shoots, river snails), facilitating players to make quick selections. The Gesture area below provides interactive gesture prompts (grab, stir, pour) to guide users to complete operations correctly, enhancing the sense of immersion and learning. The Replay and Tip buttons at the bottom enable users to watch again or obtain tips, reducing the learning threshold. The Customer Rating module in the lower right corner instantly provides feedback on the user's completion rate and performance in the form of a score. The Finish! and Exit buttons offer options to end or exit the current task. The overall design takes into account teaching guidance, cultural experience, and gamified interaction, enabling audiences to not only acquire knowledge but also enjoy the sense of accomplishment from interesting operations.

*5.5 Cultural Content*


**Figure 5. The Digital Exhibits Presentation (Doubao, 'Guilin Rice Noodles with the Scenery of Guilin', 2025), Further Edited in JS Design**

This picture showcases the digital presentation of Guilin rice noodles in the exhibition, reflecting the combination of cultural content and interactive functions. On the left side of the picture is a high-definition real-object image, directly presenting the color and details of the ingredients of the rice noodles. On the right side is a concise English cultural introduction, covering the origin, development, and cultural significance. The imagery of Guilin's mountains and waters is incorporated into the background to strengthen the regional association. At the bottom, there are four interactive entrances labeled 3D, Audio, Video, and AR. Visitors can browse the ingredient structure through the 3D model, listen to multilingual audio explanations, watch videos of the production process, or use the AR function to overlay digital information on-site. This multi-modal design ensures that visitors can comprehensively perceive the historical and cultural value of Guilin rice noodles through visual, auditory, and interactive experiences, while also meeting the immersive experience goals of the online and offline hybrid exhibition.

## 6. Conclusion

This study has explored the conception, design, and critical reflection of the Guangxi Rice Noodles Museum as a hybrid digital–physical exhibition. At its core, the project has aimed to preserve and reinterpret the tangible and intangible heritage of rice noodles through a multisensory and participatory framework. The museum was envisioned not simply as a cultural showcase but as a dynamic platform that could bring together tradition, technology, and community in meaningful ways.

Throughout the project, several priorities guided the work. First, accessibility was central to the design. The museum integrated tactile replicas, scent stations, multilingual voice interaction, and universal design to let different audiences participate fully. Second, education and intergenerational learning were emphasized. Gamified modules, VR cooking demos, and interactive storytelling were developed for school curricula and to spark curiosity. Third, the museum was a participatory archive where community members could contribute stories, images, and oral histories, keeping the rice noodle narrative alive and collective.

In terms of process, the project has drawn extensively on precedents from multisensory exhibitions, and participatory museology as discussed by Simon (2010). At the same time, it has extended these precedents by emphasising stronger user agency and technological integration. The technical layers—from AR overlays and VR environments to data architecture and content logic—were specified in detail to demonstrate how abstract ideas could be translated into actionable requirements. Each system, whether mobile AR or scent diffusion, was justified in relation to user needs, with functional specifications mapped clearly so that the museum could be realistically prototyped.

The project is also significant because it reframes food heritage as a powerful medium of cultural communication. Whereas food museums are often limited to visual displays or tasting events, this proposal argues for rice noodles as an entry point into memory, identity, and community. By engaging the senses and creating opportunities for storytelling, the museum moves beyond nostalgia to foster critical awareness of how everyday culture is intertwined with history, migration, and globalization.

In conclusion, the Guangxi Rice Noodles Museum is more than an imagined institution. It is a model for digital museology to turn everyday heritage into an immersive cultural experience. Combining tech with local traditions, it shows the need to bridge innovation and authenticity. Focusing on accessibility and participation, it emphasizes designing museums with audiences. This project proves the humble rice noodle can carry deep cultural meaning and, through good curation, be a means for education, identity, and global dialogue.

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